



Tampere University of
Applied Sciences

Business School

Final thesis report

SMART PACKAGING:

**THE NEEDS AND REQUIREMENTS OF BUSINESSES IN
PIRKANMAA AND THE TEACHING OF THE SUBJECT IN
FINLAND AND IN EUROPE**

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Degree Program in International Business
October 2007
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Tampere 2007



**TAMPEREEN
AMMATTIKORKEAKOULU**

Business School

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Degree Programme: Degree Programme in International Business

Title: Smart Packaging: The Needs and Requirements of Businesses in Pirkanmaa and the Teaching of the Subject in Finland and in Europe

Month and Year: October 2007

Supervisor: Anasse Bouhlal **Pages:** 95

ABSTRACT

Tampere University of Applied Sciences is developing a logistics laboratory that specialises in smart packaging. The laboratory services are produced in cooperation with local businesses and Finnish and European universities. The purpose of the laboratory is to engage businesses and the university in long-term collaboration in order to research and develop packaging and train experts for the field.

This work studies what kind of packaging testing equipment interests the local businesses the most, and to what extent TAMK should specialize in teaching of smart packaging. Businesses in Pirkanmaa, European and Finnish universities and logistics organizations are interviewed to develop and understanding of the current situation and future plans.

Based on the interviews, it is obvious that there is more demand than supply for smart packaging experts. The businesses are lacking the experienced employees while hardly any school is offering studies focusing on packaging issues. This shows that developing packaging studies would benefit the businesses and thus Pirkanmaa as an area.

In regard to the laboratory, businesses show interest in both short and long term projects concentrating on testing and developing packages and smart packages. Universities both in Finland and elsewhere in Europe express their willingness to participate in providing packaging teaching as well as working in the laboratory. The initial study module will be of elective nature and include two or three five ECTS credit courses.

Keywords: Logistics, laboratory, packaging, smart packaging,

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List of Abbreviations

For the sake of clarity, the following abbreviations and generalizations are used further on in the report:

European Forum for Logistics Education: EFLE

HAMK University of Applied Sciences: HAMK

Lappeenranta University of Technology: LUT

Tampere University of Applied Sciences: TAMK

Universities and Polytechnics (all institutions of higher academic education): universities, unless specified

Universities of Applied Sciences: polytechnics

Xios Technical University Limburg: Xios TUL

1 Introduction

Tampere University of Applied Sciences, later TAMK, is developing a logistics laboratory that is specializing in smart packaging. Testing equipment for packages will be placed in the laboratory. The businesses from Pirkanmaa area are welcomed to use the laboratory alongside the students, who study, practice and work in the laboratory. The idea for the laboratory comes from a similar logistics center in Belgium, where businesses and the university engage in long-term cooperation in order to research and develop packaging and train experts for the field.

The goal of the project is to study the use, need and future investment plans of businesses in Pirkanmaa area in testing packages, and to study the extent of teaching of logistics and packaging, especially smart packaging in Finnish universities and polytechnics, TAMK partner schools and EFLE (European Forum for Logistics Education) schools. The interest of these groups in cooperation to produce services in the laboratory will be mapped as well. Based on the results, TAMK should be able to make informed decisions about the kind of equipment acquired for the laboratory and the new packaging courses taught.

The secondary research investigates the following issues:

- What is smart packaging?
- How is a laboratory set up and how does it operate?
- What businesses in Pirkanmaa area may be interested in being interviewed?
- To what extent is packaging, and logistics, taught and what are the schools that should be interviewed?

The sources of the secondary research are the Internet, books and up-to-date articles while the primary research is carried out via face-to-face interviews in Pirkanmaa businesses and electronic questionnaires for the universities.

1.1 Trends in Logistics Costs and Effects of Internationalization

Logistics is about lowering the costs of the whole supply chain through efficient processes. This enables maximizing profits. Logistics helps to find the balance between quality, cost and time, which can be seen as flexibility, efficiency and responsiveness to the changes in the market. (Logy Competence, n.d.) The global logistics industry was estimated to account for approximately EUR 5.4 trillion in 2006. This is equivalent to 13.8% of the global GDP. The logistics costs are accounting for 10-15% of the final cost of the finished product. (SCADPlus, November 2006) Businesses have realized that and by reducing the logistics, and thus operating costs, firms are able to lower the total costs of their products.

The main ingredients of the logistics costs are transportation, warehousing, inventory management and administration. The total cost of logistics in Europe decreased a lot during the last 15 years, from 14.3% to 6.8% (appendix 10). Improvements are reached in all cost areas. Transportation costs have decreased most rapidly; only in recent years there has not been any change in these costs. It can be argued that the transportation costs have reached attainable level and it is difficult to decrease these costs without major changes in transportation functions. It can be also argued that for example full container loads, increasing use of multimodal transportation and better transportation networks enable optimizing of transportation. Efficiency and careful planning could thus decrease the transportation cost more than the increases in oil prices, which also are a factor in transportation costs.

Logistics has emerged and advanced significantly during the past decades due to the advancing technology. Technology also enables decreasing logistics costs. It allows businesses to use accurate and most suitable indicators and thus plan processes carefully. Thus the firms concentrating on logistics are saving significant amounts of money in the long run.

The division of logistics expenses between different cost components varies according to business size (appendix 8). In total, the logistics costs account about 13-16% of the turnover. The total logistics costs are the highest in micro businesses and lowest among large companies. Transportation expenses form the major part of the total cost for companies of all size, accounting about 5% of the revenue. (Naula & al., 2006) The costs of holding the inventory are higher for small businesses. The similar difference can be also seen in warehousing costs. These differences can be explained by the fact that it is obviously more cost effective to run bigger operations in a large scale.

The packaging expenses are one of the smaller components of logistics cost. Packaging accounts for about 1-1.5% of the total logistics costs (appendix 8). While the cost as a figure can be seen as a small part of the total costs, it can affect the whole supply chain. If the

package does not perform the functions it is expected to do, it will cause increase in other cost components as well. For example, if the package is not strong enough, it may break during the handling or transportation. The transportation company will add an extra charge for repacking the products and the customer may demand compensation due to delayed delivery. Thus, even though the proportion of packaging costs is small, they are still crucial part of the total cost and this should be taken into account when designing packages.

Internationalization of businesses affects the logistics costs positively. The increased exporting and production facilities placed abroad make operations more complicated; however, this does not increase logistics costs. The logistics costs of national companies are the highest whereas the international companies have the lowest costs compared their total turnover. The most significant differences are seen in warehousing and administration costs (appendix 9). Warehousing costs for example may decrease significantly when setting up a central warehouse in logistically critical areas of Europe. The international companies can also manage their warehousing and management related costs better than national or exporting companies. When the logistics operations of a business are not limited to the supply in one country, companies can find more attractive options for their functions. Moving production or warehousing to another country can create a significant cost savings in the long run.

1.2 Logistics in Pirkanmaa and in TAMK

Pirkanmaa is an innovative area that constantly develops itself in order to ensure success to the businesses and the province. Its location is beneficial from the logistics point of view. Pirkanmaa is a centrum along different modes of transportation and a home to successful businesses. The universities, TAMK among those, are acknowledged in Finland and also abroad. Along with the businesses, the academic institutions aim to develop logistics functions as well. Tampere Pirkkala Logistics center and TAMK Smart Packaging Laboratory are great examples of such parties.

1.2.1 Increasing Importance of Logistics in Pirkanmaa

Logistics have increased its importance as a function of business during the past years. In recent decades, the trend among population has been to move from rural to urban areas and to business centers. This means that people no longer live near production center, or on the other hand, production facilities are not located in residential areas or cities. The distance between the points of production and consumption has increased, and logistics has therefore gained importance. Another fact to consider is that businesses do not produce products to store in their warehouses but move the products to warehouses in logistics centers as soon as possible.

Globalization and tightened competition requires businesses to be more and more customer oriented by providing the customer the right materials at the right time and place in the right condition at the lowest cost possible. Businesses have started to realize that logistics is the important link between all these functions. By planning the schedules, material flows and deliveries efficiently the businesses can secure that the customers get what they want, when they want. Logistics does not only mean transportation of raw materials, components or final goods – it involves several other functions such as purchasing, plant location, inventory management, warehousing and disposal of wastes, just to mention few. (Economic Research, 2001) Logistics is thus a factor throughout the supply chain.

Nowadays companies do not operate alone but instead form networks. The cooperation should lead to improving cost efficiency. Logistics centers encourage businesses to outsource, because these centers provide wide range of logistics service from which each business will find a complete solution to suit their needs. Large logistics centers are founded all over the world in the biggest cities. In Europe, for example, there already are about hundred logistics centers in France, the Netherlands and Germany, which all play important role in logistics due to geographical advantage in part. (Laatikainen, 2006) Extra movements of goods can be minimized when a production facility is located next to packaging and transportation companies and consequently time and cost savings are obvious in the long run.

Logistics centers have been founded recently also in large Finnish cities, and Tampere is now actively planning to create its own. The project is called Tampere-Pirkkala's Logistics Center and it is going to be built on the boundary between Tampere and Pirkkala. The main reason for developing the logistics center is the new Vuosaari harbor in Helsinki, opening in the fall of 2008. This will change the goods traffic significantly in Finland, and will increase the nation wide importance of Tampere in logistics sense. (Economic Research, 2001) The increasing use of container transportation in international trade is a reason for the existence of logistics centers. The containers are no longer loaded and unloaded in harbors but instead the loading takes place in trains from where the goods are transported to the nearest logistics center. From there the forward deliveries are taken place. According to Tenho Aarnikko, the CEO of engineering office Sito Tampere, Tampere has all prerequisites to become a nation wide logistics center. "In Tampere, the road, rail and air transportation can be easily connected. Tampere has also good connections to seven Finnish harbors and it is located far enough from the capital area", Aarnikko explains. (Laatikainen, 2006) Central location is both a reason and an excellent starting point for creating the logistics center in Tampere-Pirkkala.

Pirkanmaa is a competitive area in logistics. The province is centrally located and good traffic connections make Pirkanmaa attractive for future investments. Intermodal transportation is important for

Pirkanmaa as the area is located in the cross of busy road and rail networks. Businesses in Pirkanmaa area represent a variety of fields and industries, and the area has also an increasing population, which both are expected to increase the area's logistics demand in the future. The universities located in Tampere provide teaching in logistics. The research possibilities are also good. These two factors attract students. (Vulli and Larjovuori, 2005) Pirkanmaa has the geographic and industrial grounds and the future experts which all represent the factors why the center is being developed.

1.2.2 Logistics is already Taught in Tampere University of Applied Science

Tampere University of Applied Science has offered logistics studies for many years in International Business -program. An obligatory course in basics of logistics is studied during the first year of studies. After that a student can make a decision to specialize in logistics and study a module type combination of courses during the second year of studies. During the third and fourth year, the students can deepen their knowledge in logistics through university studies and/or work placement abroad.

The compulsory first year logistics course covers the issues of green logistics and supply chain management. The study guide of TAMK describes the course content as follows:

“This module includes the procurement process and JIT (Just In Time) purchasing, integrated logistics management, transportation management including the intermodal transport and cases of dangerous goods, inventory management with EOQ (Economic Order Quantity) calculation, MRP I and MRP II. An important part of this module will focus on the recycling management and PLC (Product Life Cycle). (Tampereen ammattikorkeakoulun Opinto-opas 2006-2007, p.106-107, 230)”

This course is also available for students studying the Finnish business program in the business school. The goal is to give the student some insight to the extent of logistics and the effects of it.

BBA students choose their major during the second year of studies and continue with specific module studies. The logistics module consists of four logistics courses, which all deepen the students' knowledge on different logistics functions. Each of the second year courses cover one larger topic in detail. Students learn more about transportation management, inventory management and ERP-systems. Together with traditional lectures for instance quest lectures, project works and company visits are used as teaching methods. The module includes the components and functions of a warehouse, material handling, packaging systems and equipment and material handling productivity ratios. The basics of ERP systems are studied in general through the use of SAP R/3 sales and distribution module and mysap.com as a case. (Tampereen Ammattikorkeakoulun Opinto-opas 2006-2007, p.115) One part of the logistics module focuses on Project Management. The students cover the major areas of logistics and thus are equipped to work in various jobs on the field.

An ongoing curriculum renewal in TAMK ensures stronger position for teaching logistics. From autumn 2007 more logistics courses are available for TAMK students outside BBA-program as well. The logistics module described above is available for all TAMK students from other programs as well. It is definitely beneficial for the area, school and students to develop the cooperation between these parties as well as emphasize the importance of logistics through increasing the number of courses offered.

1.2.3 Laboratory Work in Logistics in TAMK is Being Developed

TAMK is planning to develop a new packaging laboratory and it wishes to accomplish the development of a packaging laboratory with cooperation of the businesses from Pirkanmaa area. TAMK's logistics program is being revised and expanded through the smart packaging laboratory and the courses built around it. This thesis will study to what extent TAMK should specialize in logistics and what course offerings would benefit both the students and the businesses the most.

Smart Packaging laboratory is a project of TAMK's logistics R&D department. The laboratory will be a modern meeting point where students, schools and the business world can together develop and test new ideas. It will be a neutral testing facility where both short and long-term projects are carried out.

1.3 Research Question

Research Question: Based on the research on the availability of logistics and smart packaging study programs and the use of smart packaging in the businesses in Pirkanmaa area, how and to what extent should TAMK specialize in smart packaging?

To achieve this, also the following sub-questions have to be answered:

- How are logistics and smart packaging taught in other institutions?
- Do businesses need employees, who have knowledge on smart packaging?
- What kind of studies would benefit the school most?

1.4 Structure and Limitations of the Study

This study is conducted as a pair work. Both students are majoring in logistics, which ensures they have the basic knowledge of supply chain management and logistics processes. At the moment, students, schools and businesses together in several locations engage in this type of work. A logistics school in Limburg, Belgium, for example, implements a same type of a laboratory what is planned in TAMK. This school is going to be used as an example. Also HAMK and

Jyväskylä University have carried out projects related to packaging. Therefore these schools will be used as references as well.

The business aspect of the issue was studied through interviewing businesses that produce packages or use packages. Fifty businesses were contacted and 21 were interviewed. Two promised to answer via e-mail but the answers were never received. The sample size is estimated to be sufficient when assessing the possibility to use the results in decision-making on the laboratory investments.

There are altogether 19 universities and 31 polytechnics in Finland. TAMK has more than one hundred partner schools. Mr. Anasse Bouhlal, the logistics teacher in TAMK, has contacts with about thirty schools in Europe through EFLE. Through secondary research, 36 schools were chosen to be interviewed via electronic questionnaire. The survey produced twenty replies.

When sourcing the possible business interviewees, it turned out that when contacting a manager or a president of the company or the factory, the response to the request for business visit was more positive than when the contact was known through school or a teacher. Some known contacts did not reply to e-mails or answer the phone at all. In most cases, the interviews with new contacts produced more informative and accurate results than with those who were known. For example, current and former TAMK students did not take the interview seriously enough and pass it onto the correct person.

Time set some limitations to the study of universities. The research material from Finnish schools was to be collected before the Finnish summer holidays, which mainly started on 13th of June. It was taken into account that no answers from Finnish schools were expected to be got after that. Also European schools have their holidays during the summer, but those start later, usually in July. Tiina Salmi is leaving for Germany in the beginning of September 2007 and thus the goal is to complete the final thesis before that.

1.5 Research Methods

This research is being carried out through the use of case study and benchmarking as research methods. Both methods are used when studying business possibilities and comparing the case to the others in the market.

Case study allows for both qualitative and quantitative research on the specific topic: development of TAMK Smart Packaging Laboratory. The guidelines of case study direct towards gathering information that applies to this case rather than the topic of packaging in general. This method is applied in both business and school research. Therefore the end-result should best help the decision-makers to agree on the framework of the laboratory.

The research data from companies in Pirkanmaa region is collected through company visits and interviews. These are carried out mainly in Finnish due to the fact that it is the corporate language in most companies in Finland.

Benchmarking allows comparing the situation at TAMK to other institutes, both with laboratories and those without much education in packaging. This method is applied in the research on other universities and polytechnics. First of all TAMK and the plans are compared to universities with laboratories. This is to learn about the guidelines of running such place successfully and to rule out the case of existing smart packaging laboratories in Finland. On the other hand the plan to develop teaching in packaging is compared to the other schools in regard to the number of courses to the plans TAMK has. The hypothesis in part is that smart packaging is not taught extensively enough to meet the needs of the businesses and this type of research should prove the assumption.

The research data from polytechnics and universities is collected mainly through electronic questionnaires. When creating the surveys, and later on analyzing the results, the schools are divided into four groups: Finnish universities, Finnish polytechnics, TAMK partner schools, and partner schools of EFLE (European Forum of Logistics Education).

The results were analyzed by using SPSS 13.0 for Windows and Microsoft Excel programs. Along with the written analysis, the results are illustrated through the use of frequency tables and graphs.

2 Purpose of the Study

The purpose of the study is to investigate the situation of smart packaging in Finland. TAMK is planning to develop a new packaging laboratory and this study is conducted to determine how the resources were best used. TAMK wishes to accomplish the development of a packaging laboratory with cooperation of the businesses from Pirkanmaa area. Therefore the condition and plans of those must be studied and analyzed as well.

The business view to the project focuses on the wants and needs of companies in Pirkanmaa region. The view on teaching investigates how smart packaging is included in the curricula of other Finnish polytechnics and universities as well as foreign schools. This will help TAMK to analyze and decide to what extent they should invest in the development of the teaching of logistics.

2.1 Overview of the Packaging Industry and Education

Package is an important factor throughout the supply chain. The purpose of the packaging is to protect the product inside the packet from the environment, and the environment from the product. According to Ollila, a well-planned and implemented package “maintains the properties of a packed product and improves its hygiene and safety” (Ollila 2007). In addition to this, a well-implemented package increases the efficiency of production and delivery. Ollila lists also “mechanical handling, time, temperature during the different stages of treatments, light and possible biological disadvantages” (ibid) as common challenges for the packages. When a package is suitable to suit for the production and transportation, a lot of time is saved from the extra handling and movements as the package needs to stand the transportation and handling of goods all through the supply chain.

Package acts as a source of information for customers, so it needs to be planned also from the standpoint of consumers. The importance of the package is shown for example through the prints on the package as those include valuable information for both supplier and consumer (Ollila 2007). The printings can contain information for example about transportation, usage or storage instructions. Another crucial point is also package disposal, from which customer is usually responsible of. When planning a package, it is important to consider the environmental issues and legal requirements (ibid). This is because if the laws and environment are not considered early enough, faults may cause significant problems in the future. Nowadays many companies are specializing in producing environmental packaging material and -packages. One example could be Green Can operating in Pirkanmaa, which offers its customers innovative solutions for packing their products using environmental friendly materials.

2.1.2 Smart packaging

Smart package provides information about its content, and protects and advertises the product, as does the traditional package. Smart package includes features that enhance the utilization of the package through its entire life cycle. In his article *Over to the smart side* (2004) Mr. Paul Butler defines the smart package as follows: “The smartness conferred on the package by an electronic RFID tag or label, enhances the traceability of the package – the major beneficiary being the supply chain. A radically more effective design and enhanced functional form, in which smartness is an inherent characteristic of the package through the use of smart material, will benefit the customer most.” Besides RFID, smart package can contain for example different indicators, measuring instruments and holograms. Smartness can be brought into the package also by using an innovative material, which affects for example the environmental friendliness or the favorable to the consumers.

Smart package usually contains a characteristic, which attract consumers. The features can be produced for example mechanically, chemically, electrically or electronically. According to Ollila, a smart package can also “speak, smell or react to the changes of the environment” (Ollila 2007) and this means even more functional packages for customers.

2.1.3 Food Industry and an Active Package

Active packaging materials and accessories for foodstuff refer to the materials and accessories that monitor the usability of the product. For example, an indicator can be placed inside the package, or the environment in close vicinity to the package. The indicators help to monitor and control factors affecting time-, temperature-, freshness- and leakage issues. (Ollila 2007) Smart technology clearly enhances product safety in food industry.

2.1.4 The Benefits of Smart Packaging

As stated above, incorporating smartness to the packages, packages become more functional and easier to use. A smart package enhances the tracking and tracing of the product as well as the quality and safety of it. A smart package provides also functions and characteristics that respond to the needs and requirements of consumers, and to the demographic changes of the population. In addition to the continuing development of technology, the awareness of consumers increase and therefore the demand for the smart functions continuously exists.

Smart technology is way to decrease counterfeits, which are a significant problem, especially in the medical industry. Ollila states that “when smart functions are included in the packages, the products are easier to track and the flawed products can be discovered more

faithfully” (Ollila 2007). This guarantees the quality and faultlessness of the products throughout the supply chain from producer to consumer. Researchers are working continuously for developing the traceability and safety of the products because by using the right solutions in packages, also the world wide risks of, for instance, terrorism and pandemics can be minimized. When the real time surveillance of the transportation improves, the efficiency of the transportation network increases and safety enhances.

The food industry will also use smart solutions in the future more and more. When the RFID-tag is integrated into the package, time consuming queuing in cashier can be avoided because the RFID enables the identification of products from a distance. Smart packages provide solutions also for different age groups and this way the usability of the products changes positively. As an example Ollila tells “that for elderly whose eyesight might be poor, smart package can provide a working solution” (Ollila 2007). These kinds of different solutions can be developed for deaf or handicapped people and children as well in order to improve their independency and safety can be improved. When more information is available and products can be used efficiently, consumers benefit the most.

In addition to consumers, a smart package provides advantages for firms as well. According to Ollila, the smart packaging can improve the firm’s control and brings extra value for the product (Ollila 2007). Thanks to the smartness, the package can be read easily and transferred quickly to the different information systems, for example RFID hastens the identification of the products coming to the warehouse significantly. Hence the whole supply chain becomes more efficient. Standardization makes products more global and this means that less customization is needed.

2.2 Packaging Business and Education

Customers and businesses will always need packages. Technology allows packages to advance along the time. In order for the packages to develop, experts are needed to invent, implement and test the ideas. At the moment the demand for packaging experts is larger than the supply, and thus businesses demand for adequate curriculums training students for future challenges. Polytechnic universities train future experts for the market’s needs through practical training programs.

2.2.1 The Purpose of Polytechnic Studies

The law defines that the teaching and research in polytechnics must ensure the growth of an individual to a direction that benefits the local business and vice versa. Polytechnics should provide education that responds to the needs and requirements of working life. The education should support the growth and achievement of an individual, serve the polytechnic education and respond to the development of both the business life and the whole area. Polytechnics should also take into

account the economic structure of the area in their research and development work. (Arene, n.d.) This shows how the characteristics of the business world shape the identity of the universities.

Polytechnics provide the students a possibility to learn in a strongly practice oriented environment. The core of these institutions is to operate as close to working life as possible. The education in polytechnics is supposed to answer to the challenges and demand of the rapidly changing working life.(Arene, n.d) The polytechnics in Finland are taking part to the development and maintenance of the competitiveness of the Finnish economy by producing experts in variety of fields of industries.

Finnish polytechnics cooperate actively with international universities and other organizations. Internationality is an important aspect of polytechnic studies. This is shown through large numbers of Finnish students going to study abroad as exchange students. In turn, foreigners study in Finland as a part of their degrees. This widens the perspective of students and brings international influence to the classroom. In addition to exchange, for instance teacher exchange, guest lecturing, shared projects and study trips are forms of international studies.

The research and development work, later R&D, in polytechnics is applied and it needs to serve the advancement of the teaching. Polytechnics are supporting the development of the region and R&D work play an important role here. The main tasks for the polytechnics' R&D work can be summarized to be [1] the development of the polytechnic teaching, [2] the supporting both the working life and the development of the area, and [3] to notice and respond to the needs of the area's economic life. (Arene, n.d.) The goals of R&D again show the strong link between the economic area and the universities.

2.2.2 The Link between the Business World And Schools

In order for a curriculum, and thus the educational institute, to be successful and acquire such high demand that the program can develop and grow throughout the years, it is self evident that the design and further development must be based on the style and condition of local and global business environment. When interviewed, the head of the degree program in international business in TAMK, Janne Hopeela presented a graph Appendix 10 (Chart on Developing a Curriculum) explaining the relationships between the business world, students and all the levels of authority in the school in the process. The figure provides a logical way of working when researching and developing the base for a new curriculum. The linkages between different parties involved help to understand the cause- and effect relationships of different actions.

According to the figure illustrating TAMK curricula design, the working life, the starting level of students and the feedback on

published curricula are the input for defining the job tasks and know how. The working life represents the external and students the internal inputs. The definition of job tasks and know how leads to the analysis of the current situation. The input of the management is in the form of guidelines. This again produces the definitions of the goals and job tasks, which are then broken down to modules as the figure xx shows. Several bodies in the school approve the plan and the cycle can start up again from the students' feedback and changes in business life. The comprehensive plan for curricula development by TAMK clearly shows the linkages between the business life and educational institutes and how the latter creates workforce for the previous.

2.2.3 The Outlook for the Packaging Industry

The outlook for the packaging industry is promising as packages will be needed also in future and new technologies allow development of better packages. Food, accessories, machines and almost any article that can be bought needs packaging to secure the product for example during transportation. According to Pakkaus 2020, "the need for flexibility in the industry increases; the adaptability should be built into the machines already". This means that the machines producing the packaging should be able to produce packages in different sizes and shapes and that other technology should be easy to incorporate into it. For example, a customer of a carton factory may want to add RFID into its products and the technology could be added into the products in the factory. This is the type of "fast reactivity" that Pakkaus 2020 is calling for along cost efficient, versatile and practical packages (Leppänen-Turkula et al., 2000). It could be thus argued that the businesses in the industry have a positive future ahead as long as those keep developing and integrating modern technology into the products.

New technology, regulations and the customers' preferences guide the form of modern packages. According to Pakkaaminen by Järvi-Kääriäinen and Leppänen-Turkula changes in age pyramid, the population getting older, and decreasing family size are factors affecting package design. The businesses providing an ever-growing range of products have the same effect. The whole supply chain is involved in the process as the regulations by governments are tightening and thus giving businesses an incentive to develop new technologies and better packages. Pakkaaminen also states "logistics becomes more and more important when choosing between different types of packages. In part the reason for this are longer transportation times" (Pakkaaminen p. 228). This means that the packages must be designed so that those last long enough and protect the product. In terms of transportation and warehousing, it is also important that a package takes up as little space, also when empty, as possible. This directly impacts cost efficiency.

Businesses and academic institutions have a common interest in acquiring, using and developing up-to date knowledge and solutions.

Taking the positive outlook of the industry and more demanding consumers, businesses must engage in research in order to supply what is demanded. According to Pakkaus 2020, “packaging and packaging research are needed in 2020... domestic package research must produce information that can be used to develop new systems, maintain the competitiveness of domestic industries as well as ensuring consumer safety” (Leppänen-Turkula, Meristö, Järvi-Kääriäinen, Pakkaus 2020). This statement clearly shows that both public and private sector have an interest to carry out research. For example, in order to maintain competitiveness of domestic industries, businesses must be up-to-date and invest in research and development.

The government in turn can ease the job of businesses and direct those toward the suitable way with its actions. As the majority of academic institutions in Finland are public, it is sensible to include schools in research. This in turn ensures that there are enough experts in the field to ensure the Finnish businesses can operate also in future. Thus it can be argued that TAMK Smart Packaging laboratory will be a good link between the businesses and the future workforce, and a playing field for the research. That way the laboratory will be working towards a successful future in smart packaging.

2.2.4 Teaching of Packaging Techniques in Finland

Actual teaching of packaging techniques is provided by private institutions and associations in the form of short intensive training and academic institutions in courses part of several programs. The trainings provide the students primarily with basic information of the field or of a specific, up-to-date issue. No complete curriculum for packaging exists in bachelor’s level.

According to Pakkaaminen by Järvi-Kääriäinen and Leppänen-Turkula, the purpose of packaging training is to provide people with the basics of the field. This refers to the basic training provided for example by institutions and associations. The goal is to give the trainees tools to further study materials, packages, packing, laws and the effect on environment in critical manner. According to the authors, the different types of backgrounds and expertise and thus the package experts represent a variety of schools. Järvi-Kääriäinen and Leppänen-Turkula point out that this fact has a positive effect on the quick development of the industry. Further training is provided for experts to deepen their expertise.

Järvi-Kääriäinen and Leppänen-Turkula say the following institutions provide packaging training in Finland:

- Suomen Pakkausyhdistys ry: 2 weeks’ basic training, and 1 and 2 day seminars
- The University of Helsinki: 7 credits worth of packaging technology training in the school of foodstuff technology

- Other universities provide a possibility to emphasize packaging for example in wood processing, paper processing, chemistry, mechanical engineering, art school and business school in logistics and marketing
- Polytechnic universities provide courses in packaging in the fields of food stuff, logistics, paper processing and design.
- Supplementary training is provided by Suomen Pakkausyhdistys, KCL Printing School, AEL-Insko and Pyhjäjärvi-Instituutti, where the courses are 1 day long and deal with current topics. (ibid)

In addition, Lappeenranta University of Technology, later LUT, has initiated a master's program called "Master's Degree Program in New Packaging Solutions" (LUT, n.d.). The program is a part time program and according to the university the goal is to educate experts in packaging materials and technology that can work throughout the packaging chain in businesses related to packaging.

2.2.5 Pirkanmaa Logistics Center

Pirkanmaa Logistics Center is a cluster being developed and created to the border of Tampere and Pirkkala. The cluster offers services on road, rail, air and water shipments, warehousing and terminal services as well as logistics IT services. In addition to the services provided by businesses, educational institutes and research and development organizations participate in the cluster. (Ennakoiva analyysi, p. 4-6) At the moment TAMK is not officially involved in the project, but placing more importance on logistics through offering more logistics courses and developing a logistics laboratory are a great incentive for the logistics center to involve TAMK in their cluster. Academic institutions are ideal grounds for innovative research and the new laboratory is an excellent place for that. It is also said that networking and internationalization are important factors in creating the cluster. (ibid) Including TAMK in the network would be beneficial also in order to include the public sector in the process. TAMK also represents a modern, international community with connections both in Finland and abroad.

The demand for logistics experts in Finland may exceed the supply in the future. According to Vulli and Larjovuori, the availability of workforce in logistics and transportation will become more difficult during the next 5-10 years. Along ensuring sufficient workforce, the cluster developers feel that it is essential for education to meet the needs of the businesses. (Ennakoiva analyysi, p. 4-6) Through cooperation with TAMK, the center could be involved in education and thus ensure a steady flow of logistics experts ready to work for example for one of the businesses in the cluster. The report on the Pirkanmaa logistics cluster states that among other professionals, the demand for logistics experts will increase in the future, and that is exactly the group of professionals TAMK trains. Thus it can be said

that investing in logistics teaching in TAMK is justified as jobs for future graduates are more or less guaranteed.

2.3 Benchmarking Universities' Logistics Laboratories

Some universities already teach smart packaging and packaging technologies in Finland and abroad. Studies are connected and linked to other departments or units and a laboratory work is also part of studies in some schools. Without the external funding the teaching and operations in laboratory would not have been possible.

2.3.1 Hogeschool Limburg and Xios Technical University Limburg, Belgium

Hogeschool Limburg is a Belgian university, which has a laboratory with wide range of machines for testing and planning new packages. The Packaging Center was founded in 1998 and from 2001 onward the services have covered also the packing innovation and eco-design. Xios Technical University Limburg, later Xios TUL, offers a unique study program in packaging technology. These two schools cooperate actively and the result of it is a logistics center, where businesses and the universities engage in long-term cooperation in order to research and develop packaging. This is also the planned purpose of the TAMK's smart packaging laboratory: to develop a research environment where students can study, practice and work in close cooperation and connection with local firms. Hogeschool Limburg and Xios TUL could offer a good information and example for TAMK in the developing stage, because they are already aware of the difficulties that may enter in the beginning and they have the experience of running the similar kind of laboratory and logistics study program.

The purpose of the Packaging Center is to advise the partner enterprises in choosing the best possible solutions for their wants and needs in packaging issues. The Packaging Center of Hogeschool Limburg is an independent research center which "offers services that aim at supporting small- and medium-sized enterprises in choosing and adapting packages, packaging materials and attributes with modern, fast and correct characterization and test techniques and a correct scientific interpretation of the results" (Hogeschool Limburg, n.d.). In school's web page, "applied research, technical research and evaluation of materials, packaging and accessories" are all listed to be services offered in Packaging Center (ibid). By providing extensive range of services the school has target group and good possibilities to get lot of customers from various fields of businesses. From 2001 onward customers have also been offered services related to the packaging innovations and eco-design (ibid) and these services enhance the public image of the school as well. Environmental issues and new innovations in packaging area are rapidly coming more and more important. Thus one could argue that Hogeschool Limburg is concentrating on the right issues and hence showing a good example to others.

The Packing Center has a wide range of machines and different testing equipments in its use. The equipments are expensive and therefore buying often requires external funding. This is what has happened in Hogeschool Limburg as well: in the beginning of the operation, the equipment for the laboratory accounted 1.5 million Euros and the equipment was funded by European Union, the province of Limburg and the contribution of the Xios TUL(Hogeschool Limburg, n.d.). Without this funding the operations and laboratory could not have been developed at this extent.

The Packaging Center of Hogeschool Limburg has testing equipment for many different packaging functions. These are divided into six main categories: permeability testing, transport simulation, possibilities for climate influences, paper and corrugated board testing, eco-design and physical testing. In addition to these, in the paper and corrugated board testing, the technical support is offered (Hogeschool Limburg, n.d.). This means start-up, maintenance, repair and calibration of laboratory equipment. Technical service is working under supervision of Lorentzen & Wettre, which is a Swedish company offering advanced equipment for quality control and process optimization for world's paper industry. When having a partner outside from school supervising laboratory's operations, a more attractive view can be delivered to customers. The school is not only working internally but also contacting other experts and using their knowledge in enhancing schools operations. This can be seen as improved efficiency and reliability.

In Limburg, the Xios TUL is focusing to packaging techniques. The department of industrial sciences and technology of Xios TUL organizes the unique education of Industrial Engineer Packaging Technology (Hogeschool Limburg, n.d.). These two institutions are cooperating actively, and - again - showing an example that cooperation, when planned and organized properly, will benefit the partners and customers.

Xios TUL offers both bachelor and master level education in Industrial Sciences called Packaging Technology. It is a unique program not offered in this extent anywhere else at the moment. The study program is an Erasmus program, which means that study places are available for exchange students as well. The studies in Packaging Technology program are closely connected to Hogeschool Limburg's packaging laboratory and students work actively in the laboratory in solving problems and creating new innovative packaging solutions (Hogeschool Limburg, n.d.). This seems to be a good way of working and could be used in TAMK's smart packaging laboratory as well. The students from logistics module, and later perhaps from the logistics program, could work in the laboratory with students from other TAMK programs. Cooperation could also be arranged with other interested universities in Finland.

The packaging programs of Xios TUL concentrate on the composition of different packaging materials, ecology and development issues. The students study several courses in biology and organic chemistry to develop the understanding of the nature of packing materials. The ecological aspect is intensively studied in two separate courses. The development and legal issues are studied as well. The division between the bachelor and master's degrees is that the latter concentrates on the development of the materials and the ecological causes while the first one concentrates on learning the materials and testing those. (Xios, n.d.) The programs are tightly linked to the packaging laboratory and the machinery used there.

Work placement is an important part for both programs in Limburg. Students

“get the opportunity to gather a comprehensive experience during their work placement... and for a longer period they [students] will be confronted with the reality of company life and will learn how to deal with problems or investigation aspects, how to formulate and elaborate solutions and to report the results” (Hogeschool Limburg, n.d.).

The work placement is supervised by the school and the company, so student will get the most out of work tasks. For a final thesis, students can choose their subjects introduced by the education board or they can choose it freely by themselves. Both thesis and work placement can be completed also abroad. (ibid) This is the situation also already in most of the universities in Finland. By offering the work placement in the school's laboratory, and final thesis subject related to the laboratory work, a school is educating real experts for the labor market of packaging area. It is also using students as an internal resource for the research work. The experiences gained from the supervised learning environment will most likely benefit the student in the future's working place so in addition to school, the students benefit perhaps the most.

2.3.2 HAMK University of Applied Sciences

The laboratory work is connected to the studies also in some Finnish schools. HAMK University of Applied Sciences, later HAMK, has a research and development unit called AutoMaint which offers the “top knowledge of operation and maintenance and automation” (HAMK, n.d.). The target group for services offered by AutoMaint is the Finnish industry and the firms operating with it. As the mission of AutoMaint the schools web page states the following: “to increase the efficiency of production by the help of automation and information systems, carry forward the research work of the field and generate new entrepreneurship” (ibid). In this mission HAMK seems to observe and enhance the situation of the businesses, students, and school's task to participate into research work (Arene, n.d.). The importance of cooperation between the school, students, firms and partner schools is understood and highly encouraged in HAMK. Geographically HAMK and TAMK are located quite near to each other and this provides good

pre-requisites for creating the cooperation between these two schools in the future.

The cooperation between the different study programs of the university is taking place also in HAMK. The AutoMaint unit operates in close cooperation with the degree programs in automation, industrial management and international business (HAMK, n.d). This way many programs of the school benefit from the same research and development center and laboratory. Students from these programs are carrying out their “theses in connection with project operations and are an integral resource in development work” (ibid.). So in the laboratory work both the school and the students benefit greatly. HAMK AutoMaint is also creating international connections and annually about 15 exchange trainees are involved in the project work (ibid). International cooperation adds value to the laboratory work because these trainees from abroad are bringing their own experience and expertise into the laboratory and giving the students and the school advice and examples on how to develop and elaborate the working. These trainees are also discussing their experience from Finland with their colleagues and friends in their home countries.

HAMK AutoMaint is offering new types of services to businesses. These services enable them to “enhance the integrated operations and maintenance of production systems by predicting error situations and optimizing maintenance procedures” (HAMK, n.d). The operations in AutoMaint include research work and cooperation with companies as well as the development of education services for the basic education of polytechnics and for the education of firms. The project work has got funding from various sources, which change according to cases. According to HAMK web pages, Finnish Funding Agency for Technology and Innovation (Tekes), European Regional Development Fund (ERDF) and European Science Foundation (ESF) are the most important sources of financing at the moment but in the future the aim is to more effectively capitalize the EU framework programs in funding projects (ibid). So, as it was the situation with the laboratory work of Hogeschool Limburg, HAMK’s project work has not survived without funding coming outside.

When cooperating with businesses AutoMaint is working as an actuator, or the companies initiate projects, whereupon AutoMaint provides the scientific aspects and knowledge of the subject. In its laboratory, AutoMaint has a wide range of equipment, which acquisitions are carefully planned to respond to the demand of the businesses’ needs in the market (HAMK, n.d). The laboratory equipments are expensive and thus thorough planning and matching the goods and the needs is essential.

2.3.3 Lappeenranta University of Technology

LUT is the only Finnish university offering packaging related study program and it is continuously investing in packaging studies. The press release of LUT in 9th of May 2007 states that LUT is going to develop a five-year long packaging techniques program into the mechanical engineering department. The professorship will enhance the international research and teaching. LUT is also going to develop an international master program “New Packaging Solutions”, and in years 2008-2010 there is going to be planned and implemented machinery for teaching and testing packaging techniques. For this project, LUT has set the funding for one full-time researcher. The biggest donator for this project is Finnish paper manufacturer Stora Enso but also significant number of other sponsors is involved. (LUT, n.d.) LUT invests extensively in packaging study programs, which should result in increasing number of packaging experts in Eastern Finland.

The mechanical engineering department of LUT is actively working to enhance the situation in the research field. The school is an important factor in the project of South-East Finland’s Center of Expertise, “Functional Packaging”. The professorship in packaging techniques is strongly linked to the other professorships of mechanical engineering and therefore the new program will easily be connected to the existing research environment. (LUT, n.d.) Cooperation between departments is important as the expertise is exploitable for many different units. Remarkable cost savings are also incurred, when the same research environment is utilized.

The packaging program in LUT clearly concentrates on the use and development of different materials and technologies. In addition to learning the packaging materials, the general studies include the “interaction of the package and the content” (LUT, n.d.). Majoring in packaging includes intensive study of the different technologies, for example fibres, laser, coating and laminating as well as ”printing and varnishing” (ibid) The students also study how to design machines for the industry. In order to ensure that the students develop useful and feasible products, they are introduced to the legislation of the field as well. (ibid) The program supports the format of learning about new solutions well as the development issues are incorporated intensively.

3 Data Collection

Pirkanmaa's Businesses, Finnish and foreign universities, TAMK's other departments and logistics organizations were interviewed in order to find out what is the current state and need for packaging studies and the parties' interest towards TAMK smart packaging laboratory. The results show most of the interviewed businesses do not use smart technology at the moment but are interested in exploring the possibilities. Similarly, the supply of packaging studies is almost inexistent but there is interest in developing programs since experts in the field are on high demand. All the groups show some interest towards cooperating with the laboratory. Specific suggestions were raised as well.

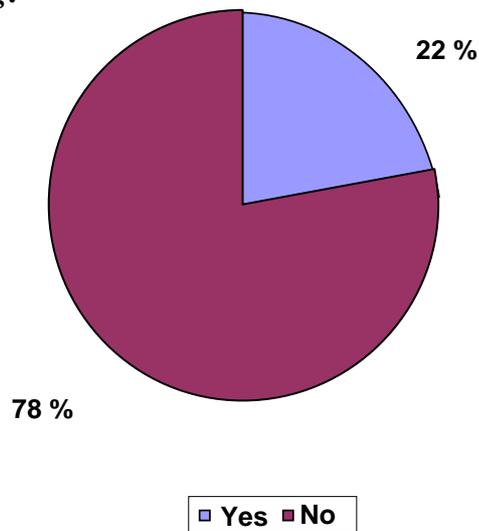
3.1 The Perspective of Businesses in Pirkanmaa

The majority of the interviewed businesses does not employ smart packaging but are very much interested in doing so in the future. The businesses feel that integration and finding fit solutions with reasonable cost are reasons for the slow spread of the technology. Another problem is that while the employees often have skills in packaging, the smart technology is not familiar to them. The respondents view the suggestion of developing packages together with TAMK positively.

3.1.1 The Use of Smart Packaging

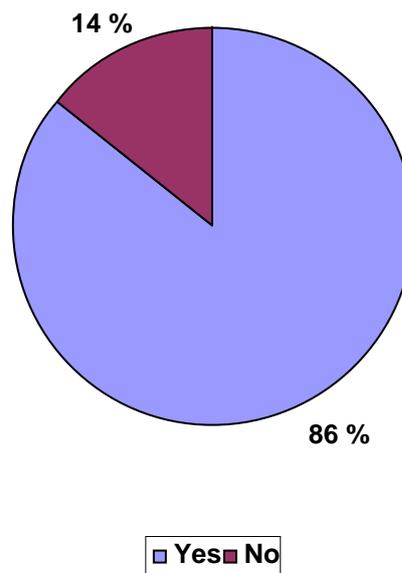
The majority of surveyed businesses from Pirkanmaa do not employ smart packaging at the moment. However, they are interested in doing so. The businesses with no interest in investing in the technology have rather specific reasons for not doing so. The companies may consider their in- and outbound logistics to be too small in order to benefit the investments required for smart packaging functions. Other reason is that the packages are considered to be so simple that no smart functions are needed.

Graph 1: Can Current Packaging Be Classified as Smart Packaging?



According to the survey, majority of packaging used at the moment cannot be categorized as smart packaging. 78% of the respondents do not consider the packaging materials used by the company to possess qualities categorized as smart. 22% say they use some type of smart packaging. These businesses were GNT, Green Can, Inion and Saarioinen. The smart functions used consist of different kind of indicators, innovative materials or the utilization of RFID-technology.

Graph 2: Will Your Business Be Using Smart Packaging in the Future?

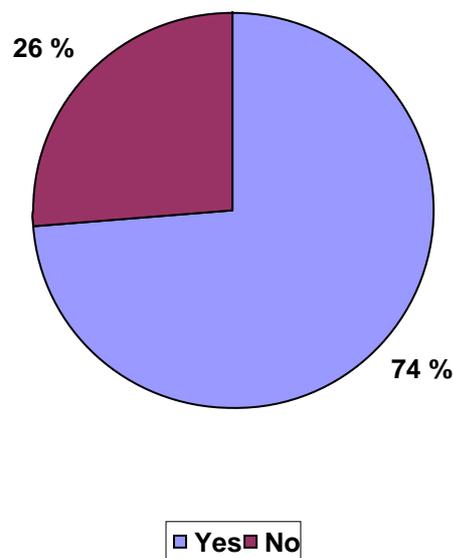


The businesses that are not using smart packaging at the moment were asked if they have plans for changing to it in the future. 86% of the businesses are interested in taking the advantage of smart packaging in the future. 14% of the businesses, Kiilto and ValLog, are not interested in changing to smart packaging, at least not in the near future. This is because both of these businesses think that they may not make the best use of smart functions in their operations.

3.1.2 The Staff's Knowledge and Training in Smart Packaging

When surveying the businesses, they were asked about training their staff. The goal was to determine the level of knowledge and skills in (smart) packaging among the staff. According to the results, packaging is not clearly taught in any institution or university, which is why most of the training and familiarization with the concepts takes place in the company, specifically to the issues they deal with.

Graph 3: Does the Staff Possess Skills And Expertise in (Smart) Packaging When Entering the Business?



The majority of businesses interviewed say their staff is skilled in packaging when the employment begins. 26 % of businesses say their employees do not have the expertise in packaging when entering the firm. According to survey, the packaging experts are needed in the logistics field. TAMK's efforts in the field of logistics, and especially in the field of packaging, would be highly appreciated among the companies in Pirkanmaa area.

According to the interviews, it is very difficult to find packaging experts in Finland since packaging is not extensively taught at any university. For example Jarmo Kuikka, the president of Takon

Kotelotehdas, clearly states that “there is a lack of packaging experts because the subject is not taught anywhere” (Kuikka, 13.4. interview). The logistics manager of Inion, Sami Eweiss’s answer supports Kuikka’s view and he also says that on occasion, a business may employ a person from a competitor, when the employee already possesses the skills and knowledge. Otherwise the employee must be trained in the business. The staff also has to be trained to include logistics and optimizing packages as a part of their work. (Eweiss 26.4.2007, interview) Inion produces biodegradable implants for the pharmaceutical industry and the smart functions are a very important part of their packages.

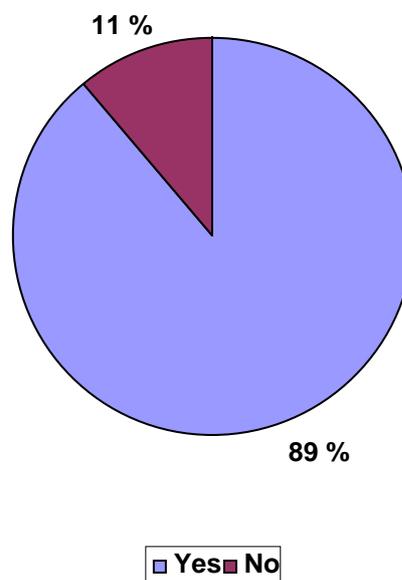
Research and development and managerial positions require higher level education as well as experience. It is common for the R&D and logistics personnel to have a university level degree. When interviewed, the businesses say that the staff has basic knowledge of for example RFID, but more detailed information for example on the available machinery and different possibilities is more rare. Many of the companies do not know, for example, that the smart solutions are highly customizable for the needs of a specific company.

Both package producers and users rank Suomen Pakkausyhdistys as an important player in packaging education. The institution’s courses on packaging are designed to provide the students with the basics of the field as well as informing the professionals about the innovations on the field. (Pakkaus.com) When interviewing the businesses in April-May 2007, Suomen Pakkausyhdistys was the best identified trainer of packaging matters.

3.1.3 Smart Packaging in the Future Business

When interviewed, the businesses were interested in a variety of smart packages. More than half of the businesses say they are planning to integrate RFID in the future. Other packaging techniques, for example indicators and innovative packaging materials were mentioned. Especially the foodstuff industry is interested in this type of packaging.

Graph 4: Is Your Business Interested in Investing in Smart Packaging?



As the Graph 4 shows, a clear majority of the respondents, 89%, are interested in investing in smart packaging. Only two interviewed businesses say they have no interest in smart packaging. These businesses are Kiilto and ValLog. The representative of Kiilto says that there is no interest in RFID, only some developed materials suitable for chemical products might interest the business. ValLog is a rather small warehousing business operating manually without automation and its functions can be regarded to be too small for RFID or other big (smart) investments.

Designing packages to be more global, safe, unified and environmentally friendly are goals of every business. The interviewed businesses say it is difficult to find or develop new packaging materials as those should be environmentally friendly but the price should not be much higher than what it already is. A key issue, according to the surveyed businesses, is also substituting plastic with a material that burdens the environment less. Another way to reduce packaging waste is to use thinner materials, which demands for extensive testing of strength and durability. This is because thinner materials change the attributes of the package. All alterations of packages must obviously be done within the laws.

The appearance of a package is increasingly important factor in selling the product to the consumers. According to the package producers interviewed, the development of printing techniques provides the industry with new opportunities. In general, the amount of ink and printing area used are to be reduced without losing the quality of the imprint. The development of the techniques makes this possible. Enabling this, the packages become more environmentally friendly and thus the waste and emission fees imposed on the businesses decrease.

Mr. Miettinen from Liha-Saarioinen says that the package sizes are decreasing, which means that the packaging machines must work at higher capacity in order to reach the same output. He also points out that a smaller package size leads to larger amounts of package waste as the physical size of the package does not reduce in proportion to the product size. (Miettinen, interview, May 7, 2007) This clearly shows the strong relation between the industry and consumer needs.

Moving towards smart packages often increases the price of the packaging, at least at the beginning of the process. The president of Green Can, Mr. Markku Anttila, says that even though customers demand more environmentally friendly packages, for example substitutes for plastic, they are not willing to pay for the difference (Anttila, interview, April 16, 2007). Hence an imbalance between the wants of the consumers and their willingness to pay exists.

One of the problems in developing packages, according to the interviewed package users, is that the users are at the mercy of the producers. The customers, the users, can suggest improvements and state the requirements for their packages but in the end the producers decide the end result. Anita Hiltunen from Laboratoriokeskus says that they can “affect the packages only indirectly by telling the producers what they want and need” (Hiltunen, interview, April 27, 2007). She also says they are always interested in new possibilities and inventions and thus read magazines and follow the research in the industry quite closely.

3.1.4 Problems in Integrating Smart Technology

In addition to RFID, especially food industry is moving towards using other types of smart packaging. This is shown as extensive, ongoing research and development. There is interest in adding indicators, for example to monitor temperature, into the package. Mr. Pekka Kähkönen, the head of purchasing in Linkosuo is interested in indicators measuring the amount of mold spore in dry bakery products, as mold is the largest problem with the dry products (Kähkönen, interview, April 20, 2007). This is an example of an indicator measuring the shelf life of the product.

Businesses that produce or use packages invest in developing new packaging materials. Especially finding more environmentally friendly materials is important from the businesses' and consumers' points of view. The goal of food industry is to pack the product so that it is easier to use for the customer. For example, packing the product in a container that can be heated or put in the oven, making opening and closing the package easier, or adding a stopper in a carton to ease pouring the product and closing the package are ways to make the package easier to use. (Miettinen, interview, May 7, 2007) The demanded improvements clearly are practical and, from the consumers' point of view, simple.

The main obstacle that the surveyed businesses find in introduction of RFID is the high cost of the equipment needed. It is thought that the screening equipment is very expensive, but the belief is also that as the technology advances and RFID becomes more common, the prices decrease. The businesses see this as a possibility for them and many others to integrate the technology.

It was discovered in the interviews that some businesses had tested smart packaging solutions. The reason for not integrating the tested technology into the system permanently was that the system did not work and thus further investigation was not carried out. Sami Liponkoski from UPM Raflatac explains that most of the time the solutions were not properly designed to meet the needs of the company. He also says that the businesses today have basic knowledge of RFID but the understanding of complete and customized solutions is lacking. (Liponkoski, interview, May 2, 2007) Thus UPM Raflatac arranges briefings for prospective customers in order to inform them about the different types of RFID solutions available.

Some businesses interviewed are a part of a chain store and thus introducing RFID in their part demands the approval of the whole chain management. The assumption is that the cost of integration is very high as the change has to take place in every part of the organization (Sillanpää-Jaatinen, interview, May 3, 2007). Integrating RFID into the packaging machines was viewed in various ways among the surveyed businesses. Some believed that integrating RFID does not change the system much because the package size or shape does not change radically. Others believe the whole packaging machinery should be changed in that occasion.

The retail business is interested in the self-service possibilities that RFID can offer. Self-service counters would lead to shorter lines and faster transactions. This type of service has been tested in some stores in Pirkanmaa area. The problem has been monitoring, because the risk of selling alcohol and cigarettes to under-aged people increases.

Retail business also views RFID as a tool to monitor the products' movement and customer's buying habits. It can be a tool that helps to increase efficiency in follow-up of products through its life, for example in warehouses. Another advantage of RFID here is smaller possibility of stealing when antitheft alarm systems are integrated with RFID. Prisma manager Mervi Sillanpää-Jaatinen also says that RFID can create more possibilities for using member cards (Sillanpää-Jaatinen, interview, May 3, 2007). These changes, while still a minority, are visible and usable by customers.

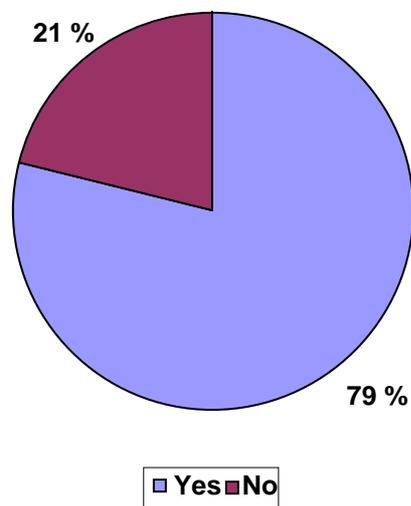
RFID is already introduced in some libraries in Finland, where it speeds up customer service, helps control the book collections and reduces loss of material. Kaisa Toikka and Marjatta Ojala from TAMK's library say that the school investigated introducing RFID to

the library two years ago but the system was too expensive. They also say it most probably takes more than five years to adapt the system both librarians find interesting. In addition to the financing, the actual integration of the system is problematic. The books and other material has to be marked with new stickers, which is difficult as the loan times can be long. Thus the project would have to be long term in nature and would require separate budget. Toikka and Ojala also say that both the old and new system would be used at the same time for a while. They also think that bar code would be needed for physical identification even if RFID were used. (Ojala, Toikka, interview, May 9, 2007) But when opening a new library, RFID would be a reasonable option.

3.1.5 Cooperation with TAMK

The surveyed businesses' opinion about TAMK Smart Packaging Laboratory is positive. Cooperation is a possibility when needs and resources meet. The cooperation would have two main forms; long-term and short-term projects. The package producers are interested in long-term projects while the case studies are the demanded by customers of the former group. The need for specific type of testing equipment, especially RFID, was clear when asked about the practice of the laboratory. It was also important for the respondents that the laboratory is neutral.

Graph 5: Would You Like to Develop Your Packaging Together with TAMK?



The majority of respondents, 79%, are interested in developing packaging together with TAMK. Only four respondents did not feel that the cooperation would be useful. Of the package producers, 83% wanted to develop packages in TAMK laboratory while 71% of the package users are keen on plans for cooperation.

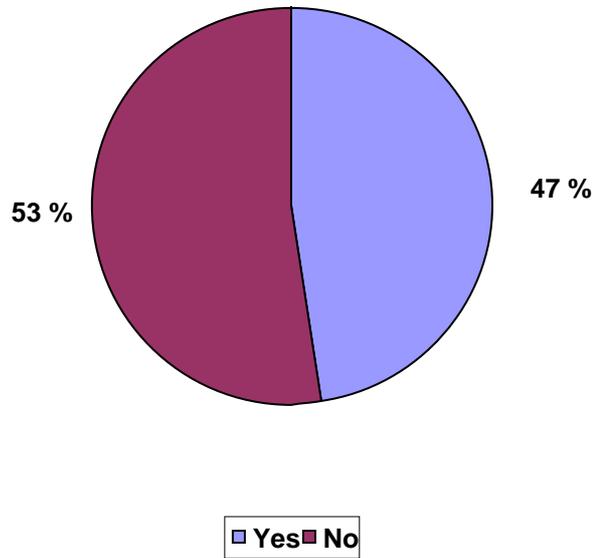
The package users are interested in a neutral laboratory where they can quickly test different producers' products as well as cooperate

with the producers in specific projects. One respondent told that they ask the producers to test other producers' products but that an easier way would be to test the products in one neutral lab. He is interested in finding out "if the package is as strong as the producer says it is" (Almen, interview, April 23, 2007). Along the neutrality, the benefit of one laboratory is quicker testing, which according to the respondent leads to smaller costs (ibid). Another possibility for cooperation with both package users and producers is a specific project, a case study. In that case the package is developed in accordance to certain specifications for a specific product.

The package producers are clearly interested in long-term development and better education of packaging techniques. The idea of the laboratory and study program specializing in packaging was well received. Jyri Weiste from SCA Packaging says that testing of the packages in realistic circumstances in regard to temperature, humidity and handling is important to them. He points out that in order to take the advantage of the testing results, the equipment has to be in accordance with universal standards. (Weiste, interview, May 4, 2007) Another business producing carton packaging, Takon Kotelotehdas, says they would benefit the most from "a study program for packaging engineers, testing of materials and long-term testing in a laboratory which is run by full time staff of two experts (Kuikka, interview, April 13, 2007). The interviews clearly state both testing and education in the field are needed.

Some package producers interviewed had a totally opposite, negative view of the laboratory. According to the interview of Markku Anttila, the president of Green Can, a small business producing environmentally friendly packages, does not benefit from the laboratory in any way (Anttila, interview, April 16, 2007). The interviewee at Suominen Joustopakkaukset says cooperation could be possible but that the business does enough testing internally. He also said that the customers of Suominen do not need outsider testing because the products are so good. (Tuomimäki, interview, April 25, 2007)

Graph 6: Are You Willing to Outsource Testing of Packages to TAMK?

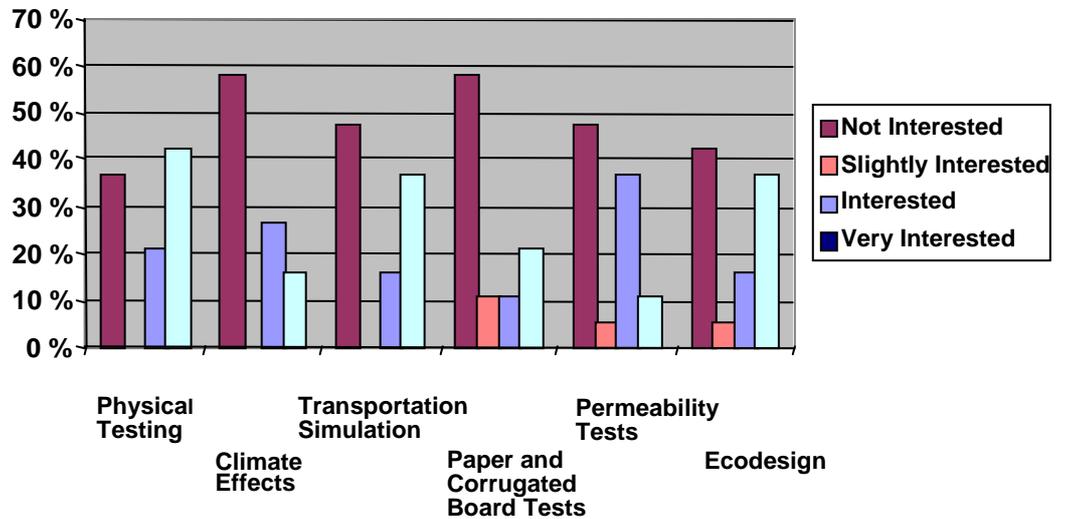


47% of the respondents are interested in outsourcing the testing of packages to TAMK. Among the package producers, 57% of the respondents viewed the proposition positively while among the package users the number was slightly smaller, 53%.

3.1.6 The Attractiveness of the Testing Machinery to the Businesses

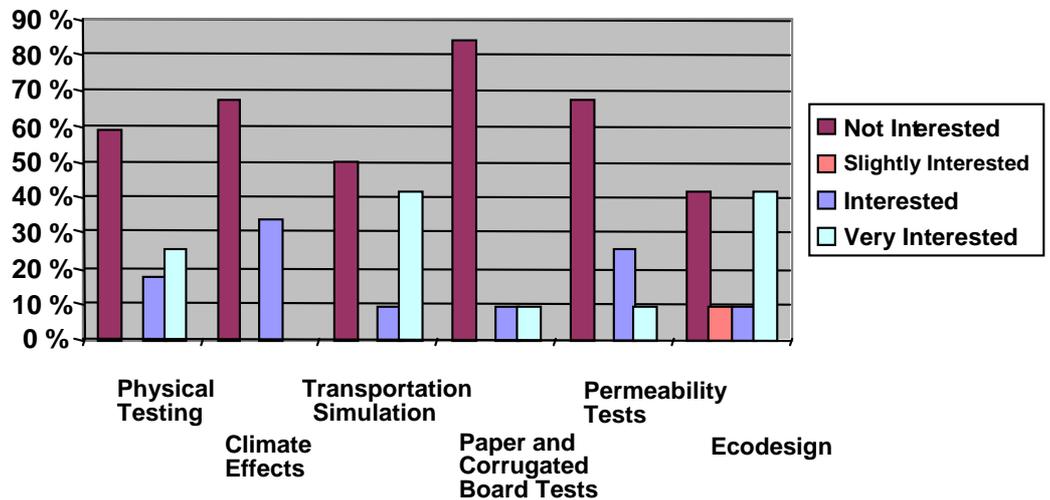
The businesses were asked to rate their interest towards different types of testing machinery based on a scale from one to five. In order to better illustrate the results, the two top categories, very interested and extremely interested, were combined.

Graph 7: Attractiveness of Testing Equipment, All Respondents



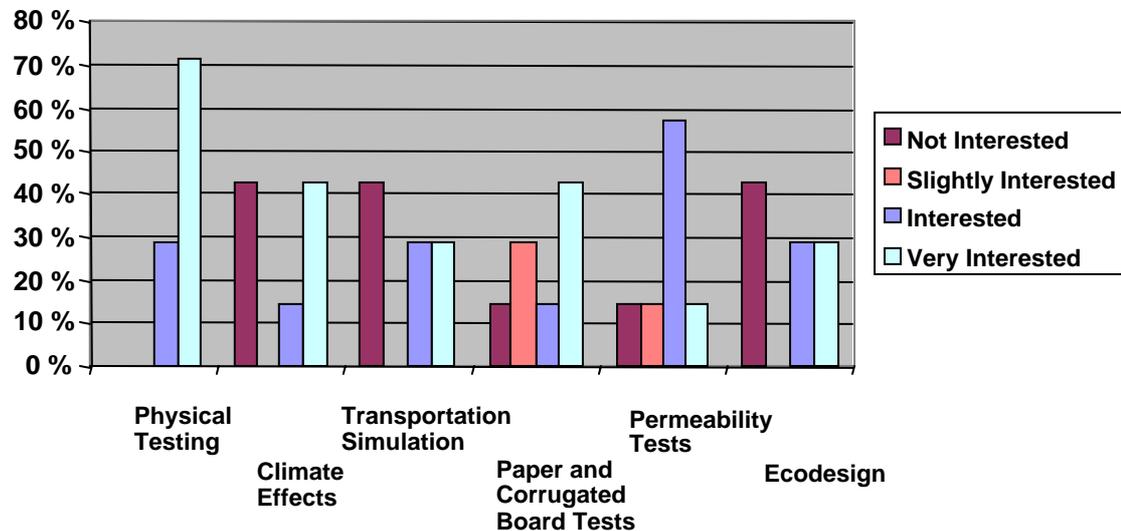
Based on the results, physical testing seems to be the most interesting, 63%, group of testing machinery to the respondents. Transportation simulations, permeability tests and eco design are rated to be the next most interesting. Approximately 55 % of the interviewed businesses are interested or very interested in these tests while the least interesting tests relate to paper and corrugated board as well as climate. The least interesting tests are rated to be paper and corrugated board tests as well as climate effects, 58%. In order for a group of machinery to be interesting, the machinery would have to be standardized.

Graph 8: The Attractiveness of Testing Equipment, Package Users



Among the package users, 12 respondents, the most interesting testing groups are eco design and transportation simulation. Approximately 50% of the respondents are interested in both of these groups. The next most interesting group is physical testing, 42% while the majority, 67%, are not interested in climate effects and permeability tests at all. Corrugated board and paper testing is the least interesting group as 83% of the businesses are not interested at all.

Graph 9: The attractiveness of Testing Equipment, Package Producers



When assessing the results of the package producers, seven respondents, it can be seen that the most interesting form of testing is again physical testing. All of the respondents show keen interest. The next most interesting is paper and corrugated board testing and permeability testing, since only 57 % of the respondents show interest in these. The next most interesting are the climate effects, transportation simulation and eco design. At least half of the respondents are interested in these.

3.1.7 The Ideal Smart Packaging Laboratory

In order for the laboratory to be as useful, practical and highly appreciated, it must be neutral. Mr. Miettinen from Lihasaarioinen says that “neutrality is important, just as is cooperation with package producers in order to provide information about new materials and packages” (Miettinen, interview, May 7, 2007). Thus, the idea is that the laboratory could provide information to all players in the field as well as act as a middleman between the producers and users. Another factor to be considered was brought into the attention of the researchers at Linkosuo, where Mr. Kähönen says that “the laboratory should be neutral and the staff must be discrete” (Kähönen, interview, April 20, 2007). This way the customers of the laboratory feel safe to share their business with the school.

Standards ensure high level of work and usability of the results. Standards ensure that the equipment is set in a proper way and can be used as reference. Standardized work covers both universal standards as well as controlled environment in the laboratory. Accrediting the laboratory with standards ensures that the customers truly get the

maximum benefit from the service. The outcome is a promise from the producers to the users about the quality of their products.

A controlled laboratory environment leads to testing results that are accurate and reliable. This is because the environment does not change from one experiment to another. According to the surveys, a common way to test the effect of transportation on the package and product is to send the shipment for example from Tampere to Rovaniemi and back and see what the effects were. According to the respondents there are two major problems associated with this method. Firstly, it takes a lot of time to make many rounds. Another problem is that it is impossible to know which route the truck took and what happened. Thus the end-results cannot be compared to each other without bias. A laboratory provides the businesses with better chance to observe the test and reliably compare the results of trials.

The package users are especially interested in the following kinds of tests and actions:

- Consulting
- Testing ideas for example in automation
- Testing exertion
- Testing transportation
- Tying up and marking the loads in a truck
- Permeability tests
- RFID testing
- Observation of the products during transportation
- Innovative packaging technology and development of materials
- Indicators
- Testing opening and closing packages
- Measuring the amounts of microbes and remnants (of heavy metals, paint, mold, nut and soy for example) in food industry
- Testing the specifications of products- is the product what the producer says it is

The package producers are interested in the following kinds of tests and actions:

- Mechanic testing of packages (water, vapor) and the effect of it on radio frequencies (RFID)
- Testing exertion
- Permeability of moisture and fat
- Drop tests
- Testing transportation of a pallet
- Strength tests
- Innovative packages
- Standardized testing (Weiste; Laine; Eweiss, interview, April 2007)

Jyri Weiste from SCA Packaging describes the ideal laboratory as follows: “the laboratory should be a place of which temperature and humidity could be altered between -50 – 50 °C and 0-100%” (Weiste, interview, April 4, 2007). He also adds that it is obvious these

extremes won't be reached but the message is that the range should be wide. The range would allow testing how packages last in different weathers across Europe, for example. He notes that ensuring a product is usable in different conditions is an important part of product development.

An important aspect of transportation tests is a real environment. Raimo Laine from Transpoint describes an ideal laboratory as a place where a truck can be driven in. (Laine, interview, April 16, 2007) It would allow for testing of tying up the loads. The controlled lab environment together with a real truck would allow to do drop and vibration tests in an environment close to the situations on the road.

3.2 How Packaging Techniques Are Taught in Academic Institutions

Teaching of logistics and packaging techniques varies slightly between the groups of schools, Finnish polytechnics and universities, TAMK partner schools and EFLE schools, but some generalizations on the format of teaching and networking can be made. While the polytechnics and foreign schools say half of the studies is practical, internships as practical work and a channel to businesses is valued the most. Further work experience together with a bachelor's degree seems to provide a student with good knowledge for entering a master's program. The interviewed schools do not feel that further specialization to for example smart packaging is against the ideology of polytechnics. Along with that, the schools express their interest towards cooperating with TAMK in the laboratory in the form of guest lectures and common projects.

3.2.1 Studied Schools in Numbers

The research among schools was carried out during the spring and summer 2007. In the secondary research all together 23 Finnish universities, 33 Finnish polytechnics, 56 TAMK partner schools and 28 member schools of EFLE were studied using schools' own Internet pages. Those schools of who indicated on their website that they offer numerous logistics courses or program were sent the questionnaire. The questionnaire was sent to six universities, nine Finnish polytechnics, ten TAMK partner schools and 11 member schools of EFLE. Total number of answers received was twenty. From those three were Finnish universities, six Finnish polytechnics, four TAMK partner schools and seven member schools of EFLE.

The study investigated how smart packaging is included in the curricula of other Finnish polytechnics and universities and schools in Europe. This will help TAMK decide to what extent they should invest in the development of logistics teaching.

Finnish Universities provide a higher level of education, and studies usually take from four to eight years. Finnish polytechnics have both

bachelor and master level studies. Bachelor's program takes on average 3,5 years and after that, masters program usually two years.

TAMK has about seventy partner universities with business schools all over the world. The partner schools were screened through their websites to find out which ones offer logistics courses. The questionnaire was sent to those schools. Most of the TAMK partner schools in Europe do not offer logistics studies, but instead they are more focused on other business functions, such as accounting, marketing and economics.

European Forum of Logistics Education (EFLE) is a forum for logistics educators who aim to improve and facilitate the growth of logistics education network in higher education in Europe. EFLE was founded in 1993 in France and at the moment it has 32 schools as its members from 14 European countries. TAMK is already part of this as TAMK's senior teacher of logistics, Mr. Bouhlal, is a member of EFLE. EFLE aims to increase both student and staff mobility and to share their best practices and experiences.

In 2007 the main theme of EFLE is "New Technologies in Logistics Operations", where identification of current and future business needs is important. EFLE's priority this year is also to find out how to utilize and connect businesses' needs to education (EFLE, n.d.). The continuing cooperation between the member schools is an important goal as well.

The number of responses from schools met the expectations of the researchers. Quite low percentage of answers was expected because of several reasons. The most important reason was the timing: the survey was carried out in end of May and early June and this is already holiday period in most of the schools in Finland. Schools abroad start their holidays later, and from foreign schools some answers was got back still in the end of June. Occasionally it was difficult to find the right person whom to contact and the questionnaire was sent to person, who may not have been the right person to answer the questionnaire. The cover letter requested the receiver to forward the questionnaire to the correct person but it can be assumed it did not happen in every case. All the Finnish institutions were also contacted by phone in order to increase the possibility of getting answers.

There were some problems with the electronic questionnaire at the beginning. The fields for answers were set too short and the respondents were not able to put enough characters into the fields. This problem arose after receiving the first answers. The problem was fixed promptly. Some schools abroad had problems with opening the questionnaire and thus were sent the questionnaire via email.

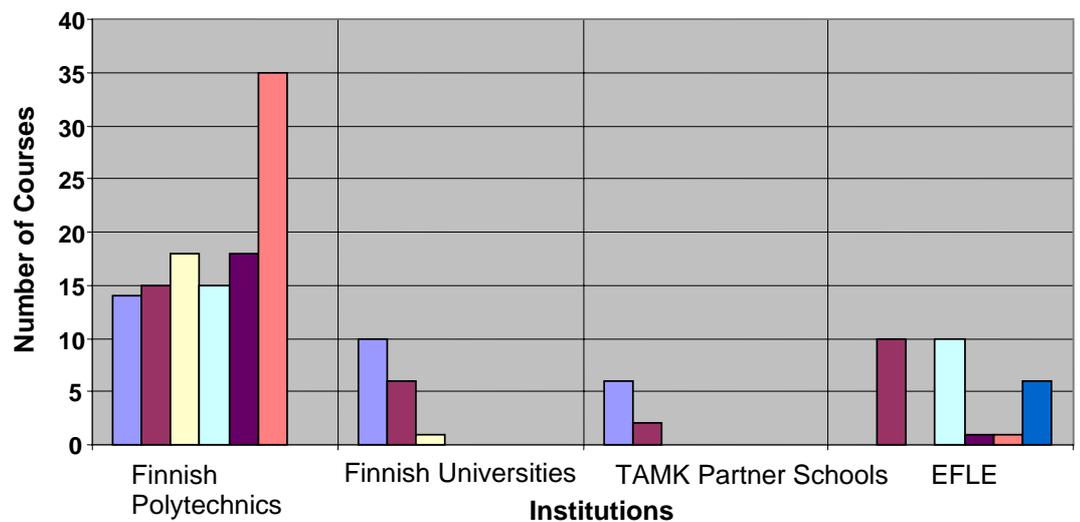
One of the goals of the survey was to compare the four school groups, Finnish universities, Finnish polytechnics, TAMK partner schools and member schools of EFLE. Less than five answers were received in some groups, which is too little to receive a valid result through

quantitative research. Thus qualitative methods were used to analyze the results in this part. However, some data comparing the groups of schools is illustrated through the use of graphs and diagrams.

3.2.2 Number of Logistics Courses Offered in English

The schools were asked how many logistics courses they offer. The schools abroad were asked the number of logistics courses taught in English. The answers are shown in Graph 7.

Graph 10: Number of Logistics Courses



The figure shows that Finnish polytechnics have the widest range of logistics courses. They have on average 19 courses available for students. This is clearly the highest among all the studied groups. Finnish universities and EFLE schools follow behind by having both about five courses included in their curriculum. TAMK partner schools have only two logistics courses available.

One of the pillars in the figure 10 is significantly higher than others. This pillar represents the logistics courses offered in the Satakunta University of Applied Sciences (SAMK). SAMK has three different programs focusing on logistics, two of them is taught in Finnish and one in English (SAMK, n.d.).

3.2.3 Length of the Logistics Program in Different Schools

The length of the logistics program varies only a little between the groups of schools. Polytechnics offer logistics programs usually under BBA- or engineers program. Finnish universities have shorter logistics programs than polytechnics. Both TAMK partner schools and EFLE schools abroad offer as long programs as the Finnish polytechnics.

According to the study, the logistics program in a Finnish polytechnic is four to five years long. It can be assumed that the respondents have added up the lengths of bachelor's and master's programs. First year studies provide student the basic knowledge of logistics, whereas during the second and third year the logistics functions are studied in detail. The fourth year is usually more practice oriented and it is spent doing projects, work and final thesis. In addition, master's program is two years of studies.

Finnish universities have shorter logistics programs than Finnish polytechnics. The average length of logistics studies is 2,16 years. This includes only the actual logistics studies and courses, no other studies are counted here. The work placement is not a part of university studies either. Usually the university level studies take four to six years. People, who study logistics, study also other subjects, such as business or engineering.

The study shows that the length of the logistics programs varies significantly among researched TAMK partner schools. One school informed that the length of their logistics studies is only one year whereas other schools had three to four years long programs. The average length of logistics studies was two years. Two schools stated that they do not offer any logistics courses. The largest number of courses among TAMK partner schools was in Upper Austria University of Applied Sciences, where seven logistics courses are offered.

EFLE member schools' logistics programs last 3,3 years on average. It is the second highest figure after Finnish polytechnics. Some EFLE members have recently included logistics courses in their curriculum and thus do not offer a complete program yet.

3.2.4 Number of Logistics Students

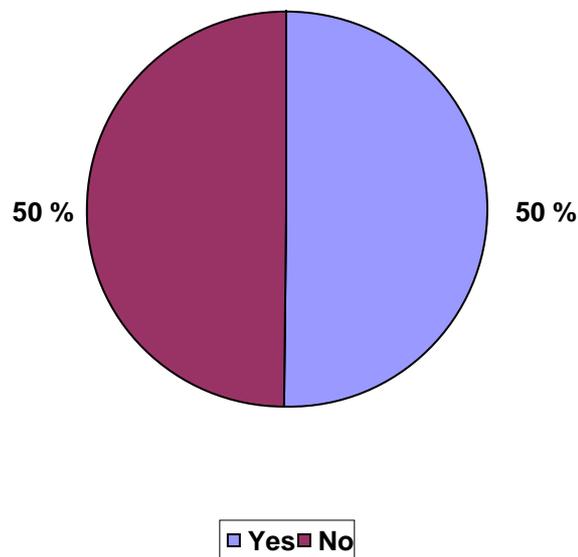
The research shows that the number of logistics students vary according to schools and programs offered. The schools offering both bachelor's and master's programs available have more than 200 students logistics students. This means that there are approximately 20-30 new students coming in for both programs each year. Obviously, the number of logistics students is higher in those universities that offer both bachelor's and master's programs than in universities that offer only bachelor level logistics studies.

According to the research, the member schools of EFLE have the largest number of logistics students. 43% of the respondents stated that they have 200 or more logistics students. All these schools offer both bachelor's and master's degrees in logistics, so the figure is comparable to about sixty new students each year, thirty for both programs. Finnish polytechnics have almost the same number of students as EFLE schools. There are about new 20-25 students per program each year. The number of logistics students is slightly lower among the Finnish universities than other schools. According to the respondent from University of Turku they have only five new logistics per year. Other Finnish universities have about same number of logistics students than other Finnish and foreign schools.

3.2.5 Teaching of Packaging Techniques

All the schools studied were asked whether or not the packaging techniques are taught in their schools. Half of the schools in Finland and abroad informed that they have some packaging techniques studies available and half of the schools stated that they do not offer studies in packaging techniques at all. All Finnish polytechnics interviewed offer some courses about packaging techniques whereas none of the Finnish universities who answered the questionnaire teach packaging techniques.

Graph 11: Are Packaging Techniques Taught?



The courses in which packaging techniques are taught concentrate mainly on other logistics functions. These courses carry names such as supply chain management, logistics management, material handling and inventory techniques. Packaging and packaging techniques are only briefly handled in the lessons.

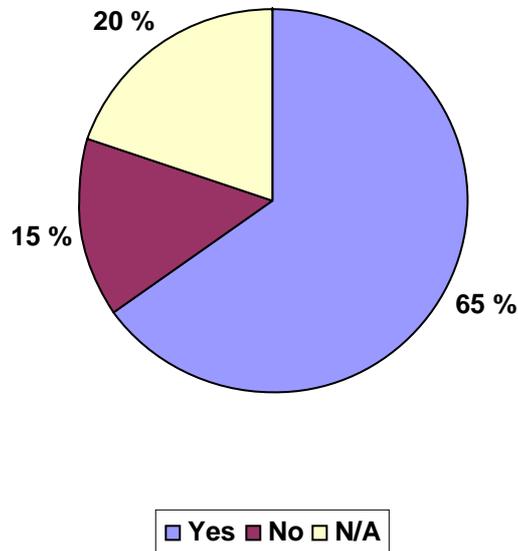
Two Finnish polytechnics, HAMK in Forssa and Satakunta University of Applied Sciences (SAMK in Rauma), have a separate course for packaging. The course is called Packaging techniques in HAMK and Packaging planning and -techniques in SAMK. The purpose of packaging is studied, and packaging materials, - techniques and - tools are introduced. Attention is also given to the packaging of special materials such as liquids, powders and dangerous goods, and to the recycling and packaging disposal.

There are significant differences in packaging techniques studies between TAMK partner schools, EFLE schools, and Finnish universities and polytechnics. The respondents representing Finnish universities do not offer any packaging studies. On the contrary, the Finnish polytechnics that answered have at least some packaging technique studies available. Two of these polytechnics also offer a course, which concentrates on packaging techniques only. But as mentioned earlier, in other Finnish polytechnics packaging studies are mainly a small part of another course. TAMK partner schools gave more or less same results than Finnish universities: only one of the researched TAMK partner schools provides packaging techniques studies. Logistics is taught as a part of supply chain management in the schools. Three EFLE schools who answered teach packaging techniques as a part of another logistics course as well. These courses are called for example Basic Course of Packaging, Material Handling or Logistics Management.

3.2.6 Practical Training as a Part of the Studies

According to the survey, schools incorporate practical work into the studies to the best of their abilities. When asked if students can get credit for working with real businesses in laboratories, the majority (65%) said the credits are awarded. This is illustrated in Graph 9. 20 % of schools answered the question was not applicable. These schools are universities and foreign schools. 15 % of the respondents, all polytechnic universities, said no credits are awarded to students working with businesses actually do not have laboratory facilities in use at all.

Graph 12: Is It Possible, And Common for Students to Get Study Credits for the Work with Real Businesses in a Laboratory?



Practicality is incorporated into logistics studies in the form of computer work, laboratory work and practical training. According to the respondents, laboratory work is compulsory when the premises are available and in use. On the other hand, several respondents pointed out that there is no laboratory work in logistics. One respondent concludes this by saying that there is “no special logistics laboratory, [students are] working in computer classes with logistics software only”. One respondent mentioned that the course contents depend on the teacher and thus the work can vary. Yet school staff supervises the exercises.

3.2.6.1 Real Businesses and Schools: The Cooperation Methods

Most of the schools stated that the cooperation with companies is done mainly through work placements. Some schools have different projects with local businesses, where students can take part the real business life and learn things in practice. Schools in Finland and in abroad have many similar ways to include the real business in the studies.

On the basis of the research, Finnish polytechnics cooperate with real business life most actively. In Finnish polytechnics every student is required to accomplish three to six months internship period in some company that provides work in keeping with student’s education. Studied schools organize also company visits to interesting companies and firms, and visits are done also other way round, when companies send employees to schools in order to present company’s activities to students. As the representative of HAMK University of Applied Science says “the cooperation methods with companies are actively

being enhanced”. Thus one could argue that the cooperation between schools and companies is increasing all the time.

In Finnish polytechnics the purpose and goal is that students make their final thesis for a company. This way the cooperation between school and business life gives the most benefit to both participants: student gets to know the real business environment and a company gets solution to its problem that is researched in the thesis. A student may also get a position in a firm, when she/he performs his/her task well.

Also in some Finnish universities the cooperation with companies is active. As the representative of Tampere University of Technology tells “the goal is that students do the thesis for a company”. Business perspective is often taken into account in the lessons but quest lectures and company visits are not popular among universities than in polytechnics. Technical universities in Finland cooperate with businesses more than other universities.

Universities and other studied schools abroad have quite similar cooperation with businesses than schools in Finland. Only one school, University of Zagreb (Faculty of Transport and Traffic Sciences), stated that they do not have any business cooperation for now. Students do their internships in companies and they do also their thesis for them. Schools abroad have also lot of case studies and problem based learning in cooperation with companies. Real business life is also included to the study programs via guest lectures, company visits and business related group works.

3.2.6.2 Proportion of Theory to Practice in Logistics Teaching

Most of the schools that took part in the research incorporate practice into the studies as well. Almost 30% of all the schools informed that half of the logistics studies are theoretical, half are practice. The exceptions are the Finnish universities, which replied that they have none or only some excursions and case studies included in the studies. The teaching methods in universities are more theoretical, this means lectures and essay writing.

As Finnish polytechnics’ mission is to provide students a good knowledge of working life, practical studies are strongly involved (Arene, n.d.). All subjects are taught keeping the real business life in mind, the teachers give real examples and students have company related case studies. There are still some polytechnics that do not invest in practice as much as others. However, in general, the research indicates that polytechnics have got good results when combining theory and practice in the lessons. The proportion of practice in the courses depends a lot on teachers. Some teachers are more active to organize trips and different kinds of case studies whereas other teachers prefer lecturing.

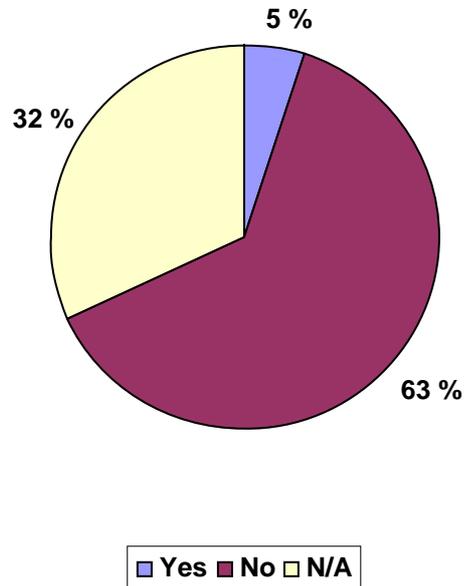
According to the research, TAMK partner schools are most eager to combine theory to practice in logistics studies when comparing Finnish schools, EFLE- and TAMK partner schools together. 75% of TAMK partner schools who answered say half of the studies are theory and other half are practice.

Both Finnish polytechnics and EFLE schools put great emphasis on practical studies. 50% of the respondents conclude that that theory and practice are given the same weight. Other schools had a bit lower level of practice. The practice side of studies included methods such as business cases and job placements. EFLE schools, similar to other schools interviewed as well, think that the practice is the most effective way to learn new things. Learning by doing is a way of applying and developing skills learned in lectures. Carefully considered division between theory and practice leads to the best results in learning.

3.2.7 Specialization in a Certain Field of Logistics versus the Ideology of Polytechnic Universities

Specialization within the field of logistics is certainly not seen as contradictory to the ideology of Polytechnics. As it is pointed out in Graph 10, 63% of the respondents think specializing is acceptable while only 5 % say it is against the ideology of polytechnics. It is said to be suitable because “individual’s special skills lead the student to a suitable field for sure“. 32% of the university personnel surveyed did not think the question was applicable, which may have been due to the fact that the schools are foreign. A few respondents however expressed their concern for too deep specialization. This is because “going too much in depth however may weaken the competitiveness of the area or the availability of professionals (outside the specific speciality).” Another expert is concerned about the total output of graduates to the market and says, “the polytechnics must cooperate to ensure the schools specialize in different fields so that the specialization is not too narrow.”

Graph 13: Is Specializing in a Certain Field of Logistics, For Example Smart Packaging, Contradictory to the Ideology of Polytechnics?



3.2.8 Preparing for Further Logistics Studies after Bachelor's Degree

Prerequisites for logistics students from polytechnic universities to universities vary according to the possibility to accept transfer credits. One school states it accepts 80 credits to be transferred while a few point out that even with a BBA or equivalent, the student would have to start from the beginning. When a student has polytechnic background, the degree should provide the student with basic skills in the subject as well as languages and studying. Two respondents strongly communicate this idea:

“Bachelor’s degree should provide the student with wide understanding of the basics of logistics as well as with good language skills and command of logistics vocabulary.”

“Along with the basics of logistics, bachelor’s degree should prepare the student with knowledge of different reading and studying techniques, good language skills and understanding of different research methodologies.”

The factors stated clearly associate with the ideology of polytechnic universities. However, it is up to the university itself whether or not the BBA is appreciated in terms of credits.

According to the answers from the foreign schools, there is no clear path from BBA logistics to master’s. This is because there is no clear and strong linkage between the two levels of education in logistics. The answers varied a lot and were rather unclear in terms of the factors that a student should possess and have attained from an educational institute. The main message, however, is that a student

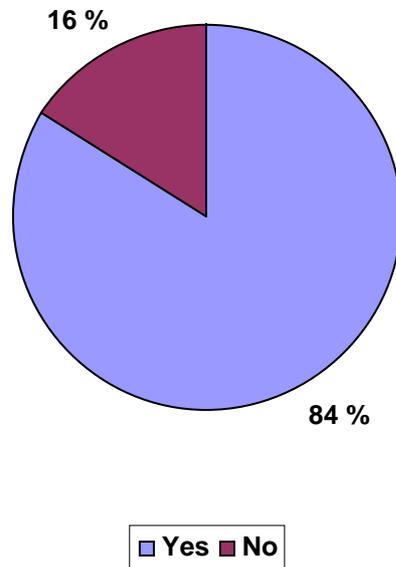
should work in the field of logistics for several years before entering a master's program.

Both Finnish and foreign schools emphasize work experience in logistics before entering a master's program and that a bachelor level degree is seen as an asset. Especially the foreign schools state that before entering a master's program, a student should finish a BBA degree and work in logistics. The Finnish polytechnics define the required work experience as a period of three years. Thus it is mandatory to work for the period before entering a Master's program in a polytechnic. On the other hand, in order to enter a Finnish university and study logistics, a student needs a high school degree only. Another possibility introduced by a foreign university is to attend a yearlong preparatory program (Mornie, interview, June 2007). Several representatives of Finnish Universities say that intensive mathematical studies shorten the studies in the university. Knowledge of natural sciences is also seen as an advantage if entering a department of engineering.

3.2.9 Cooperation with TAMK at the Smart Packaging Laboratory

Most schools that were interviewed are interested in exploring the possibilities to cooperate in TAMK Smart Packaging laboratory. As seen in Graph 11, 84% of the interviewees have a positive attitude towards the laboratory and the possibility of cooperating at some level. Both Finnish and foreign schools represent this view. For example, a few foreign universities may be interested in "guest lecturing or a project" (Mornie, interview, June 2007) and one says he would like to see how the project advances in Tampere and then "try to implement laboratory services in VeA" (Hilkevich, interview, June 2007). Another type of response came from the representative of Kemi-Tornio Polytechnic University who says that she "frequently uses your (TAMK's) study material and would be interested in guest lecturers and laboratory work especially" (Ketola, interview, June 2007). The schools who are not interested in cooperation conclude that they are not offering logistics as a study program at bachelor level but rather for example as supplementary studies for professionals. Thus the goal and resources do not meet.

Graph 14: Are You Interested in Cooperating With TAMK in Producing Laboratory Services And/Or Teaching Logistics?



3.3 TAMK Internal Questionnaire about Cooperation Possibilities in the Laboratory

Other departments than Business School of TAMK were interviewed in order to take full advantage of school's resources and venture possibilities of cooperation within different departments. A short electronic questionnaire (Appendix 2) was sent to the representatives of five different study programs via email. These programs were Automobile- and transportation engineering, Environmental Engineering, Mechanical and Production Engineering, Construction Engineering and Technological industry. The questions were to find out about the benefits and extra value the packaging laboratory and cooperation between different study programs could bring. The goal was also to determine if there is any laboratory equipment in the school, or if any study program has the resources to build any.

The results show that the internal communication in TAMK is not very effective. Some respondents did not know that there are plans for harmonizing the logistics studies. On the other hand, the representative of Mechanical and Production Engineering states that "logistics has become more and more important factor in controlling of material flows and in cost efficiency of production" and continues that "the cooperation possibilities could be found in the applications of RFID-technique" (Kaakinen, interview, May 2007). So the importance of logistics is realized and many of the respondents were interested in cooperating with the packaging laboratory.

Each study program introduced also their own special viewpoint to the issue. As introduced before, the representative of Mechanical and Production Engineering is interested in RFID-functions whereas the

representative of Environmental Engineering (ENVE) sees the environmental issues, such as the reduction of packaging material and environmental friendly materials, important. The representative of Automobile and Transportation Technology brought up naturally the transportation part of logistics that all packages must bear. Most suspicious to the cooperation possibilities was the representative of Construction Engineering who comments that “the logistical problems of construction business are quite far from the functions of packaging laboratory” (Nippala, interview, May 2007). On the other hand, he continues that the cooperation in the laboratory interests them when the issue is important for the construction. The study indicates that the cooperation, in any field, is seen as beneficial for both the customer and the producer.

A variety of study programs could bring different inputs and views to the laboratory. According to the study, the prerequisite for the cooperation is that the study program should benefit from it somehow. The representatives could not define what the benefits for their programs could specifically be, but the cooperation should be put into use in the study programs.

The study indicates that there is no testing equipment or machinery already available for the packaging laboratory. The representatives of Machine and Production Engineering and Automobile and Transportation technology consider that they might have the knowledge of preparing some testing machines for the laboratory, but these are issues that can be answered more exactly only after specific plans.

3.4 Development of Education and Possibilities of Cooperation with Logistics and Packaging Organizations

In addition to schools, there are few other organizations operating in the field of packaging and offering also education related to packaging in Finland. A short research was carried out among these organizations by using an electronic questionnaire. The purpose of the study was to find out the cooperation possibilities with TAMK. Another goal was to discover on which topics in packaging TAMK should concentrate. All together four different organizations, Suomen Pakkausyhdistys, Pakkausteknologia –PTR ry, The Council of Tampere Region and LOGY Competence, were contacted via email. Regardless of the many attempts to contact The Council of Tampere Region, the contact did not reply.

3.4.1 The Level of Teaching of Packaging in Universities

The quality of current studies is good while the course offerings are scattered. Packaging as a study program is taught in very few Finnish universities. Mr. Laiho from Suomen Pakkausyhdistys ry says that LUT is the only university offering a full program in packaging. He also mentions that the University of Helsinki in part concentrates on teaching and research in packaging of foodstuff. Several universities offer studies in logistics and visual package design. (Laiho, interview, August 28, 2007) The representatives of Pakkausteknologia –PTR ry agree with Laiho about the fact that the study offerings are not uniform enough. They also note that there is development towards broader programs instead of narrow offerings in many universities. (Järvi-Kääriäinen, Ollila, interview, August 13, 2007) All in all the institutions provide quality programs in their limited areas of interest.

Universities should aim towards offering larger modules in packaging. According to Järvi-Kääriäinen and Ollila, the packaging courses should be offered in larger scale because it allows the students to explore the subject more in depth (Järvi-Kääriäinen, Ollila, interview, August 13, 2007). This would diminish the incoherence of the packaging studies. In addition, Mr. Laiho points out that the prerequisites for developing useful programs, the universities and businesses must cooperate (Laiho, interview, August 28, 2007). The cooperation between businesses and universities leads to better coordination of packaging studies.

3.4.2 Packaging Courses Offered by Suomen Pakkausyhdistys ry

Suomen Pakkausyhdistys offers education for both newcomers and experts in packaging. The basic course is organized twice a year. During the two weeks of learning the students acquire the basic skills in packaging. The employers often send the new employees to this course. Experts can update their knowledge on current topics in shorter seminars specific to their interests and job tasks. (Laiho, interview, August 28, 2007). The courses of the Suomen Pakkausyhdistys ry concentrate on basics as well as specific topics in detail. It is obvious that one institution can not cover all the topics of such versatile industry.

In addition to the actual training, the packaging courses help students to form networks. These courses are an important channel for students to acquaint themselves with colleagues (Laiho, interview, August 28, 2007). Such cooperation is crucial for development and success. It calls for cooperation outside the trainings as well.

3.4.3 Pakkausteknologia –PTR ry 's View on the Future of Smart Packaging

The strength of Finland in smart packaging is the technical expertise while the lacking marketing resources make it more difficult to sell the products. Finnish businesses have extensive skills in variety of technical fields. This allows the businesses to explore the possibilities of smart technology. Järvi-Kääriäinen and Ollila from PTR present the case of UPM Kymmene's RFID-tags. (Järvi-Kääriäinen, Ollila, interview, August 13, 2007) The technical development has been top class in the world, while it has taken very long to convince the customers that they should invest in the solution.

The forums for current and innovative packaging technology are available in Finland and in Europe. According to Järvi-Kääriäinen and Ollila, the following forums and conferences are worth attending:

- Trade fares: Pactec (in Finland) and Interpack (in Germany) organized once in three years
- Magazines: Pakkaus, Packamarknaden, Verpackung-Rundschau, Packaging Today, online publications
- Congresses: International Association of Packaging Research Institutes (IAPRI) and Pira (Järvi-Kääriäinen, Ollila, interview, August 13, 2007)

The variety of sources contributes to discussing innovative packaging solutions. Fares and magazines represent reliable sources for the latest innovations and topics of the industry.

3.4.4 TAMK's Opportunities in Developing Packaging Studies

Businesses demand graduates with understanding of logistics in general as well as long-span neutral testing of packaging materials. Mr. Nieminen from LOGY Competence reminds that the demand for expertise in logistics is increasing and therefore the understanding of the whole logistics chain should be emphasized in studies. This is because it has a great effect on the total cost of running a business. (Nieminen, interview, August 17, 2007) In regard to smart packaging, organizations should aim towards carrying out intensive, long term research (Järvi-Kääriäinen, Ollila, interview, August 13, 2007). The work should be scientific in nature and run in a neutral environment also in universities.

Careful planning should ensure that the operations of TAMK laboratory will not overlap those of other institutions, and that the center is large enough to differentiate itself from others. Insufficient resources lead to a small laboratory that will further scatter the field of teaching packaging. Järvi-Kääriäinen and Ollila from Pakkausteknologia – PTR ry express their concern in regard to the issue. Yet they feel that there may be need for the laboratory as long as it is unique and large enough. (Järvi-Kääriäinen, Ollila, interview,

August 13, 2007) This way the laboratory would be more of a center than a small operator among the others.

Several logistics and packaging organizations are interested in cooperation with TAMK. Pakkausteknologia – PTR ry, Suomen Pakkausyhdistys ry and LOGY Competence all list possible forms of cooperation specific to each one of them. LOGY Competence and Pakkausteknologia – PTR ry may be interested in creating study modules and producing teaching material whereas Suomen Pakkausyhdistys offers its help in marketing and public relations. (Nieminen; Järvi-Kääriäinen, Ollila; Laiho, interviews, August 2007) Pakkausteknologia – PTR ry specifically could help create the following:

- Standardization of the testing machinery
- Producing teaching material
- Collaboration or partnership

The representatives also point out that the organization expects to receive adequate compensation for its service. (Järvi-Kääriäinen, Ollila, interview, August 13, 2007) It can be seen that the opportunities for cooperation are versatile and numerous. TAMK is being offered help both in business operations as well as in specific consulting in packaging.

4 Result Analysis

It is evident from the results that an imbalance between the supply and demand of packaging experts in such a noteworthy field exists and should be fixed. Packaging techniques are mainly taught as a part of another logistics course while businesses say they would have use for graduates of packaging programs. A neutral meeting point for discussion and testing is needed. TAMK laboratory would be an ideal place for such networking in such an environment. Teaching along the testing possibilities would bring the supply and demand of experts to a better balance. This would require specific packaging study modules instead of partial courses. Along with the businesses and other schools, the advantage of TAMK's other study programs should be taken in order to share the opportunity with as many parties as possible. Logistics organizations such as Suomen Pakkausyhdistys and Pakkausteknologia – PTR ry should be approached as well.

4.1 Businesses

Based on the research on the local businesses, the demand for the packaging laboratory exists. The development of the laboratory should be done in cooperation with the Pirkanmaa businesses. The customer base of the laboratory will consist of businesses using and producing packages and a school can have an important role in connecting these businesses together. There is demand for both short- and long term projects.

The businesses' view on the laboratory is primarily positive. It was noted that contacting businesses via telephone is much more efficient than via e-mail. Most of the contacts were discovered via Internet and their answers were very informative. The project group's personal contacts did not always forward the interview request to the correct person. These contacts did not always possess the knowledge and authority to answer the questions thoroughly.

4.1.1 Forum for Introducing and Testing Smart Packaging Is Needed

Smart packaging is slowly being introduced to the markets. The majority of interviewed businesses does not use smart packaging but are interested in integrating it to the product in the future. This proves that there is need for the type of a laboratory that TAMK is developing. This is because, along with the resources, businesses are lacking a forum where to test and develop their ideas.

Large businesses and new projects would benefit from a school laboratory the most. The target businesses should be large in size, or plan new projects about the topic in future. This is because the results show that smart package producers, package producers and large

businesses most often have the best knowledge of the topic. Thus they are an easier target than small businesses with no monetary resources and sufficient knowledge of smart technologies. Another possibility is to target new projects in small and medium sized companies as well. This is because they would benefit greatly from the laboratory's resources and benefit the smaller burden of responsibility as it would be somewhat shared with the school. This type of networking is a way for the small- and medium-sized enterprises to take the advantage of experts without having to hire them permanently.

TAMK would be an ideal forum to join the businesses and the smart technology because the polytechnic could become the currently lacking source of experts in the field. It has been established that the businesses need the laboratory to support their product development. The businesses have also communicated that the lack of packaging experts exists. Therefore a school is a natural place to provide the customers with both the service and future employees.

4.1.2 Short- and Long Term Projects are Interesting to the Businesses While Outsourcing Requires More Marketing

Package producers and users have different types of needs in regard to the laboratory. The package users are interested in short projects while the producers have need for long term development projects. A similarity between the two groups is that both demand a neutral testing environment. The package producers are interested especially in environmental solutions and physical testing while the package users are more concerned at the persistence and reliability of the package.

Outsourcing the package testing to TAMK is an idea that needs further development. It is understandable that the businesses do not want to outsource tasks to the school without more information about the actual laboratory. But the businesses do not see the suggestion impossible, on the contrary they are interested in cooperating with the laboratory as the operations model and functions of the laboratory are clear. The descriptions of an ideal laboratory gained from businesses help to develop the specifications of the laboratory. Later on, businesses can be approached again with an actual product, or a service, to market.

Mr. Eweiss from Inion is interested in outsourcing the final packaging to TAMK. Currently, the products are sent to England to be sterilized, but the final packaging after the goods return to Finland is taking place in Inion's premises in Tampere. In Eweiss' future vision, the final packaging would take place in TAMK's laboratory. Inion could provide the laboratory with some packaging staff who would carry out the task together with the lab workers. (Eweiss, interview, April 26, 2007) It is worth discussing this together with Inion to see how the idea could be developed. Even if the actual packaging could not take

place in TAMK, the business still is an ideal partner for the laboratory. This is also because the Inion premises are located less than one kilometer from the Teiskontie campus.

School needs to consider marketing actions when planning the laboratory. Marketing should be directed towards the prospective customer groups. This is target marketing and it should be effective. Marketing can be done through school's channels as well as personal relationships in the field. Suomen Pakkausyhdistys ry has promised to introduce the laboratory in its Pakkaus-magazine. This opportunity is valuable for the school because Pakkaus is the most wide spread logistics magazine in Finland.

The interviewed firms are interested in cooperating with the laboratory in the means of different projects. But the firms are more suspicious of outsourcing the whole packaging testing to TAMK's laboratory. This is obvious, because yet no specific information of the laboratory functions is available. In order to make firms less suspicious, the services offered must be clearly defined. In the beginning of operations it would be beneficial to take part in trade fairs and introduce the laboratory project to businesses. Also clear, informative and attractive ads and letters are an effective way to gain interest in the early stage and would back up the project.

4.1.3 Communication Problems Make Integrating Smart Technology Difficult

The package producers and users view their position in product development differently. First of all, the package producers are willing to fulfill their customers' needs as any business is. However, the users feel that they can only suggest changes but in the end they will have to do with the products that are currently available. This leads to a situation where the users are waiting for the technology to develop, when actual solutions are already available.

Poor communication between the package producers and users lead to slow spreading of the use of smart packaging. A laboratory, a third party, could be a solution to the problem. The result would, consequently, be spreading the knowledge about smart packaging and thus increase the use of the actual solutions. This shows that both parties would benefit from a neutral third party.

In addition to the neutral testing environment, the laboratory would benefit the packaging producers by offering the wide range of testing machinery for businesses' use. The laboratory would serve businesses also with the latest and continuously developing services and with young and enthusiastic work force, students. The laboratory acting as a contactor between school, students and businesses would be an excellent place for students to create networks with businesses and for

businesses the laboratory work would give a change to influence the content of the studies.

The packaging users are also looking for a neutral testing environment. Additionally, the laboratory could rectify the misconception of the packaging users' beliefs and introduce the suitable packaging producers and solutions to the users. The laboratory work could benefit the packaging users a lot, because the laboratory environment could encourage users to introduce their ideas to the producers using laboratory as an intermediary. In the laboratory the packages already containing the product can be tested. This gives more reliable results than testing the empty package and therefore losses and damages occurred during the transportation and mechanical handling can be minimized.

The importance of logistics throughout the supply chain and business processes must be communicated in order to show how improving packages is so important. While the package producers have difficulty in communicating this to their customers, who often simply wait for better solutions, the laboratory can illustrate to the customers how the specifications and nature of a package can actually affect the whole life span of the product. This aspect covers for example environmental issues as well as how easy it is to handle the products and thus the transportation and warehousing issues are brought in as well. The laboratory can help the businesses to lower the cost in all parts of the business while still improving the product and the package.

4.1.4 The Benefits of TAMK Smart Packaging Laboratory to the Package Producers and Users

The package producers and users are expecting to benefit from the TAMK smart packaging laboratory in many ways. Both producers and users are interested in having a neutral environment for testing packages. The laboratory is also a source of new networks and employees for both customer groups. As a meeting point for the businesses, the laboratory expands the networks in the packaging industry and thus speeds up the utilization of smart packages. The laboratory is a forum and a meeting point where the producers can meet the package users and develop packages together.

The package producers need a neutral environment that provides them with the equipment and solutions to concentrate on improving their packages. This way the businesses do not have to acquire the equipment themselves. The savings are obvious, when there is no need to invest in testing machinery or - place. Instead, the resources can be used to further develop and market their ideas and products, which allows for more innovation as more ideas can be tested without more cost.

The school's laboratory would provide the packaging producers with constantly developing, up-to-date services and expertise. This way the businesses can develop their ideas together with the field experts operating in the laboratory. Up-to-date services ensure that the latest innovations can be tested and also development work can be done. This would obviously create demand for the laboratory.

Package producers have also possibility to take part in educating the future experts when cooperating with the school's laboratory. It is the evident form the interviews that there are not enough packaging experts and thus the laboratory is offering a change to shape the education of the future experts. This way businesses get to decide how ready the graduates are for their business and instead of spending their resources on training, they can employ more ready employees and spend the resources on something else. The society also benefits, when the students have the required expertise of the specific field rather than if the students are educated for something without use.

Networks and full testing services benefit the package users as well. The package users can bring packages to the laboratory and get a neutral opinion on the strengths and weaknesses of those. Compared this to getting the specifications from a producer, the customer gets a more realistic view. The producer is of course always concentrating to the good features of the product without telling much about the problematic parts. Testing in the neutral environment also allows for unbiased comparison of the products.

Package users can also bring their products into the laboratory and get help in designing the best package for their innovations. Different plans can be tested and introduced to the package producers. As the interviews showed, the package users often think their possibilities to affect the packages are limited whereas package producers are willing to fulfill customers' needs. The laboratory would be a place for putting this misconception straight. While the producers are well represented in the clientele of the laboratory, it can provide the users with the best producers in the market.

The laboratory enables the testing of packages in real life situations, the product being already inside the package. This way the real effect of handling and transportation on the product and the package can be seen. The packages can be developed to be more durable and suitable for specific requirements during the transportation and handling. This lessens naturally waste and the number of broken packages and products. Reliability creates again cost savings and satisfaction among all the parties involved.

For the producers the benefit is the fact that their current and prospect customers are using the laboratory as well. The businesses can this way expand their business and form relationships with other businesses who are interested in modern, smart packaging solutions.

In turn the package users have possibility to source the best subcontractors and business partners as well. While this ensures the producers have customers and new users find better solutions, it also means that the laboratory can advance and participate in specific projects between two companies.

4.1.5 Physical Testing Interests Businesses the Most

The seller's interest in delivering the customers' ultimate need is seen in the package producers' and users' mutual interest in physical testing. In the end, the users want the package, for example a cardboard box, to be strong enough and the producers are concentrating their efforts into fulfilling that. The reasoning behind this is that the physical effects are the easiest to see. Therefore the users most probably face problems with the physical attributes of the packages and thus are interested in developing those.

The package users demand for testing services that are tailored specifically for their products. In regard to packages, the users appreciate environmental approach while the physical features of the package must be up to standards. That way the package will hold during transportation. The users will most probably benefit from the expertise available at the laboratory. This is because they do not have the knowledge or interest in the technical specifications of packages but know exactly how their product must be protected. Thus they should be offered a type of a walk-in service.

The package users' interest in eco design but not in climate effects shows how they concentrate on the products, not necessarily the package. Businesses today follow strict recycling guidelines in their plants but the fact that eco design is interesting whereas climate effects are not indicate lack of understanding product life cycles thoroughly. One could assume that eco design can lessen climate effects, but it is difficult for the businesses to relate on these mechanisms. This again shows how the laboratory should not provide the venue for testing alone, but experts and know-how in areas the customers are lacking.

In contrast to the package users' scattered interests, the producers clearly value an opportunity to develop the technical qualities of packages. This is normal because the producers all share similar interests while the users are from different industries. While the specifications are important to the producers, they place great emphasis on environmental facts as well. Such customers will use TAMK logistics laboratory as a tool that provides the technology and support for innovative ideas. The goal is to further develop existing packages and test new, innovative ideas easier and at a lower cost than when businesses are doing it alone.

4.2 Schools

According to the research on universities, logistics is an important subject for many of the schools since schools are offering both basic and post-graduate studies for students. A large number of logistics students can indicate a quality curriculum, as students prefer the institution with good offerings. When specializing in logistics, and offering in-depth studies in packaging, TAMK has great possibilities to become a leading logistics education institute in Western and Central Finland. The businesses are also lacking logistics experts because there is more demand than supply for smart packaging experts in the field. Thus, by developing a packaging study program TAMK would reply businesses' demand.

The research shows that the logistics laboratory is needed, as other schools would be interested in using it as well. The cooperation between different universities is important for TAMK. In abroad, the member schools of EFLE seem to be interested to participate the project. As the members of EFLE are experts in logistics, the knowledge of this network should be utilized already when planning the laboratory. Also the schools offering packaging programs, LUT and Xios TUL, are important prospective partners for TAMK. These two institutions provide framework for curriculum and TAMK should develop courses with similar qualities as these two institutions have.

4.2.1 Large Number of Logistics Students May Indicate a Quality Curriculum

The results of the research show that the universities have a large number of logistics students in their logistics programs. Thus one could argue that logistics is an important subject for many of the studied schools since they are offering both basic education, bachelor's degree, and post-graduate education, master's degree. If there are about 200 students taking logistics courses, this could already be seen as a guarantee of quality. Schools attract students by providing interesting and versatile courses in a specific field. When specializing in a such topic and possibilities are unique and highly valued, students come to study from far away. In other words it could be stated that when the number of logistics students is high and the students come from various places, the curricula offered in a school must plenty to offer to students.

Approximately fifteen of TAMK's students specialize in logistics each year. The number could easily be increased because, as the study shows, there is a demand for logistics experts in Pirkanmaa area. At the moment TAMK's offerings are rather limited and this could explain why the number of students is not as high as in some foreign universities. However, in addition to degree students, many foreign exchange students take logistics courses in TAMK. If the logistics program would be more extensive and of good quality, the number of students would be expected to increase and in the long run the

program would become valued among both the students and employers.

Universities enhance the development of the area when offering a quality curriculum in a specific field. This is because the students are the future experts leading projects and companies to success in the area and field of logistics. As the study indicates, many firms are lacking the specialized knowledge of smart packaging and it may be inferred that these businesses are not willing to invest in smart solutions either. The students graduating from a packaging program would bring their knowledge to these businesses and thus help the businesses cope with the change with smart technology. When the know-how of the technology increases within the business, it is more likely that an informed decision is made than if external consult introduces the idea.

4.2.2 Packaging Issues Are Mainly Taught as a Part of another Course

According to the research half of the schools teach packaging techniques, but this does not indicate thorough studies in packaging. Because packaging techniques are mainly taught as a part of another logistics course, the information cannot be studied in-depth. This means that the students do not have an opportunity to get the knowledge and teaching in any university, apart from few exceptions, while it is proven that there is demand for the studies.

TAMK's logistics courses also touch the issues of packaging only as a part of a basic course. Packaging issues are briefly introduced in the course Green Logistics and Operations Management. The students majoring in logistics are familiarized more in packaging during the course Warehouse Management. No courses concentrating purely on packaging are offered. However, the importance of logistics and especially packaging is observed in TAMK and a smart packaging laboratory is being developed in the near future. This will improve the supply of logistics experts in Pirkanmaa area.

Smart packaging is quite new topic in the field of logistics but this area is rapidly growing and becoming more important all the time. As the survey done among businesses in Pirkanmaa shows, there would be a definite need for packaging experts and especially knowledge on smart packaging is highly valued. The firms show interest in collaborating with institution focusing on packaging issues and TAMK should definitely take advantage on that. When the school would respond the businesses' needs by providing the demanded education in a specialized field, the result would benefit both partners.

The only Finnish university offering packaging techniques program is Lappeenranta University of Technology, which is located in East-Finland (LUT, n.d.). As TAMK is located far away from LUT, it can be argued that these institutions could specialize in the same subject

without disturbing and harming another's efforts. The demand in the field can be seen so high that there should definitely be one institution focusing on packaging teaching also in Central- and Western Finland.

4.2.3 EFLE, an Active Player in Logistics Education, Offers Opportunities for Cooperation

EFLE schools' response rate to the survey was among the highest and show portrays their activity in the field. The members seem to be interested in the project and eager to participate in it. While the member schools do not yet teach packaging as separate courses, their logistics programs are strong and long in length. Thus their networks and know-how can for sure be utilized in other ways. This situation gives TAMK an opportunity to be the leader EFLE member in packaging techniques. The edge means a possibility to invite the member schools' students and teachers to visit TAMK to learn more about the subject. Since the members all feel that practice is the best way of learning, they would greatly benefit from the laboratory environment.

The cooperation with the member schools of EFLE could be developed also in the form of guest lectures. The survey done among the member schools of EFLE supports EFLE's goal to encourage sharing the best practices and experiences with other members. In the future, the members of EFLE are strong prospects for guest lecturing and other forms of cooperation with TAMK. The cooperation already exists at some level, and with the laboratory, the possibilities to widen the cooperation increase significantly. Guest lectures provide an attractive way of collaboration since the lecturer comes outside from the customary environment. This way new ideas are brought into the studies and also new networks are created.

The benefits of working with EFLE are the networks to abroad and the mobility and synergies brought by it. EFLE can provide TAMK with the best experts from Europe but also a chance to bring Finnish know-how to abroad. Quality students will be eager to spend their study abroad year in TAMK. As it is known that there is a lack of experts in the field and that Finland will be lacking workforce in the future, the incoming foreigners are a great opportunity for both the school and the society.

When searching partners, TAMK could make an agreement with EFLE that the laboratory would get help from the others, when it is needed. An official seal for the partnership would guarantee visibility and good position in the network.

4.2.4 Universities Are Interested in Cooperating with TAMK in the Smart Packaging Laboratory

TAMK smart packaging laboratory creates an environment in which a student can best prepare for future. The laboratory will have all the inputs a modern, innovative platform for learning is recognized for. These are expert teachers, modern technology, local and international businesses and a place to test skills and collaboration of the network in practice. The research through surveys to businesses in Pirkanmaa area and the network of schools in Europe show that both businesses and universities support the idea of setting up a smart packaging laboratory and recognize the strong need for one. This supports the assumption that TAMK should invest in the laboratory, as the members of the network are willing to integrate and benefit from the synergy.

Universities are interested in cooperating producing services, doing projects and also using the resources to widen their own programs. The environment provided by TAMK smart packaging laboratory is advantageous and according to the interviewees, worth taking the advantage of. The schools with lesser resources are interested in the facilities and expertise, which shows TAMK can further benefit from the laboratory through selling the expertise. Schools with expertise are willing to provide their resources for use and also learn from the experience. TAMK can further market its expertise in setting up such a lab. The interest other universities show in participating in the laboratory and later considering developing their own premises shows that smart packaging is a current topic which is expected to expand in future. The fact that TAMK is developing the service now shows it is a type of a pioneer. Thus the laboratory is rather unique in the area.

4.2.5 Computer Exercises and the Lab Work Form the Practical Base of Logistics Studies at Bachelor Level

Laboratory work in logistics mainly consists of computer exercises by using different logistics software. Laboratory work is seen as traditional work such like technical programs or natural sciences require it. With logistics, the students accustom oneself for example with ERP, warehouse and packaging programs. At the moment TAMK BBA students learn to use SAP R/3, SAP Business One and a warehouse planner program (LORD) during the logistics module studies. Such work is seen as regular and fundamental part of logistics studies. Thus one could argue that TAMK is concentrating its efforts in logistics teaching into the right direction.

Universities incorporate laboratory work into the studies, as a compulsory component but in case there is no laboratory, there is interest in buying the service from elsewhere. Especially universities seem to be equipped with laboratories while the polytechnics have

lesser resources in this area. Improvement and expansion of the offered program through cooperation was seen for example through the approach of Kemi-Tornio University of Applied Sciences as they would be interested in doing so through the expertise and resources of TAMK. This shows that the logistics laboratory is needed, as other schools would be interested in using it as well.

4.2.6 The Benchmark Universities Provide a Basis for the Curriculum and Forms of Cooperation

The packaging programs of Xios TUL and LUT show that bachelor students can work in a laboratory and also provide a framework for the best curriculum. The packaging programs of both schools indicate that it is important to introduce the students to the different packing materials. That way the students develop an idea of the current opportunities in the field. The logic behind the use of the materials is brought in through the science courses, which TAMK Business School could attempt to organize together with other of its departments. The benefit of such act is more efficient use of existing resources and the synergy created through the cooperation. The effects of these are saving capital and helping students to form networks at an early stage of their careers. Especially Xios TUL shows that bachelor level students can be tied into the laboratory work and testing of packages in a real environment. Their curriculum is built around the laboratory, which is why TAMK should develop courses with similar qualities.

Xios TUL and LUT possess knowledge and resources that can help TAMK develop the laboratory. It is essential to contact Xios University to learn more about setting up such a complex as the laboratory and a teaching program around it. Lappeenranta teaches developing of packaging machines, which is why TAMK should approach them when seeking different possibilities to acquire the machinery. It may be possible to use the students' work and discoveries to build the machines instead of buying those from some business. This may be a way to bring down the starting cost of the laboratory.

Both of these universities could be asked to offer guest lectures in specific areas of packaging. While it is impossible for one institute to offer lectures widely, guest lectures could either complement the basic program or even be a part of it. For example, the Xios University could offer guest lecturing in chemistry and/or the ecological issues of packaging. This would support the students' learning to think in an environmentally friendly way so that such qualities would be obvious to them rather than be value-added qualities of the package. Lappeenranta University in turn could offer lectures concentrating on specific techniques used to develop packages. This way the students would get in touch with the state of the art technology and get a

possibility to form networks within Finland as well. A further advantage of cooperation with universities strong in packaging issues is that the students would become aware of the possibilities to master in the area while TAMK would get more publicity in terms of competent students continuing their studies in innovative programs elsewhere.

4.2.7 A Good Basics Skills in Logistics and Languages Ensure Possibilities for Further Successful Studies

Specializing within a certain field of logistics is acceptable for a student as long as the schools cooperate to ensure the specialties are not too narrow for the whole marketplace. The specialty a student is choosing should not be too narrow. This is because narrow skills instead of a broad basic knowledge lessen the student's possibilities to apply for many kinds of positions in the field. It may also mean the student may miss another subject of logistics, which may be interesting to him or her. When thinking overall view of logistics market, all the specialties available should together ensure balance between supply and demand of logistics experts in the area. This means schools must cooperate and teach specialties that are not too near each other. At the moment, the only higher education institute in Finland offering a full program in smart packaging is LUT. Thus it can be argued that TAMK would not distort the equilibrium of logistics graduates entering the market but rather bring it to a better balance as there is more demand than supply for smart packaging experts in the field.

A good bachelor level degree with practical training eases landing a successful career and provides with a base for further studies. It is self evident that if a student has contact to businesses and experiences real logistics business during studies, it is easier to land a job and thus ensure a career and base for further studies. By developing the smart packaging laboratory, TAMK is in fact creating students more possibilities to interact with businesses during studies. The laboratory is a different type of forum for the interaction if compared to the internships, which are carried out at businesses' premises without much control or supervision from the school's point of view. The laboratory is a tool for TAMK to ensure positive and fertile interactive experiences for students because the school can control the environment.

4.3 Internal Cooperation in TAMK is Important

According to the research, which was conducted to find out the willingness and possibilities of internal cooperation between the different study programs in TAMK, the internal cooperation is seen as an important feature in developing the smart packaging laboratory and studies around it. The study programs have specialized in different

fields and by bringing all this expertise into the same laboratory a wide range of services can be offered to the customers. Students have also a great chance to learn from each other, when working together with colleagues from other programs.

Different study programs have obviously much to offer to the laboratory. The study programs of TAMK understand that the cooperation between the departments and with other schools and businesses is crucial. Thus it can be argued that it is possible that different departments offer services to customers using the same laboratory and its facilities. The research seems to indicate also that even though there is no testing equipment existing in TAMK premises, there is interest in building those. The problematic issue can be the problems in information flow and communication inside the TAMK. This would be a crucial thing to put effort in the future. When the communication works well and quickly this provides a good base for other cooperation as well.

When the laboratory work and logistics study program is being planned, following aspects should be taken into consideration and under investigation:

- Cooperation between different study programs should be encouraged when possible.
- The department of Environmental Engineering is strongly focusing to the environmental issues and these are also important factors when planning smart and developing smart packages. The knowledge of the ENVE-program should be utilized in packaging laboratory.
- The representatives from both Automobile and Transportation Engineering and Mechanical and Production Engineering should be taken along when the procurement of the testing equipment is planned and discussed. Both of these departments might have materials, machinery and expertise in developing the right equipment for the packaging laboratory.

4.4 Interviews of Logistics Organizations

The three logistics organizations interviewed, Suomen Pakkausyhdistys ry, Pakkausteknologia – PTR ry and LOGY Competence support the plan for the laboratory but strictly recommend to consider the size, scale and possible overlaps carefully. Teaching of packaging should be in modules to ensure that enough information can be passed onto students who thus are able to work at the laboratory. When seeking possible partners and experts, packaging trade fairs and magazines should be used as sources of information and contacts.

Cooperation with other universities teaching packaging techniques would allow TAMK to offer quality teaching without overlapping programs. First of all, meetings with teachers from other universities

would clarify the most important topics that should be taught. It is not possible in a small country like Finland for one university to possess all the resources for running a useful, up-to-date program in such a specific field. Thus planning with other universities would be an ideal situation to agree on guest lectures. Another benefit of networking is making sure that the contents of the study module are large enough to differentiate from the others.

In order for students to acquire understanding of the effects of business functions on the whole operations, it would be beneficial to include the packaging module as a part of TAMK's existing logistics module in the BBA program. It is crucial that packages are environmental, economical to transport and store and of reasonable cost in addition to the actual purpose of the package. These effects can be learned through general business studies and logistics in general. The BBA program's logistics module cover the issues rather well and thus would act as a proper prerequisite to the packaging module.

Partners, current sources of information and teaching materials can be seek from packaging trade fairs and magazines. While these can provide with reliable and substantial amounts of information, the most attractive businesses could current and different views to the laboratory. Such businesses could be approached with the intention of agreeing on projects and/or partnerships. The technical know-how in Finnish businesses is world class and thus this opportunity should be utilized. The international presence could be strengthened through the EFLE network as well as European trade fairs. It can be assumed that the networks of EFLE members meet and grow in international trade fairs. As a part of EFLE, Mr. Bouhlal and TAMK could take the advantage of the other contacts.

5 Conclusions and Recommendations

TAMK laboratory should benefit the school, businesses and the society. The purpose of the education is to train students for the needs of the society and thus the laboratory must serve the students along the other beneficiaries by offering the unique and valued studying and working environment. The supply of packaging experts in the field is inefficient. Thus the laboratory would benefit the society and businesses when those would be better off with more experts to hire.

As the study shows, there is a definite need for logistics study program focusing on packaging and for the kind of packaging laboratory TAMK is planning to create. The school should aim to building the packaging courses so that those would prepare and support the students' work at the laboratory. The logistics studies should first be developed and widened by creating two to three elective courses to the curricula. The courses would introduce students to packaging different functions, especially smart packaging. The courses could be worth of five ECT credits, which is comparable for 35 hours of teaching, each. Compared to three credit courses, the longer courses would allow in-depth studies of each subject. It can be assumed that the students attending packaging courses are committed and demand quality courses that do not only introduce the students to the basics of the topic. As the operations of the laboratory advance and the optional courses have reached a steady state and appreciation in the school, logistics studies could be developed to a full logistics program that would specialize in packaging.

The students will benefit the most from the packaging courses when they have a basic knowledge of logistics functions before specializing in packaging. Thus the new courses should be directed to BBA students concentrating in the logistics module. At least basic logistics studies should be prerequisites for the packaging courses. According to the study, the main features of packaging and smart packaging taught especially at bachelor level are:

- Packaging materials
- Use of different types of packages
- Development and testing of packages

When planning the module, these topics should be included in the contents of the courses

TAMK logistics laboratory gives a chance for students to use and improve their skills in logistics through the use of modern software and machinery specific to the field. When TAMK is developing the smart packaging laboratory, it is important that the packaging related courses are linked to the laboratory work. This way the students are gaining the experience businesses are looking for and have change to apply their knowledge in practice. Quest lectures, different projects and group works are all seen as effective teaching methods among the

interviewed firms. A higher, more official level of combining studies and laboratory work are theses written for businesses working in the laboratory. Larger projects such as writing a thesis allows for students to individually test their skills and take steps towards the business world. Quality theses and satisfied customers in turn raise the standards of the laboratory. It can be assumed the students and experts both in Finland and abroad would then increase their interest in the centre.

The laboratory is not able to offer requested services unless it is supported by external financing. Large businesses are an important resource for this. Both package producers and smart technology producers showed interest towards the project and are worth of contacting again, when more specific plan of laboratory functions is available. Businesses planning to test and further implement smart packaging in long term classify as potential partners as well. Such characteristics and future plans would allow TAMK to agree with the business on a long-term contract. Different kinds of organizations and unions have resources reserved for projects like this and thus funding should be applied for example from EU, TEKES and Opetushallinto.

The cooperation with other institutions and organizations as well as other TAMK departments, especially Environmental Engineering program, is crucial in order to create a successful and meaningful study unit. Many of the Finnish and foreign schools and local businesses were remarkably interested to collaborate with the laboratory and these are listed in the Appendix 6.

The leading Finnish polytechnics and universities in logistics should be approached to develop relationships. The first steps in exploring the possibilities are to find out which schools could provide TAMK with guest lectures. The lectures could be permanently included in the packaging courses, as it would ensure high quality teaching, which one school cannot do alone. Another view to consider is finding the schools that are interested in buying packaging lectures from TAMK. The third group of schools is those who are interested in cooperating in specific projects in the laboratory.

EFLE member schools has a wide network in Europe, which is why TAMK should explore the possibilities offered by the organization both at planning stage and in the future when long time partnerships are been created. In regard to these schools, the following actions should be taken:

- Discuss the project with the board of EFLE to get official recognition and support for marketing the laboratory
- Arrange to participate in the next EFLE meetings to further introduce the project
- Contact again the schools who responded to the survey and showed interest towards the laboratory

- Create a separate campaign for the schools who did not respond to the survey to reach them

Suomen Pakkausyhdistys ry has promised to introduce TAMK's projects in its publication, Pakkaus. This marketing effort will help the school to get desired and needed publicity. TAMK should take the advantage of the knowledge and help offered by the packaging organizations Suomen Pakkausyhdistys, LOGY Competence and Pakkausteknologia - PTR ry, which show interest in contributing to the development of the logistics laboratory. The following actions should be taken to examine the possibilities to integrate their valuable expertise in creation of the laboratory:

- Possibility to produce teaching material specific to TAMK's new packaging courses
- Standardize testing machinery
- Long term cooperation

Businesses in Pirkanmaa area are willing to buy testing services from the school. Profound discussions should be held especially with Inion and M-Real Tako Carton already in the initiation stage. The following kinds of tests and conditions are demanded by local businesses and thus should be considered to be located in the laboratory:

- extreme weather conditions (temperature and humidity) as controllable variables
- a laboratory where one could drive a truck inside to test marking and tying up packages and testing the effects of transportation
- testing ideas in automation
- exertion tests
- permeability tests
- RFID tests
- The use of indicators
- Opening and closing packages
- Testing microbes and JÄÄMÄT (heavy metals, colors, mold, nuts, soy) in food industry
- Testing the specifications of packages: is the package what the producers promises it to be

Consultative services that concentrate on innovative packaging and the development of materials should be developed. Of these tests, the packaging center in Limburg offers permeability, climate and transportation tests. In addition, innovative development is constantly carried out in the laboratory. Thus TAMK should consult Limburg when deciding what type of machinery to acquire. Other parties to consult are the future partners. For example, if a large package producer becomes a partner in the laboratory, their wants and needs naturally will affect these decisions. It is crucial that the laboratory equipment meet the customers' expectations and thus fulfill their needs. This is to ensure that the resources are invested in the best possible way and that the investment creates return on investment as planned.

While developing the services, the keskuslaboratorio, KCL, packaging laboratory and services of other schools must be studied in order to avoid overlapping services. If KCL offers similar tests as TAMK laboratory is planning, it should be clarified what their target market and goals of testing are. Thus it can be determined if TAMK should alter plans due to withdrawing some testing machinery.

Along with the specific type of machinery, the laboratory must be standardized and have its own staff. In order for the testing results to be valid and applicable, the testing machinery must have universal standards. These can be for example ISO standards or other recognizable certificates. The laboratory must be neutral in nature to guarantee the clients feel safe bringing their business into the laboratory. It is crucial for the laboratory to have staff of 1 or 2 people at least. Without clear division of responsibility and time budgeted for the laboratory, running it professionally will be too large of a challenge.

The services, consultative or not, should vary in length. Especially the package users demand short-term projects while the producers must be offered long-term development projects as well. Networking within the clientele as well as prospects should be made easy to ensure growth of the industry and use of the laboratory.

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Appendices

Appendix 1: Business Interview, Questionnaire

Questionnaire for Businesses

1 Basic Information

- 1.1 Description of the Business:
Offices, factories, number of employees, national or multinational
- 1.2 Products and Services
 - Product category
 - Classification / Dangerous goods?
 - Customers
 - Modes of Transportation used

2 Package

- 2.1 Basic Information
 - 2.1.1 What packaging materials are used?
 - 2.1.2 What kinds of labels are used and what information do those contain?
 - 2.1.3 Describe the packaging process from employee's point of view.
- 2.2 Machinery /Equipment
 - 2.2.1 What machinery and equipment are used in packaging?
 - 2.2.2 How automated is the process?
 - 2.2.3 What equipment is used to track and locate the packages?

3 Warehousing

- 3.1 Where is the warehouse located?
- 3.2 How smooth is the process of handling the goods in warehouse and in transportation? Are the export products handled differently?
- 3.3 How are the products categorized?
- 3.4 How automated is the warehouse?
- 3.5 How are used packages handled?

4 Evaluation of Packages

On a scale of 1-5, evaluate the package in regard to:
(1 = weak, 2 = fair, 3 = good, 4 = very good, 5 = excellent)

- 4.1 Utilization of Potential
- 4.2 Environment
- 4.3 Recycling
- 4.4 Safety and Reliability
- 4.5 Usability
- 4.6 Price

5 Smart Packages

5.1 Can the packages used at the moment be categorized as smart packages?

5.1.1 Will the business move into smart packaging in the future? (Y/N)]

5.2 Which ERP system, and to what extent, is in use?

5.3 RFID / Barcode

On a scale from 1-3 (1 = no change, 2 = small change, 3 = significant change), how does RFID/Barcode change the package in regard to

5.3.1 Reliability

5.3.2 Safety

5.3.3 Traceability

5.3.4 Efficiency of handling

5.3.5 Price

5.3.6 Frequency/ radio standards

5.3.7 Recycling

5.4 Staff's knowledge in packaging

5.4.1 On a scale from 1-5, evaluate the staff's expertise in smart packaging. (1 = weak, 2 = fair, 3 = good, 4 = very good, 5 = excellent)

5.4.2 Do the employees have the skills in packaging when entering the firm?

5.4.3 Does the firm offer training for the staff?

5.4.5 How much is invested in staff training?

5.4.6 What is included in trainings?

5.4.7 How is the packaging process monitored and evaluated in the factory?

6 TAMK Smart Packaging Laboratory

6.1 Future

6.1.1 What are the investment plans in terms of packaging?

6.1.2 Is the business willing to invest in smart packaging? If so, in what kind of technology?

6.1.3 What are the difficulties in carrying out these plans?

6.2 Testing equipment

On a scale from 1-5, how interesting are the following equipment to your business? (1 = not interested, 2 = slightly interested, 3 = interested, 4 = very interested, 5 = extremely interested)

6.2.1 Physical Testing (e.g. tensile and compression tests, thickness, static tests)

6.2.2 Climatic Testing (e.g. temperature, UV, Xenon tests and dry oven)

6.2.3 Transport Simulation (e.g. drop and vibration tables)

6.2.4 Paper and Corrugated Board Testing (COBB, crushing, bending, bursting tests, water resistance)

6.2.5 Permeability Tests (e.g. Oxygen, vapor, CO₂, Nitrogen, Leak detector)

6.2.6 Eco-design (e.g. packaging innovations: cardboard and plastic, graphic design, eco-design, palletizing)

6.2.7 What are the benefits of smart packaging (processes, ROI)?

6.3 TAMK

6.3.1 From your business' point of view, how would TAMK Laboratory fit into your future plans?

6.3.2 Would you be interested in developing packaging in cooperation with TAMK?

6.3.2.1 If so, how?

6.3.3 What kind of development in TAMK Laboratory would benefit your business the most?

6.3.4 Would you be interested in outsourcing the testing of packages to TAMK?

Appendix 2: TAMK Internal Questionnaire

Haastateltava

Yksikön nimi

Opetuskieli

1. Opetusohjelmaanne on lisätty logistiikan perusopinnot alkaen syksystä 2007. Mitä hyötyä muutoksesta on yksikölle ja opiskelijoille?
2. Mitä hyötyä yksikölle olisi yhteistyöstä pakkauksen testauslaboratoriossa?
3. Mitä lisäarvoa yksikölle pystyisi antamaan laboratoriolle?
4. Oletteko halukkaita toimimaan laboratoriossa?
5. Laboratorioon tulee yritysten kiinnostuksen mukaan esimerkiksi joitakin seuraavista laitteistoista:
 - Fyysinen testaus (mm. veto- ja painetestaus, paksuus, staattisuus)
 - Ilmaston vaikutus (lämpötila, UV, Xenon, kuivatesti)
 - Kuljetussimulaatio (pudotus- ja tärinätesti)
 - Paperin ja aaltopahvin testaus (COBB-, murskaus-, jäykkyys-, taivutus, vedenpitävyydesti)
 - Läpäisevyydestit (happi vesihöyry, hiilidioksidi, typpi, vuotaminen)
 - Ekosuunnittelu (Pakkausinnovaatiot: muovi ja pahvi, graafinen suunnittelu, ekosuunnittelu, palletisointi)
- a) Onko yksiköllänne joitakin edellä mainituista testauslaitteistoista, tai muita pakkausten testaamiseen soveltuvia laitteita?
- b) Onko yksiköllänne asiantuntemusta ja osaamista erilaisten testauslaitteistojen valmistamiseen?

Appendix 3: University Interviews, Questionnaire

Logistics Study Programmes in Universities and Colleges

The purpose of this survey is to examine the extent of teaching and studies of logistics and packaging techniques in European universities and colleges.

All the answers are handled confidentially. All the questions written in **bold** are compulsory.

Contact Information

- 1. Name of the institution**
- 2. Name and title of the respondent**

Teaching of Logistics in Undergraduate Level

- 3. How many logistics courses is offered in English? (You can attach the curriculum at the end of the questionnaire.)**
- 4. How long is the logistics programme?**
- 5. The number of logistics students**
- 6. Is packaging technics taught?**
 - 6.1 If yes, please list the courses.
- 7. Is smart packaging studied in any course?**
 - 7.1 If yes, please list the courses.

The Proportion of Theory to Practice in Logistics Studies

- 8. What is the proportion of theory to practice in logistics studies?**
- 9. How are the real businesses included in the studies?**
 - 9.1 Is it possible, and common for students to get study credits for the work with real businesses?
- 10. How is working in the laboratory incorporated into the studies?**

The Aims of Different Study Programmes

- 11. Polytechnics prepare students with skills in different areas of business instead of a specific area. Do you think that specializing in one specific area in logistics, for example packaging, is contradictory to the ideology of polytechnics?**
- 12. Some students want to study further after polytechnic studies. What combination of logistics studies best prepares a student for university studies? What other options are available?**
 - 12.1 What are the prerequisites for polytechnic students when entering a master's programme?**

TAMK Smart Packaging Laboratory

Tampere Polytechnic University offers a thorough logistics module for International Business students and basic studies for other students. To support and develop the teaching and offer more practical ways of learning together with businesses, a smart packaging laboratory is to be developed. Specific packaging courses are to be developed to complement the new learning environment.

- 13. Are you interested in cooperating with TAMK in producing laboratory services and/or teaching logistics (e.g. partnership or guest lecturers)? How?**
14. Other comments, suggestions and contacts.

Appendix 4: Other Interviews, Questionnaires

Suomen Pakkausyhdistys

TAMKin logistiikan opetuksen kehitys ja yhteistyömahdollisuudet

Yhteystiedot

1. Nimi, nimike, puhelinnumero, osoite.

Pakkausalan opetuksen taso korkeakouluissa

2. Millaisena näette pakkaustekniikan ja pakkausalan opetuksen laajuuden ja tason tällä hetkellä suomalaisissa korkeakouluissa?
3. Miten korkeakoulujen tulisi kehittää opintotarjontaa tällä alueella?

Suomen Pakkausyhdistyksen tarjoama opetus

4. Millaisia kursseja ja koulutuksia Suomen Pakkausyhdistys tarjoaa?
5. Ketkä osallistuvat pakkausyhdistyksen pakkauskursseille? Mitä hyötyä osallistujat saavat kursseista?
6. Mitkä pakkaustekniikkaan liittyvät asiat jäävät kurssienne ulkopuolelle? Voisivatko nämä mahdollisesti kuulua korkeakoulujen opintotarjontaan?

TAMKin rooli pakkausalan opetuksen kehittämisessä

7. Mikä mielestänne on yritysten tarve logistiikan osaamisen ja innovaatioiden saralla, ja miten TAMK voisi vastata tähän tarpeeseen opintokokonaisuuksien ja laboratoriopalveluiden kautta?
8. Kuinka tarpeellisenä näette TAMKin pakkauslaboratorion ja miksi?
9. Onko Suomen Pakkausyhdistys kiinnostunut tekemään yhteistyötä laboratorion kanssa? Jos, niin minkä tyyppinen yhteistyö hyödyttäisi osapuolia eniten?

Muut kommentit ja ehdotukset

10. Kuulemme mielellämme teille mahdollisesti heränneitä ajatuksia ja ehdotuksia laboratorion kehittämistä varten.

Tampere-Pirkkala Logistics Center

TAMKin logistiikan opetuksen kehitys ja yhteistyömahdollisuudet

Yhteystiedot

11. Nimi, nimike, puhelinnumero, osoite.

Pakkausalan opetuksen taso korkeakouluissa

12. Millaisena näette pakkaustekniikan ja pakkausalan opetuksen laajuuden ja tason tällä hetkellä suomalaisissa korkeakouluissa?
13. Miten korkeakoulujen tulisi kehittää opintotarjontaa tällä alueella?
14. Minkälaiset logistiikan opinnot valmistaisivat opiskelijoita Pirkanmaan ja globaalin yhteisön haasteisiin?

Tampere-Pirkkalan Logistiikkakeskus ja TAMKin laboratorio

15. Mikä mielestänne on yritysten tarve logistiikan osaamisen ja innovaatioiden saralla, ja miten TAMK voisi vastata tähän tarpeeseen opintokokonaisuuksien ja laboratoriopalveluiden kautta?
16. Onko Tampere-Pirkkalan logistiikkakeskuksella kiinnostusta tehdä yhteistyötä TAMKin pakkauslaboratorion kanssa?
17. Koetteko, että logistiikkakeskus voisi toimia välikätenä alueen logistiikkayritysten ja TAMKin välillä?
18. Millaisesta yhteistyöstä koette logistiikkakeskuksen ja koulun hyötyvän eniten?
19. Kuinka tarpeellisena näette TAMKin pakkauslaboratorion ja miksi?

Muut kommentit ja ehdotukset

20. Kuulemme mielellämme teille mahdollisesti heränneitä ajatuksia ja ehdotuksia laboratorion kehittämistä varten.

Pakkaustechnologia PTR - ry

TAMKin logistiikan opetuksen kehitys ja yhteistyömahdollisuudet

Yhteystiedot

- Nimi, nimike, puhelinnumero, osoite.

Yleisesti pakkaustekniikasta

- Mitkä ovat/tulevat olemaan Suomen valtiot älykkäissä pakkaustekniikoissa?
- Mitkä ovat parhaat ajankohtaisen ja innovatiivisen pakkaustekniikan foorumit Suomessa ja ulkomailla?

Pakkausalan opetuksen taso korkeakouluissa

- Millaisena näette pakkaustekniikan ja pakkausalan opetuksen laajuuden ja tason tällä hetkellä suomalaisissa korkeakouluissa?
- Miten korkeakoulujen tulisi kehittää opintotarjontaa tällä alueella?
- Mihin asioihin pakkaustekniikan alueella tulisi erityisesti kiinnittää huomiota opetuksessa?

TAMKin rooli pakkausalan opetuksen kehittämisessä

- Mikä mielestänne on yritysten tarve logistiikan osaamisen ja innovaatioiden saralla, ja miten TAMK voisi vastata tähän tarpeeseen opintokokonaisuuksien ja laboratoriopalveluiden kautta?
- Kuinka tarpeellisenä näette TAMKin pakkauslaboratorion ja miksi?
- Onko Pakkaustechnologia Ry kiinnostunut tekemään yhteistyötä laboratorion kanssa? Esim:
 - yhteistyö pakkausten testauslaitteiston standardoimisessa
 - opiskelumateriaalin tuottaminen
 - yhteistyö ja/tai kumppanuus laboratoriossa
 - muut mahdollisuudet

Muut kommentit ja ehdotukset

- Kuulemme mielellämme teille mahdollisesti heränneitä ajatuksia ja ehdotuksia laboratorion kehittämistä varten.

LOGY Competence

TAMKin logistiikan opetuksen kehitys ja yhteistyömahdollisuudet

Yhteystiedot

21. Nimi, nimike, puhelinnumero, osoite.

Yleisesti pakkaustekniikasta

22. Mitkä ovat/tulevat olemaan Suomen valtit älykkäissä pakkaustekniikoissa?
23. Mitkä ovat parhaat ajankohtaisen ja innovatiivisen pakkaustekniikan foorumit Suomessa ja ulkomailla?

Pakkausalan opetuksen taso korkeakouluissa

24. Millaisena näette pakkaustekniikan ja pakkausalan opetuksen laajuuden ja tason tällä hetkellä suomalaisissa korkeakouluissa?
25. Miten korkeakoulujen tulisi kehittää opintotarjontaa tällä alueella?
26. Mihin asioihin pakkaustekniikan alueella tulisi erityisesti kiinnittää huomiota opetuksessa?

TAMKin rooli pakkausalan opetuksen kehittämisessä

27. Mikä mielestänne on yritysten tarve logistiikan osaamisen ja innovaatioiden saralla, ja miten TAMK voisi vastata tähän tarpeeseen opintokokonaisuuksien ja laboratoriopalveluiden kautta?
28. Kuinka tarpeellisena näette TAMKin pakkauslaboratorion ja miksi?
29. Onko LOGY Competence Oy kiinnostunut tekemään yhteistyötä laboratorion kanssa? Jos, niin minkälainen yhteistyö hyödyttäisi osapuolia eniten?

Muut kommentit ja ehdotukset

30. Kuulemme mielellämme teille mahdollisesti heränneitä ajatuksia ja ehdotuksia laboratorion kehittämistä varten.

Appendix 5: Business Interviews, April-May 2007

Almen, Kari. GNT, Production Manager.
Interview April 23, 2007. Tampere.

Anttila, Markku. Green Can, CEO.
Interview April 16, 2007. Ylöjärvi.

Eweiss, Sami. Inion, Logistics Manager.
Interview April 26, 2007. Tampere.

Hakala, Maarit. Metso Minerals Oy, Logistics Assistant.
Interview April 27, 2007. Tampere.

Hiltunen, Anita. Laboratoriokeskus, Head of Material Services.
Interview April 27, 2007. Tampere.

Hovatta, Elina. Sokos, Logistics Manager.
Interview May 4, 2007. Tampere.

Jokinen, Jorma. Takon Kotelotehdas (M-real Tako Carton).
Interview April 13, 2007. Tampere.

Kuikka, Jarmo. Takon Kotelotehdas (M-real Tako Carton), CEO.
Interview April 13, 2007. Tampere.

Kähönen, Pekka. Linkosuo, Manager of Purchasing.
Interview April 20, 2007. Tampere.

Laine, Raimo. Transpoint, Quality Manager.
Interview April 16, 2007. Tampere.

Liponkoski, Sami. UPM Raflatac, Sales Manager.
Interview May 2, 2007. Tampere.

Malinen, Mervi. Kiilto, Purchasing.
Interview May 4, 2007. Lempäälä.

Miettinen, Mika. Liha-Saarioinen Oy, Production Manager.
Interview May 7, 2007. Tampere.

Ojala, Marjatta. TAMK Library, Designer.
Interview May 9, 2007. Tampere.

Riisö, Anna. Vallog, Purchasing.
Interview April 19, 2007. Tampere.

Sillanpää-Jaatinen, Mervi. Prisma, Store Manager.
Interview May 3, 2007. Tampere.

Tiensuu, Sari. Suominen Joustopakkaukset Oy, Sales Assistant.
Interview April 25, 2007. Tampere.

Toikka, Kaisa. TAMK Kirjasto, Designer.
Interview May 9, 2007. Tampere.

Tuomimäki, Marko. Suominen Joustopakkaukset Oy, Accounting
department. Interview April 25, 2007. Tampere.

Uusikartano, Mika. UPM Kymmene Oy, Technical Customer Service
Manager. Interview April 12, 2007. Valkeakoski.

Vaara, Kari. Valio, Production Facility Manager.
Interview May 2, 2007. Tampere.

Weiste, Jyri. SCA Packaging Finland, Expousre & Print Management,
Nordic R. Product Development Manager, Finland.
Interview April 4, 2007. Tampere.

TAMK Internal Questionnaire, May 2007

Jokihaara, Arto. TAMK Electrical Engineering.

Kaakinen, Pekka. TAMK Mechanical and Production Engineering.

Kulojärvi, Tauno. TAMK Automobile and Transport Engineering

Nippala, Eero. TAMK Construction Engineering.

Viskari, Eeva-Liisa. TAMK Environmental Engineering.

University Interviews, May-June 2007

Babic, Darko. Universtiy of Zagreb, Faculty of Transport and Traffic
Sciences, Master of Sciences.

Elbers, C.W. Hogeschool Drenthe, Professor.

Franco, Gino. University of Derby, Head of the Program.

Heirbaut, Inge. Karel de Grote Hogeschool.

Heitz, Christoph. Zurich University of Applied Sciences, Professor.

Hilkevich, Sergey. Ventspils University College, Vice-Rector.

Jansen, Jan H. Arnhem Business School HAN University, Professor.

Juga, Jari. University of Oulu, Professor.

Kallberg, Harri. Tampere University of Technology, Professor (part-time).

Kandelin, Niko. HAMK University of Applied Sciences, Forssa Unit, Senior teacher, Researcher.

Ketola, Kirsti. Kemi-Tornio University of Applied Sciences, Lecturer.

Käenmäki, Jouko. Jyväskylä University of Applied Sciences, Degree Program of Logistics, Study Coordinator.

Lindinger, Jörg. Upper Austria University of Applied Sciences, Professor.

Mornie, Fabienne. University College Ghent, Faculty of Applied Business, Coordinator Section Logistics.

Peeters, Roos. XIOS Hogeschool Limburg, Head of Education 'Packaging Technology', coordinator of Packaging Center.

Saarinen, Jussi. Satakunta University of Applied Sciences, Department of Technology, Rauma, Head of the Program.

Salmijärvi, Olli. Jyväskylä University of Applied Sciences, Full-time lecturer, Logistics.

University of Turku, Maritime College, Head of Department.

van Vlierberghe, Erik. Karel De Grote Hogeschool Antwerp Belgium, Lecturer of Logistics Management.

von Bagh, Antero. South Carelia Polytechnic, Head of the Program.

Other Interviews

Hopeela, Janne. TAMK, Head of the Program. Interview May 21, 2007.

Järvi-Kääriäinen, Terhen (Head of Research) & Ollila, Margareetta (CEO). Pakkausteknologia – PTR ry,. Interview August 13, 2007.

Laiho, Reino. Suomen Pakkausyhdistys ry, Manager of Pakkausyhdistys. Interview August 28, 2007.

Nieminen, Seppo. LOGY Competence. Interview August 17, 2007. (S. Nieminen, Interview, August 17, 2007).

Appendix 6: Organizations Interested in Cooperating with TAMK

GNT. Almen, Kari, Production Manager.

Hatanpään valtatie 48
33900 Tampere
Tel: 045 6361007
e-mail: kari.almen@gnt.fi

Inion. Eweiss, Sami, Logistics Manager.

Lääkärintie 2
33520 Tampere
Tel: 010 8306600
e-mail: sami.eweiss@inion.com

Liha-Saarioinen Oy. Miettinen, Mika, Production Manager.

Tikinmaankatu 21, PL 122
37601 Valkeakoski
Tel: 03 244 7111
e-mail: mika.miettinen@saarioinen.fi

Linkosuo. Kähönen, Pekka, Manager of Purchasing.

PL 77
33101 Tampere
Tel: 0500 628393
e-mail: pekka.kahonen@ykkosleipurit.fi

Metso Minerals (Tampere) Oy. Hakala, Maarit, Logistics Assistant.

PL 307
33101 Tampere
Tel: 050 3170772, 020 4844503
e-mail: maarit.hakala@metso.com

SCA Packaging Finland. Weiste, Jyri, Exposure & Print Management, Nordic R. Product Development Manager, Finland.

PL 426
33101 Tampere
Tel: 010 2452111, 050 68174
e-mail: jyri.weiste@sca.com

M-real Tako Carton. Kuikka, Jarmo Managing Director.

PL 207
33101 Tampere
Tel: 050 3833300
e-mail: jarmo.kuikka@m-real.com

Transpoint. Laine, Raimo, Quality Manager.

Lempääläntie 2
33100 Tampere
Tel: 040 8630299
E-mail: raimo.laine@transpoint.fi

UPM Raflatac. Liponkoski, Sami, Sales Manager.

PL 669

Myllypuronkatu 31

33101 Tampere

Tel: 0204 16 8243, 040 842 2470

e-mail: sami.liponkoski@upmraflatac.com

Pakkausteknologia – PTR ry. Järvi-Kääriäinen, Terhen (Head of Research) & Ollila, Margareetta (CEO)

Pakkausteknologia – PTR ry

Kiskontie 7

00280 Helsinki

Tel: 09 643497 and 09 643496

Suomen Pakkausyhdistys ry. Laiho, Reino. Manager of Pakkausyhdistys.

Ritarikatu 3 b A

00170 Helsinki

Tel: 0400 501091

email: risto.laiho@pakkaus.com

LOGY Competence. Nieminen, Seppo. Head of Education.

Särkiniementie 3

00210 Helsinki

Tel: 09 6963746 / Mobil: 050 1814

email: seppo.nieminen@logy.fi

Appendix 7: Interested Universities and Their Comments about the Laboratory

Finnish Polytechnics:

HAMK University of Applied Sciences, Forssa Unit. Kandelin, Niko, Senior teacher, Researcher, niko.kandelin@hamk.fi. Veli-Jukka Kara, Head of Programme, jukka.kara@hamk.fi.

Tottakai [kiinnostaa tehdä yhteistyötä].

Jyväskylä University of Applied Sciences. Salmijärvi, Olli, Full-time lecturer, Logistics, olli.salmijarvi@jamk.fi.

Kyllä [kiinnostaa tehdä yhteistyötä].

Kemi-Tornio University of Applied Sciences. Ketola, Kirsti, Lecturer, kirsti.ketola@tokem.fi.

Kyllä, olen käyttänyt opetuksessani paljon teidän laitoksen opintomonisteita ja vierailijat (= opintomonisteiden tekijät) kiinnostavat sekä varsinkin laboratoriotyö kiinnostaa.

Satakunta University of Applied Sciences, Department of Technology, Rauma. Saarinen, Jussi. Head of the Program, jussi.saarinen@samk.fi.

Aina kiinnostaa keskustella [yhteistyömahdollisuuksista].

Finnish Universities:

Tampere University of Technology. Kallberg, Harri, Professor (part-time), harri.kallberg@tut.fi.

Vain rajoitetusti [kiinnostaa yhteistyön tekeminen]. On kapasiteetipula. Uusi logistiikan professori saataneen loppuvuodesta ja hän muodostanee oman kantansa.

University of Oulu. Juga, Jari, Professor, jari.juga@oulu.fi.

Periaatteessa voisi olla kiinnosavaa [tehdä yhteistyötä].

TAMK Partner Schools:

Ventspils University College. Hilkevich, Sergey, Vice-Rector, hil@venta.lv.

Yes. It will be good to visit Tampere, exchange experience and after that try to implement laboratory services in VeA.

University of Derby. Franco, Gino, Programme Leader, g.franco@derby.ac.uk.

Possibly [interested in cooperation with TAMK laboratory].

Upper Austria Univ. of Applied Sciences. Lindinger, Jörg, Professor, joerg.lindinger@fh-steyr.at.

Would need more information [about the project and laboratory].

EFLE Member Schools:

Arnhem Business School HAN University. Jansen, Jan H., jan.jansen@han.nl.
Yes [we would like to cooperate with TAMK].

Hogeschool Drenthe. Elbers, Ir. C.W., elbers.cw@hsdrenthe.nl.
Perhaps [we could cooperate with TAMK].

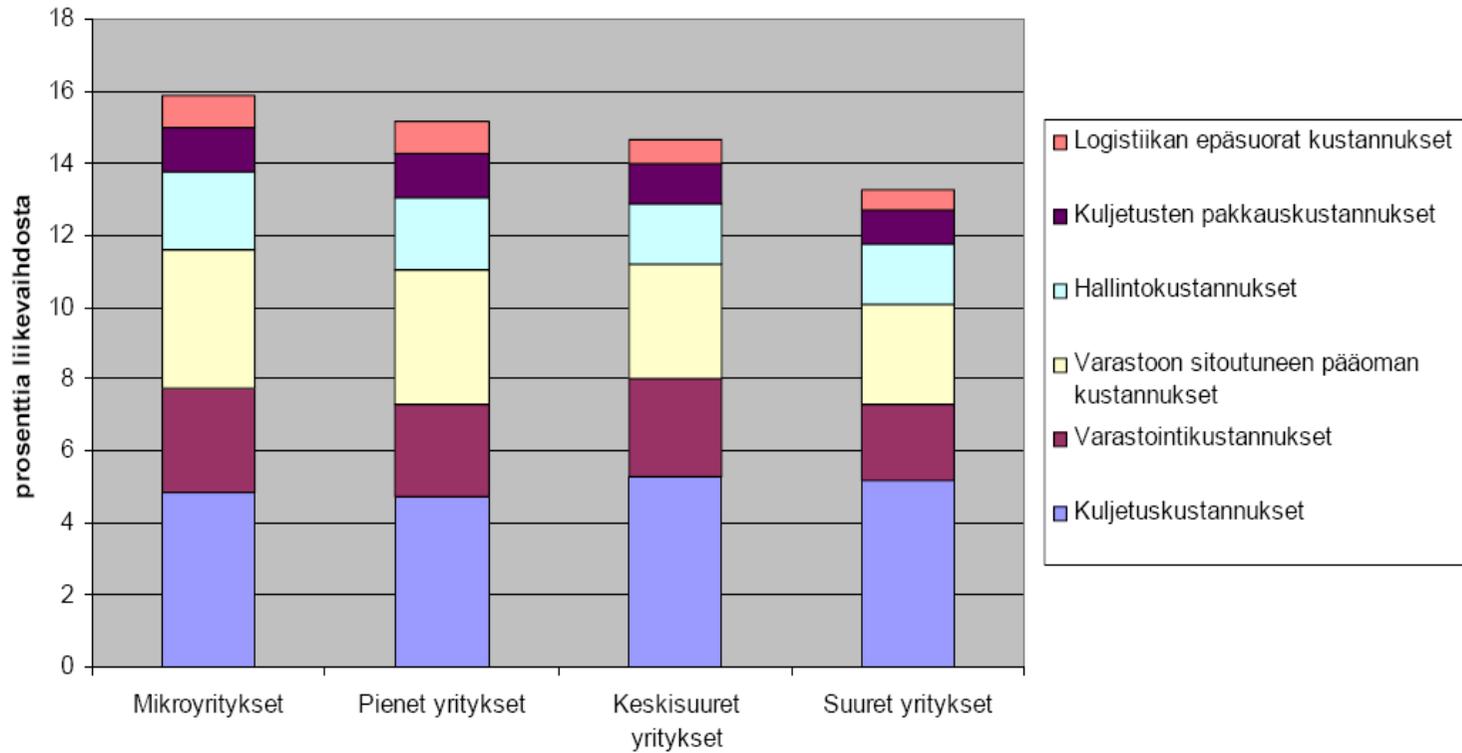
Karel de Grote hogeschool. Heirbaut, Inge, inge.heirbaut@kdg.be.
Question [about cooperation possibilities] has to be asked at the logistics teacher.

University College Ghent, Faculty of Applied Business. Mornie, Fabienne, Coordinator Section Logistics, fabienne.mornie@hogent.be.
Yes, guest lecturing or a project [interests us].

Universtiy of Zagreb, Faculty of Transport and Traffic Sciences. Babic, Darko, Master of Sciences, dbabic@fpz.hr.
We are in cooperation with Jyvaskyla Polytechnic, with that and lots of other things. For example I [Mr. Babic] will go in September there and stay for two-three months. So we are very interested also in cooperation with your Polytechnic. Maybe when I will be in Finland I can visit you and Anasse Bouhlal.

XIOS Hogeschool Limburg, Peeters, Roos, Doctor, Head of Education 'Packaging Technology', Coordinator of Packaging Centre, roos.peeters@xios.be.
Maybe there is cooperation possible for guest lecturers in our institute concerning smart packages.

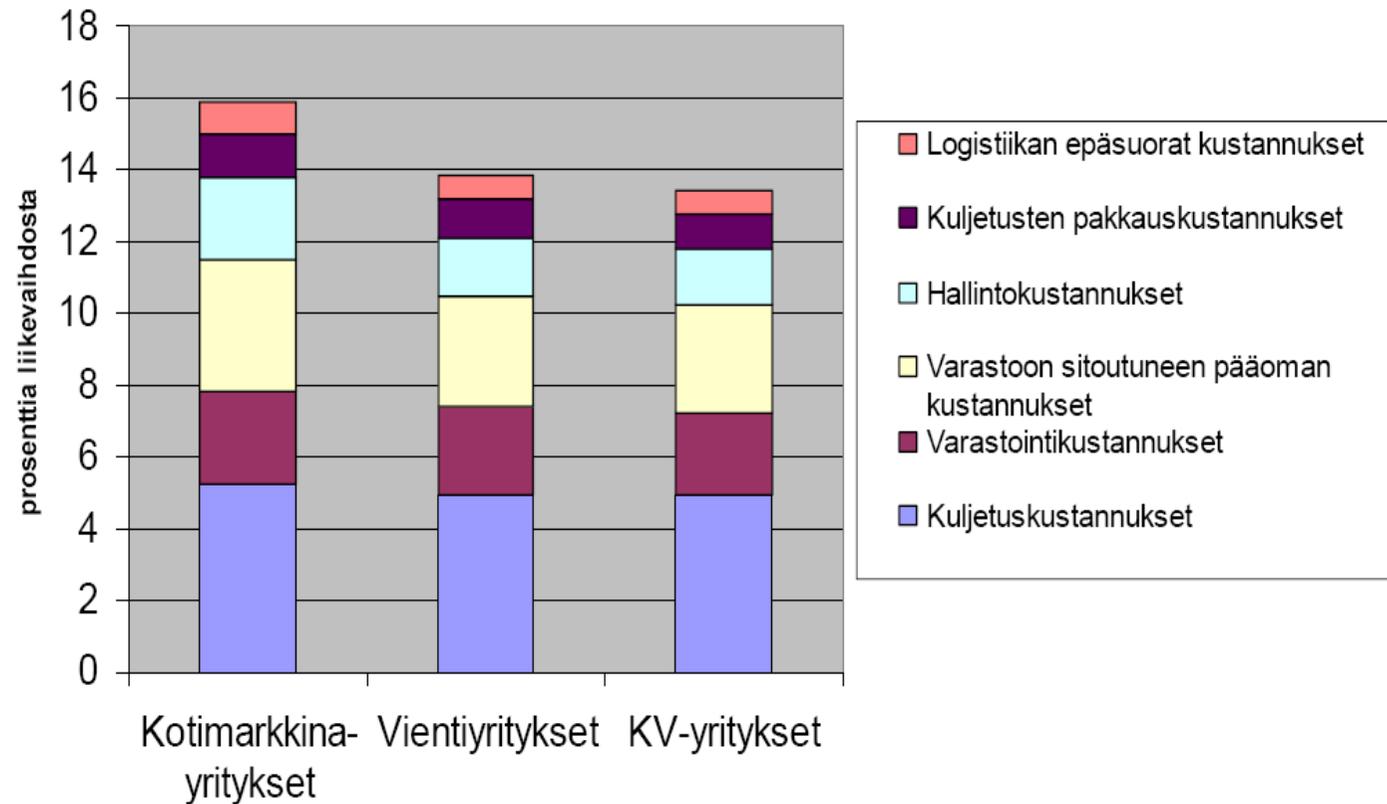
Appendix 8: Logistics Expenses of Industrial Businesses According to Business Size
 (Teollisuuden logistiikkakustannukset yrityskoon mukaan)



Kuvio 17. Teollisuuden keskimääräiset logistiikkakustannukset kustannuskomponenteittain ja yrityksen koon mukaan (N=816)²⁵

Source: Liikenne- ja viestintäministeriö 35/2006, Logistiikkaselvitys 2006

Appendix 9: The Effect of Internationalization in Logistics Costs
 (Kansainvälistymisen vaikutus logistiikkakustannuksiin)

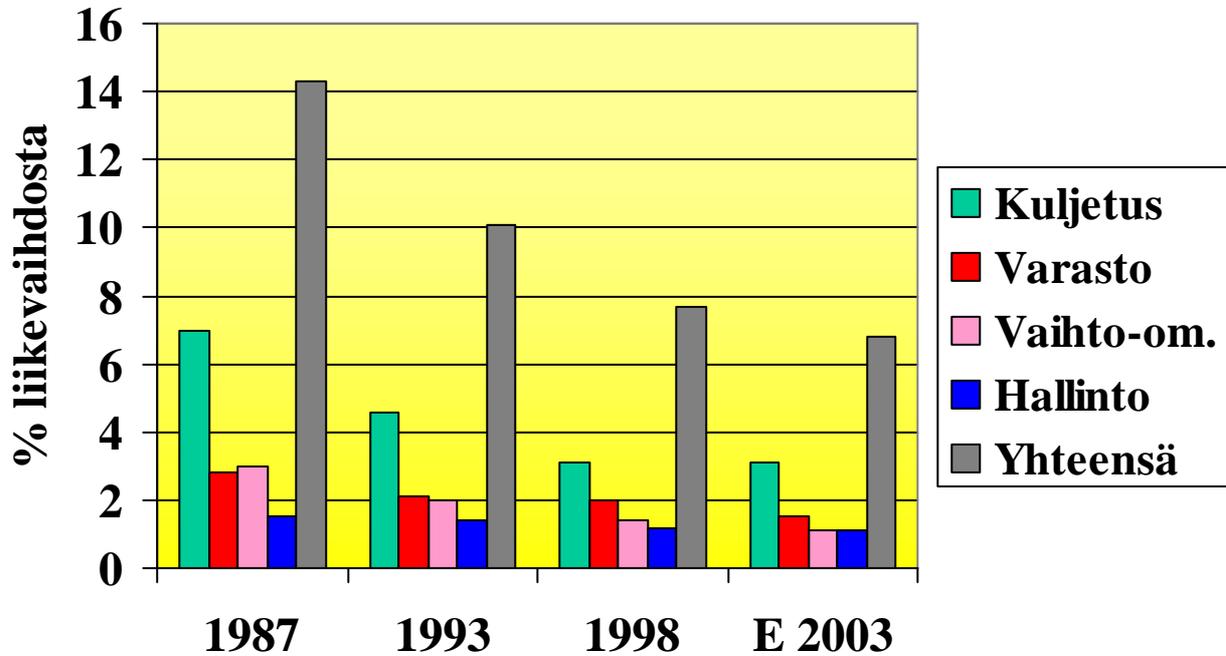


Kuvio 19. Kansainvälistymisen vaikutus teollisuusyritysten logistiikkakustannuksiin. Aineisto ei sisällä mikroyrityksiä. (N=814)

Source: Liikenne- ja viestintäministeriö 35/2006, Logistiikkaselvitys 2006

Appendix 10: Logistics Expenses
(Logistiikkakustannukset)

LOGISTIKKAKUSTANNUKSET



Source: ELA (European Logistics Association) 1999

Appendix 11: Chart on Developing a Curriculum (Opetussuunnitelmatyö)

