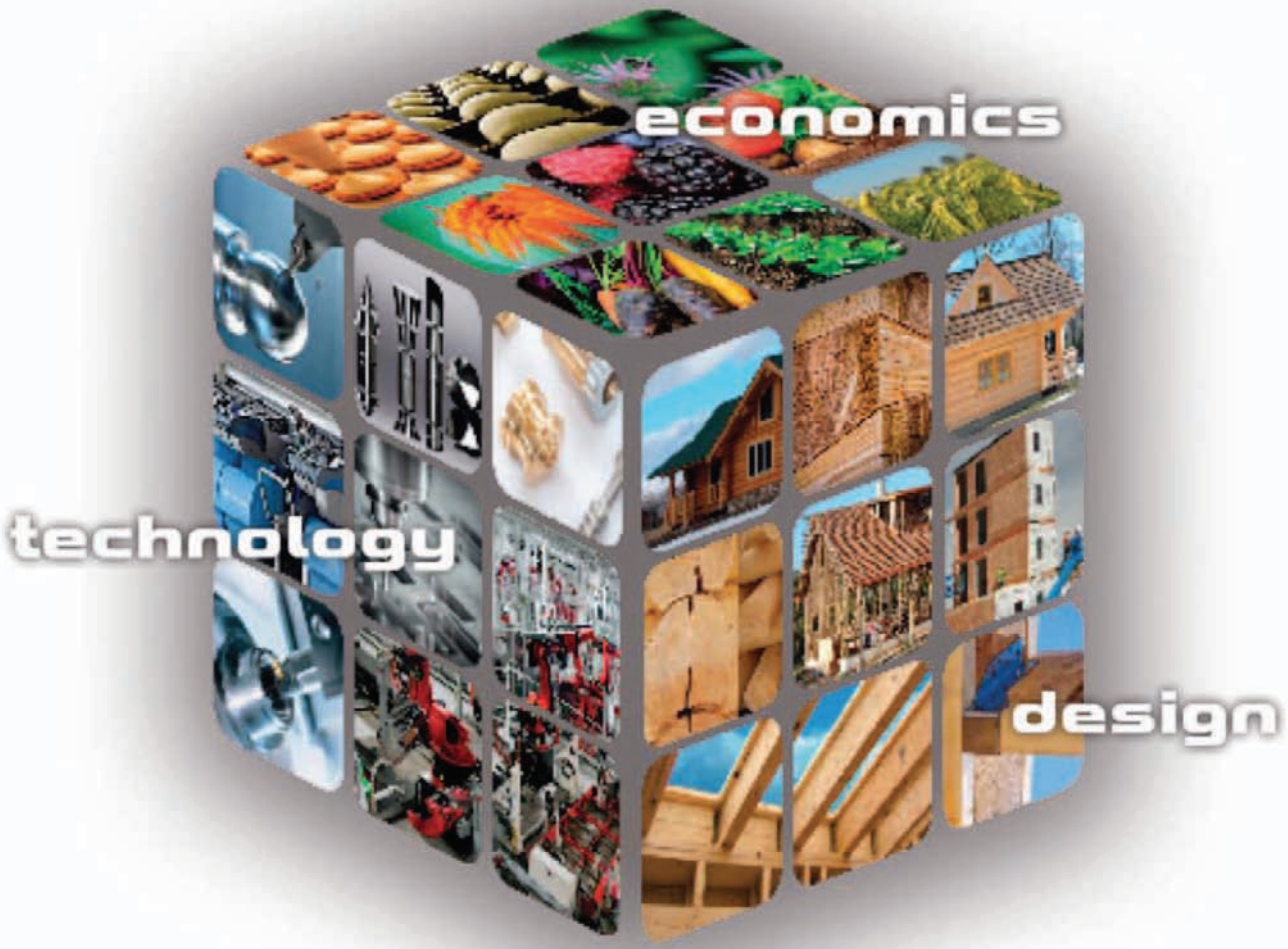
GUIDEBOOK FOR CAREER COUNSELORS

REZEKNE, TALLINN, KAUNAS 2019

#CareerBaltics



IMPLEMENTING INTERDISCIPLINARITY IN CAREER GUIDANCE

Erasmus+

IMPLEMENTING INTERDISCIPLINARY IN CAREER COUNSELING

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INTRODUCTION

At the national and EU level, a major issue of the debate on education policy is the adaptation of the European education and training system to the needs of today's economies and societies. Skills that promote growth and well-being are particularly important. In this context, the European Commission has published a report: "Rethinking Education: Investing in skills for better socio-economic outcomes" (2012). In response to the new social, economic and technological situations, the communication called for a renewed vigour to address the challenges of the 21st century, promote open and flexible learning, and prioritise investment in education and training.

Another major challenge is the need for further integration of cross-sectoral skills (e.g. ICT, entrepren EUR ship and civic skills) in teaching and learning. An important task is to encourage more young people to choose a profession in mathematics, science and technology, as the adequacy of the number of graduates in these highly sought after fields is extremely important for innovation and growth.

In the context of Latvia, Lithuania and Estonia, the fields of Wood-Forestry, Metal-Machinery, and Agriculture-Food are considered to be fast-growing industries. However, the number of trained specialists is insufficient, and the motivation and interest of potential employees should be facilitated by school career counselors. Since education in schools mostly implemented by women who are not familiar with the specifics of technical professions, there is a need to prepare methodological materials based on the study of professions standards. In this way, interdisciplinarity will be provided, enabling students to apply their knowledge in studying and learning professions.

This guidebook is based on the recommendations elaborated during Erasmus+ Strategic Partnership Project "Implementing Interdisciplinarity in Career Counselling", No.016-1-LV01-KA201-022681 in a partnership of Rezekne Academy of Technologies, Vytautas Magnus University and Tallinn Technical University. The project idea is:

- to develop and implement innovative practices in career education at secondary school,
- to promote secondary school teachers with career guidance competence based on interdisciplinarity among design, technology and economics,
- to facilitate motivated and targeted career choice of learners in selected fields of industries.

THEORETICAL BACKGROUND

Career education is the planned provision of events, courses and programs at educational institutions to help learners develop skills for mapping their interests, abilities and opportunities, setting their career goals and career management. It provides knowledge and understanding of the world of work, its link with education, career planning and further education opportunities and ensures active participation in one's working life (Career Education at School, 2010).

A modern, competitive economy requires employees who have the skills, knowledge and attitudes that can be used in any work situation and who have the ability and desire to adapt and succeed in a changing world continuously. Therefore, skills relevant employment are an essential part of career management skills. Employment skills are defined as "the set of qualities, skills and knowledge that is needed by every participant in the labour market to ensure their effectiveness in the workplace – for their growth, for their employer and the economy of the country as a whole" (Kenneth, 2001).

When it comes to the professions of technical disciplines, it is essential to recognise the set of skills needed – the specific, technical and general work skills that are partly recognised and learned in general education, such as subjects of design, technology and economics.

The topicality of the interdisciplinary approach in today's world determines the required values:

- The ability to operate independently and at the same time be able to work in multidisciplinary teams;
- The ability to perceive thoughts, things, phenomena which may look completely different and unite them into common, new forms.

The task of career education – to shift from a mono-individual proposition view to strengthening the readiness of a complex worldwide solution of today's issues by creating a new "open dialogue" relationship between education and industry.

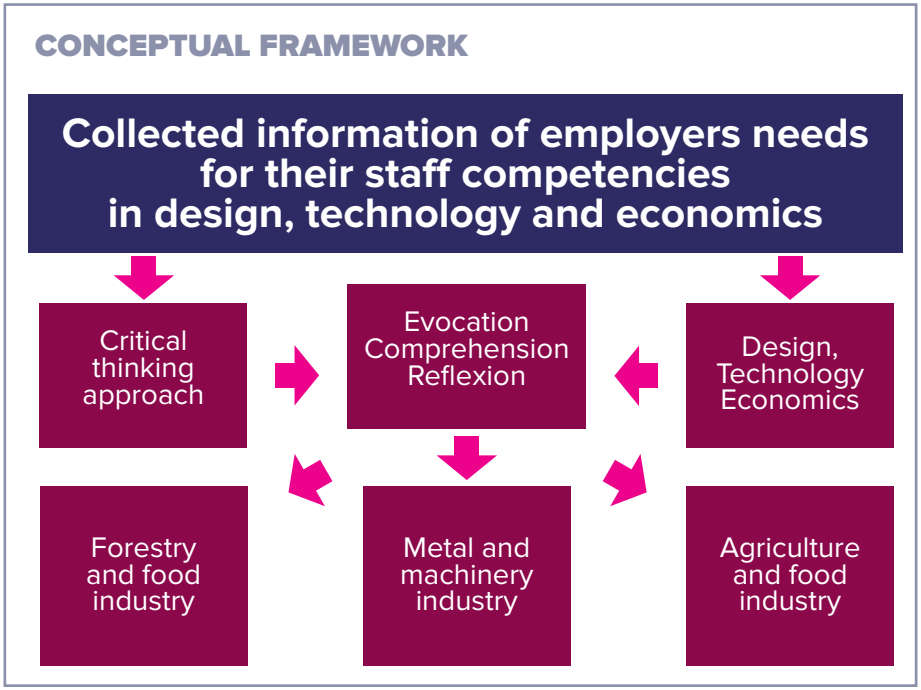
Interdisciplinarity – extending the boundaries of the existing fields by applying and using epistemology (a method of knowledge acquisition) methodology, canons, and pedagogical techniques of other areas. The benefits of interdisciplinarity, combined with epistemology and the use of different research areas can reveal new aspects that could not have been foreseen in the past (Collin, 2009; Boden, 2004). The principles of interdisciplinarity are consistent with the constructivist view of the multidimensional problem views and solutions. A constructivist approach is perceived by human activity as a base in the creation and design of knowledge. The learning process focused on mental development involves four guiding and interrelated elements (David, 2015; Brooks & Brooks, 1994):

- Knowledge acquisition and understanding, which is the basis for creating new forms of thought;

- The disclosure of new knowledge in independent student activities;
- The expansion of the acquired knowledge boundaries in new conditions;
- The inventions/possible solutions to the problem with many alternative solutions.

The main idea in a constructivist approach is the student's thinking activity and the development of critical thinking. That requires a radical renewal of teaching methods and resources, and the teacher's ability to use diverse teaching techniques. In J. Andersen's study, this was called Schema theory. It is essential for students to create an understanding of the succession and continuity of the learning process (Marshall, 1999). The learning process is structured in successive phases:

- Evocation – an offence phase in which students identify their previous knowledge, predict the knowledge and skills to be acquired, and set learning goals;
- Comprehension – is the phase in which students are looking for new knowledge and as a result of their actions, create their awareness and significance;
- Reflection – is a phase in which students look at the ideas learned and understand their meaning, ask questions, interpret, apply, discuss, test, and extend meaning by transferring it to other areas of activity. For the successful implementation of the system of principles, critical thinking offers innovative methodological solutions (Meredith et al., 2001).



Picture 1. The conceptual framework of guidebook elaboration

Critical thinking and problem-solving skills include the ability of individuals to a) reason effectively, b) ask pointed questions and solve problems, c) analyse and evaluate alternative points of view, and d) reflect critically on decisions and processes. Critical thinking focuses on the ability of learners to: a) reason effectively, b) use system thinking, c) make judgments and decisions, and solve problems (21st Century Skills for Students and Teachers, 2010).

Critical thinking is defined as the ability to analyse, interpret, evaluate, summarise, and synthesise information. What gives these, perhaps traditional, critical thinking skills a twist in the 21st Century is the availability of advanced technologies for accessing, manipulating, creating, analysing, managing, storing, and communicating information (Fleming, 2018; Trilling & Fadel, 2009). The conceptual framework of guidebook elaboration is introduced in picture 1.

MATERIALS AND METHODS

The first project task was to study the most demanded professional competencies in the Wood-Forestry, Metal-Machinery, and Agriculture-Food industries and elaborate recommendations for designing a methodology for the professional development training of career counselors on career guidance in secondary school.

To collect information on employers needs for their staff competencies in design, technology and economics a questionnaire was used for data collection.

For the development of questionnaire profession standards from Latvia in Forestry and wood, Metal and machinery, Agriculture and food sectors were analysed and bachelor level graduates competencies in design, technology and economics collected. Descriptions of work processes were elaborated based on competencies from professional standards. The term of Competence was not used in the questionnaire, but work process description was close to competence given in profession standard. The questionnaire was elaborated in Latvian then translated to English for discussion between partners and after that translated to Estonian, Latvian and Lithuanian languages.

Data collection via online questionnaire was done from January 12, 2017, till March 15, 2017. The questionnaire was delivered in Latvian, Lithuanian and Estonian languages. One hundred thirty questions from Forestry and wood, Metal and machinery, Agriculture and food sectors of industry were collected. Administrative, Sector manager and Sector specialist from each company voluntary answer to questions online. Each respondent was invited to evaluate the relevance of the different work processes related to design, technologies and economics referring to his/her company activities and their future development. Fourteen work processes related to design,

31 work processes related to technologies and 21 work processes related to economics are included in the questionnaire. Each work process described in the questionnaire were marked in 10 points scale, where ten is "Very, very necessary" and 0 "not necessary". Respondents answered questions from the perspective of his/her company or department.

Data analysis of questionnaire and elaboration of recommendations for career counselor in-service training program development were done from March 15, 2017 till May 15, 2017.

RESULTS

Data analysis of the questionnaire and elaboration of recommendations for career counselors in the service training program development were done from March 15, 2017 till May 15, 2017. Work processes in Design, Technology and Economics were ranked by mean score in each selected Industrial sector – Forestry and wood, Metal and machinery, and Agriculture and food. We can see four high ranked work processes/competencies demanded by respondents in Table 1.

TABLE 1: FOUR HIGH RANKED COMPETENCIES IN DESIGN, TECHNOLOGY AND ECONOMICS IN FORESTRY AND WOOD, METAL AND MACHINERY, AGRICULTURE AND FOOD INDUSTRY SECTORS

Industry	Design		Technology		Economic	
Wood-Forestry	Creative and independent development of existing and new products	7,80	Forming a safe workplace in complying with fire safety regulations in the production facility.	8,96	Handling problem situations adequately and timely adopting necessary decisions.	9,44
	Navigating and managing the used materials, to analyse their improvement and development trends, and to be able to use them at work	7,73	Managing technological processes.	8,630	Dealing with the sector market.	9,08
	Creating long-term products: which are innovative, functional, produced rationally and cheaply, convenient and easy to use, with aesthetically high-quality forms, colours, and textures.	7,40	Adjustment of production regimes by applying knowledge of production processes.	8,630	Development of the most cost-effective technology solutions.	8,88
	Developing projects by using computer-assisted design and computer-aided manufacturing technologies.	7,30	Making strategic and operative decisions by summarising and analysing production information.	8,56	Defining tasks in achieving set targets in order to produce products with high added value.	8,88
Metal-Machinery	Developing projects by using computer-assisted design and computer-aided manufacturing technologies.	8,24	Choosing the most rational technique and technology.	8,92	Handling problem situations adequately and timely adopting necessary decisions.	9,04
	Navigating and managing used materials, to analyse their improvement and development trends, and to be able to use them at work	7,92	Developing proposals which are directed to more efficient and useful recourse utilisation.	8,84	Development and management of projects.	8,84
	Creative and independent development of existing and new products	7,60	Adjustment of production regimes by applying knowledge of the production process.	8,600	Evaluating the calculations of the cost of services to be performed, the necessary investments and workforce consumption.	8,76
	Creating long-term products: which are innovative, functional, produced rationally and cheaply, convenient and easy to use, with aesthetically high-quality forms, colours, and textures.	7,40	Managing the production technology of Products and Services.	8,600	Using the necessary technical and normative documentation for the work, carrying out applied and professional documents.	8,68

Agriculture-Food	Navigating and managing used materials, to analyse their improvement and development trends, and to be able to use them at work	8,04	Using the latest information technologies.	8,00	Handling problem situations adequately and timely adopting necessary decisions.	8,25
	Creating long-term products: which are innovative, functional, produced rationally and cheaply, convenient and easy to use, with aesthetically high-quality forms, colours, and textures.	7,81	Contributing to the introduction of new technologies.	7,91	Calculation and evaluation of the economic performance of the holding.	8,20
	Setting products' manufacturing restrictions and choosing a set of possible solutions (possible material usage and compatibility as wells as possible constructive solution options).	7,57	Adjustment of production regimes by applying knowledge of the production process.	7,786	Analysing sector benefits and assessing the competitiveness of the holding.	8,08
	Creative and independent development of existing and new products	7,55	Choosing the most rational technique and technology.	7,77	Assessment of risk factors of the particular holding and assessment of the measures to reduce the risk.	8,00
TOTAL	Navigating and managing used materials, to analyse their improvement and development trends, and to be able to use them at work	7,92	Adjustment of production regimes by applying knowledge of production processes.	8,245	Handling problem situations adequately and timely adopting necessary decisions.	8,80
	Creative and independent development of existing and new products	7,64	Choosing the most rational technique and technology.	8,21	Defining tasks in achieving set targets in order to produce products with high added value.	8,29
	Creating long-term products: which are innovative, functional, produced rationally and cheaply, convenient and easy to use, with aesthetically high-quality forms, colours, and textures.	7,59	Forming a safe workplace in complying with fire safety regulations in the production facility.	8,19	Evaluating the calculations of the cost of services to be performed, the necessary investments and workforce consumption.	8,26
	Exploring the needs of the ultimate users and forecasting all the experience-based design aspects, technology, material and fashion trends	7,35	Making strategic and operative decisions by summarising and analysing production information.	8,11	Development and management of projects.	8,22

Source: Erasmus+ Strategic Partnership Project "Implementing Interdisciplinarity in Career Counselling" No.016-1-LV01-KA201-022681. Retrieved from http://www.rta.lv/uploads/source/projects/citi%20projekti/2017/Recommendations.pdf

Results in Table 1 show that competences related to Design are more often repeated in all sectors of the industries. 11 from 12 competencies were repeated and just one competence not repeated in two other industry sectors. That leads to the conclusion to perceive four high ranked competencies related to Design as more general.

Competencies related to Technologies also repeated in all industries, but not as often as competencies related to Design. Seven from 12 competences repeated and five are specific for their industrial sector. That leads to the conclusion that competences related to Technologies have similarities and differences.

Competencies related to Economics repeated very rarely – just 3 of 12 competencies repeated in all industrial sectors. That leads to the conclusion to perceive competences related to Economics as more specific to their industrial sector. Probably the size of companies in different industries is different and that leads to specific competency demands. This data show just preliminary demand for competences and more data collection and analysis should be made in further future studies.

In these recommendation authors try to determine the general principles of how to connect guidance and secondary school students competencies development related to specific industrial The results give opportunity to connect demand for competencies in Design, Technologies and Economics with Teaching and Learning Strategies for the Critical Thinking three phases – Evocation/anticipation, Comprehension/the building knowledge, Reflection/consolidation (Crawford et al., 2005).

Evocation/anticipation phase is for the activation of imagination, prognosis, and to create interest. In this phase, Career Counselor can base their activities during guidance on competencies related to Design as more general.

Comprehension/the building knowledge phase is for setting questions and finding answers. In this phase, Career Counselor can lead students to inquire and base their activities during guidance on competencies related to Technologies.

Reflection/consolidation phase is for the reflection and personalisation of findings and information. In this phase, Career Counselor can ask students to give personal responses based on competencies related to Economics.

All these stages can be implemented in different ways for each phase – problem-based learning, like group investigation, project, cooperative learning. (Erasmus+ Strategic Partnership Project "Implementing Interdisciplinarity in Career Counselling", 2017).

This study determined the most demanded competencies in Wood-Forestry, Metal-Machinery, and Agriculture-Food industries related to design, technology and economics. The conclusion of this study is the recommendation to use a critical thinking approach to implement interdisciplinarity in career guidance in secondary schools. The career counselors should be introduced with the most demanded professional competencies in the Wood-Forestry, Metal-Machinery, Agriculture-Food industries during professional development training for career guidance in these industries at secondary school.

As next step is to implement interdisciplinarity in career guidance in secondary schools should be the elaboration of career counselors' professional development training program were critical thinking approach is on the base for introducing with competencies related to design, technology and economics in Wood-Forestry, Metal-Machinery and Agriculture-Food industries.

In this guidebook are given a samples how to implement Critical Thinking Teaching and Learning strategies in career guidance and allow students of the secondary school to introduce with local industries through Design, Technologies and Economics competencies development. There will be samples for Career guidance in Agriculture and food, Metal and machinery, Forestry and wood sectors of industry.

CAREER GUIDANCE IN FOOD PROCESSING AND AGRICULTURE SECTORS OF INDUSTRY

EVOCATION/ANTICIPATION PHASE

At the beginning of group counseling session counselor collect students answers to questions:

Did You know about Food processing and Agriculture sectors of industry from

- media (newspapers, magazines, TV, radio)
- internet (social networks, youtube, …)
- industry company web page
- family members
- friends
- neighbours
- other

Did You participate in paid works in this industry?
Did You participate in summer works in this industry?
Did You participate in voluntary works in this industry?
Did You visit a company in this industry?
Do You have a plan after school graduation?

- Yes, I know what I'll do
- I have to decide between two choices
- I have several choices
- I don't know
- I did not think about that

Presentations of the companies design of the products, technologies and economics – pictures of real products of nearby companies.

Questions like:

How is it made?
Where this company located?
How to reach a company?

Is it produced by handmade or advanced technology? What materials needed for the product?

Where can it be used?
What should I be able to do for producing such product?

The sector of agriculture and especially of the food industry is specific regarding importance and everyday consumption of the products produced by this sector. This circumstance can be successfully exploited in the evocation and anticipation of career guidance. From the one side the everyday consumption of the product make it a self-evident and routine object, what can reduce the interest of young people in the processes of their production. From the other side, increasing interest of society in the healthy lifestyle and nutrition naturally increase attention to the processes of production in this sector, enhancing the interest in applied materials, technologies and their implications to the safety and environmental characteristics of the products. These topics are widely discussed in the mass-media, what can also be effectively used in evoking the interest of pupils in these issues. Therefore the evocation of the interest in a career in this sector can be successfully combined with the education of skills and attitudes of responsible consumption, as healthy nutrition habits. The pupils can be enhanced to find the information about the every day consumed food products, the raw materials used in their production, applied technologies (e.g. What does it mean "bacto-catch" technology mentioned on the package of milk? What does it mean *saturated, unsaturated*, and trans *fats* and why they are used in the production of food?), implications of production and consumption of products to the health and environment.

FOOD PROCESSING AND AGRICULTURE

VILNIAUSDUONA, LITHUANIA

Over 130 years ago in Vilnius, the capital city of the Republic of Lithuania (Lithuania), a bakery made of brick, fueled by wood and powered by steam was opened. Established in 1882, within three years the small business – later known as VilniausDuona UAB – was the most productive bakery in the city.

By the turn of the 20th century, the bakery was supplying most of the local population's demand for bread. This early success propelled the company's growth to 15 bakeries by mid-century. With the introduction of new facilities four years later, production doubled. A decade later, what would become the company's flagship brand – *vilniaus* – was created.

By the time Lithuania liberalised its economy in the 1990s, the now small and medium sized enterprise (SME) had established some brands and adopted a new corporate name – VilniausDuona. Soon after that, the SME expanded in the Baltic Region, ultimately leading to its incorporation in 2002 into the Vaasan Group; based in the Republic of Finland, this company is one of the largest bakeries in Northern Europe.

Rye bread-making in Lithuania has a long and illustrious history (Photo: Flickr/John Loo)

As of 2013, VilniausDuona had created a number of award-winning brands – supported by a vast intellectual property (IP) portfolio – and ensured a market leading position within the baking industry of Nordic and Baltic states.

TRADITIONAL KNOWLEDGE

Bread-making in Lithuania has a long and illustrious history. The skill was passed down as traditional knowledge via a special ceremony in which a mother would give her bread-making tools to her eldest daughter. The daughter, proud to have inherited an honourable skill, would bake bread, as part of the ceremony, that would be enjoyed by family and friends.

Traditionally in Lithuania, rye bread (*ruginėduona* in the local dialect; a type of bread made from the flour of rye grain), has been baked in two varieties: light, scalded flour bread; and, dark, naturally fermented bread.

Scalded flour rye bread, which was devised in the early 20th century, is made when part of the dough is cooked or scalded in hot water. The heated portion of dough is then allowed to cool, before being added to the rest of the dough. Following this, the bread is kneaded and fermented for up to three days and then baked in an oven.

Made of several ingredients including fermentation starter (or, simply, starter: a preparation to aid fermentation), caraway fruit (commonly called caraway seeds, a product of *Carumcarvi*, a biennial plant) and dried cabbage, the bread has a texture that is comparatively soft and chewy; it is also light coloured.

By contrast, dark rye bread – which dates to before the 20th century – is made via a long kneading process, followed by leavening (the process of adding yeast to the dough) and fermentation – the latter, typically, lasts between 10 and 12 hours. This process produces sourdough – dough made of naturally occurring bacteria and yeast.

Usually, no preservatives or additives are added to the production process for dark rye bread; only natural leavens are used – including coarsely ground rye flour, starter and water. As a result, this bread is darker in colour and stronger in flavour than scalded rye bread.

Both scalded rye bread (called *Plikytarugineduona* in Lithuanian) and dark rye bread (known as *Juodaruginėduona* in the local dialect) have been utilised in Lithuania during traditional agrarian festivals and for mythological purposes. The bread, for instance, is often placed within the foundations of a new building because, it is believed, this act protects the structure against natural and supernatural calamity.

Rich in health qualities (including proteins, vitamins and carbohydrates) and deeply ingrained in the country's culture and rituals, rye bread – eaten during breakfast, lunch and dinner in Lithuania – is one of the country's staple foods.

Inspired both by the bread's rich tradition and health-providing qualities, VilniausDuona has developed a strong reputation for baking the product. As of 2013, the company produced a wide variety of bread and other products (such as confectionaries) via modernised production processes and traditional recipes.

A traditional festival in Vilnius, pictured (Photo: Flickr/Chad Kainz)

RESEARCH AND DEVELOPMENT

To maintain its competitive edge, VilniausDuona has invested in new research and development (R&D) initiatives and on enhancing the technical knowledge base of its staff, including upgrading their awareness of the industry and consumer trends. At the same time, the SME has modernised its production processes and logistics strategies in order to meet the increasing demand for its products.

Historically, the company's bakeries relied on wood-stoked baking ovens. This all changed when a major restructuring was implemented (between 2004 and 2008), ushering in modernised production processes and equipment including machines for cooling, slicing and packaging bread.

Indeed, during part of this process (between 2002 and 2003), the company invested 10 million Lithuanian litas (LTL, approximately US$3 million) in production facilities, logistics and information technology. A similar amount was invested over the 2004 to 2005 fiscal year. As part of this investment, the company established a new bakery in Vilnius (2002) and modernised another production facility located in Panevėžys, one of the largest cities in Lithuania. Concurrently, three old and inefficient bakeries situated in Vilnius were closed.

Unproductive product lines – such as pasta, sweet rolls, cakes, and muffins – were also discontinued in this period, leading (in 2003) to a reduction by one-fifth of the company's products. Another strand of the restructuring was to implement modern quality assurance standards and logistics strategies, including the introduction of up-to-date logistics software to manage the company's delivery systems.

Further to enhance its production capacity, the SME has made it a priority to support its R&D staff (including food technologists) via refresher courses that regularly updates their knowledge and skills base. As a company spokesperson said, "We value and respect our team members. Their knowledge, skills and experience are the most significant capital of the company, which is being continuously invested into." To this end, the SME has organised both internal and external training programs for its staff.

An extensive business library, expert consumer surveys and other company literature, including VilniausDuona News (an in-house publication), is relied

The SME relies on R&D work and industry trends (Photo: Flickr/Rebecca Siegel)

VilniausDuona has over 90 products including a variety of bread (Photo: Flickr/AurimasRaciukaitis)

on to keep employees abreast of the latest developments both within the company and in the industry. A survey of consumers carried out in 2011, for example, showed that both classic and new products produced by the company occupy the top nine places among bread items in Lithuania.

This information has been relied on by the company as a guide for staff training, ensuring that employees are aware of – and proud of – the SME's strongest brands.

VilniausDuona has also relied on expert technologists who carry out R&D work into trends in the industry, including investigations in collaboration with the University of Eastern Finland, an institution with research expertise in health and wellbeing and new technologies and materials. The SME has also been the beneficiary of the Vaasan Group's R&D budget, which was 2.6 million EURos (US$3.4 million) in 2011 and encompassed 35 R&D staff.

As of 2012, VilniausDuona was set to build a new plant in Vilnius estimated to cost 35 million LTL (approximately US$13.5 million). In the same year, the company had 400 employees and managed three major bakeries.

BRANDING AND COMMERCIALISATION

Seeking to thrive in a competitive and international market place, VilniausDuona has developed a wide range of quality products that have been strategically distributed via modern logistics systems. These goods, moreover, have been supported by a vast portfolio of brands and commercialised successfully in collaboration with a number of vendors and partners. As a result, the SME's share of the market in Europe and North America has expanded while its products and brands have gained a growing reputation for excellence across Europe and other parts of the world.

VilniausDuona produces over 90 products, the majority of which are various kinds of bread: dark rye bread (8 kinds); light rye bread (6 types); grainy rye bread (8 types); plain wheat bread (9 varieties); wheat breads with additives (2 types); sandwich breads (5 varieties); and buns (3 kinds). Some of the SME's other products include groceries; pastries – such as wafers (6 kinds); bread crumbs (5 types); and confectionary. The bakery also produces *lavash* – a thin, flat kind of traditional bread that is used to make a wrap for a kebab.

These products, furthermore, are supported by a number of brands. Indeed, there are over 30 bread brands alone – including: *vilniausduona* (the SME's flagship brand); *palangosduona* (rye bread made of natural ingredients); *mociutesduona* (sliced rye loaves made in bread tins); *agostos* (dark rye bread loaves); *goja* (wheat breads); *urte* (a bread with corn and butter added); and toste (a popular bread brand).

Commensurate with its many products and brands, the company ensures its reputation in the market by developing quality products based on healthy ingredients. To this end, VilniausDuona relies on traditional Lithuanian

Modernised logistics strategies help the SME meet increasing demand (Photo: Flickr/Ian Britton)

recipes for baking bread. The SME's vilniausduona brand, for instance, is one that represents products such as bread loaves and rolls or buns made of various grains, seeds, and flavourings.

Not only are the bakery's quality products inspired by tradition; they are also underscored by modern quality assurance standards. For its production and distribution facilities, VilniausDuona has implemented ISO22000 (which deals with food safety), a standard established by the International Organization for Standardization (ISO) – an international standard-setting body for businesses.

The SME, in addition, keeps a keen eye on market trends in order to remain at the cutting edge of its customers' desires. Via market surveys, for instance, the company was able to invest in creating cut, as opposed to uncut, bread and attractively packaged, as compared to open or uncovered, bread products.

Aligning its branding strategy to meet consumer demands, the SME invested in technologies for slicing bread and for creating colourful product packaging that could be easily distinguished in a competitive bread products market.

To bring its vast array of freshly baked products quickly to market (the SME can produce over a quarter of a million products in 24 hours), VilniausDuona relies on state of the art logistics systems and distribution networks. In this way, the company can reduce costs (delays, which lead to higher fuel costs, can be expensive), save time, streamline delivery routes, and supply a large network of distributors – which comprise more than 1900 clients and stores in several countries around the world.

With over 100 delivery routes to navigate each day, the company's sophisticated logistics systems (including cross-dock stations – where inbound deliveries can be transferred quickly onto outbound services; delivery trucks; and distribution centres) ensures that its products reach the consumer while still fresh. Most of the SME's logistics is managed via a specialized centre, which was purpose-built via an investment of 10 million EURos (approximately US$13 million), in the Lithuanian capital.

As a company spokesperson said, "We are proud of our new Bakery and Logistics centre in Vilnius. As a clear market leader in Lithuania we want to supply our customers with the best-performing products and brands."

TRADEMARKS, INDUSTRIAL DESIGNS AND TRADE SECRETS

Having developed many valuable products and brands and gained a strong position in the market, Vilniaus Duona is keen to ensure its hard-earned reputation for quality by relying on the IP system. The company has developed a vast IP assets portfolio which includes over 61 registered trademarks and designs.

BUSINESS RESULTS

With a long and illustrious history stretching back generations, VilniausDuona has emerged as a modern enterprise reaping impressive growth and business results in a competitive international market. In addition, the SME's products and brands have become award-winners.

The SME's *bociu* product (sweet and sour bread) won the gold medal in a competition managed by AgroBalt (1996) – an international agricultural foods

Vilnius, where the SME opened a bakery over 130 years ago (Photo: Flickr/FromTheNorth)

exhibition based in Lithuania. Two years later, the same product placed first in the dark rye bread category of the Best Lithuanian Bread competition.

VilniausDuona's *agotos* bread, meanwhile, received the Lithuanian Product of the Year award (2005 and 2009) and the most popular bread award (2009) by the Association of Trade Enterprises of Lithuania. The SME's *urtes 7 grudu* product (a loaf of bread), moreover, won the gold medal for the Lithuanian Product of the Year (2011), an award by the Lithuanian Confederation of Industrialists.

As well as winning awards, the company continues to expand and deliver impressive business results. Not only did VilniausDuona have revenues of 34.5 million EURos (approximately US$46 million) in 2008; in 2012 the company launched a new product – called *Kepa mama*, a pre-baked bun that customers can easily reheat before consuming – and celebrated its 130th anniversary.

MORE THAN A SLICE OF HISTORY

Relying on Lithuania's traditional knowledge of bread making, Vilniaus Duona developed award winning brands that have expanded into new products with a distinct presence in the market. With a well-managed branding and commercialisation strategy supported by an impressive IP assets portfolio, the company shows how a remarkable return on investment, inspired by tradition, can be achieved.

Source: vilniausduona.lt

Tree Cake (Šakotis)

Tree cake (*šakotis*) is a unique-looking hollow cake with spikes, with flagrant flavor and the taste to die for. Served usually for large events and parties (such as weddings), tree cake is ordered from specialized bakeries, which are equipped to bake it. It is baked by pouring egg & butter-rich batter in layers on a rotating pole, one side of which is exposed to fire. Sounds complicated? It is.

Tree cake found its way to the Lithuanian food hall of fame undoubtedly from Germany. The German version of this cake, called *Baumkuchen*, is made in the same way by pouring batter in layers on a pole. But with German precision, *Baumkuchen* comes out round and smooth with even, distinct layers.

Baking of German Baumkuchen

German Baumkuchen – a cross cut

Lithuanians, however, make their tree cake by letting the batter drip into spikes, which look like tree branches.

Baking of Lithuanian tree cake

Tree cake standing tall!

For decades, the tree cake was the wedding cake of choice – often made in giant size (and decorated with tacky sugar flowers!). The trend is now disappearing, but it is still customary to have at least a tiny, symbolic tree cake in a wedding party. The tree cake is still a common table centrepiece in large celebrations and family gatherings. Source: http://www.lithuanian-homecooking.com/home/tree-cake#comments

The kitschy beauty – wedding tree cakes

COMPREHENSION/THE BUILDING KNOWLEDGE PHASE

COMPANY VISITS

To think about content and information what we need to find out in time of this visit; where in this company we can see the process of technology, design, economics; to think about potential tasks what will be included in other subjects at school.

QUESTIONS LIKE:

Where in the company I can see this technology?

Who in the company can answer my questions?

How can I collect all the necessary information to find the answers?

Is it possible to make it better?

Before company visit counselor invites students to select a product which is produced in the company and introduce students with technology how the product is made. Students introduce with technology cards and prepare questions for company staff to get more information about technology.

The survey disclosed high importance of technological work processes and related skills for the sector of agriculture and food industry. Therefore the phase of comprehension and building of the knowledge base can be strongly related to the introduction and analysis of the technological processes of production. The introduction to the technological processes of the sector could start in the school by identifying particular products and the types of technologies used in their production. There is a wide availability of different information materials that can be applied for this purpose (e.g., videos of the production processes). The second step could be organizing the visits to the workplaces, where the students could see the real performance of technological processes. Having in mind the specificity of the technological and work processes of this sector that limit the access of work processes for the observation (e.g. safety issues in the agriculture, strict hygienic requirements of technological processes of production of many food products). In some cases it could be hard to access directly these production processes, especially in the big and modern industries. In this case the observation of simulated or smaller scale technological process can successfully replace the observation of real and big scale production. For example, visiting of small bakery which accepts the visitors and even offers the possibility to have "hands-on" some production processes (to bake the bread for yourself) could be of much higher value for the understanding of technological principles of baking than the visit of a big bakery and observation of the processes from the distance. The third step could be visiting of the training centre and/or R&D laboratory to discuss what kind of knowledge and skills are needed to handle different technologies and to develop them, or what are the expected technological changes in the sector and how it will change the work.

Kaunas Food Industry and Trade Training Centre were established on the 1st of July, 2011. It resulted as a merger of two schools each of them proud of its history. Kaunas Food Industry School became the headquarters of the Centre named Food Technology Sector, and Kaunas Trade and Business School became the department of the Centre named Hotel, Trade and Services Business Sector.

Qualified food industry workers, cooks, confectioners, food products makers, hotel workers, assistants to trade enterprise managers, secretaries are trained in the Centre. We invite to study both students who have certificates of secondary education (students age from 19 years) and which do not have it (vocational secondary education, students age from 16 years). In our Centre, there is a possibility to get vocational education for students who learned in secondary school under special education programs and who have graduated or not. The centre also has a right to train adults according to formal education labour market training programs.

At present, the project approved by the Lithuanian Republic Ministry of Education and Science with the aim to establish sectoral practical training centres of food production and hotel and restaurant services is being implemented. The main task of this establishment is to create a new quality of vocational training services and increase the accessibility of very high quality training services, to create the possibility to teach using the newest technique and technologies.

In the Centre learn 1087 students. There work 92 teachers, psychologist, who teach subjects of general education, vocational disciplines, take care of students' social and psychological safety.

The following equipment is available in the laboratories: unique baking equipment for the Polish-Lithuanian traditional tree-like cake šakotis, the largest wood-fired oven in Lithuania for training students on how to bake traditional bread and cakes according to our ancestors' recipes, etc.;

FOOD INDUSTRY OPERATOR (MILK, MEAT PROCESSING, BREAD PRODUCTION)

The specificity of the activity of food industry employee depends on the field of work of enterprise (meat processing, milk processing, production of bread products). The operator of meat processing industry works with the equipment of raw meet processing, prepares the raw meet, produces different types of sausages and smoked meat products. The operator of the milk processing industry works with the equipment of milk industry (coolers, separators, fermentation vessels, thermical processing reactors, pasteurisers), processes the raw milk and executes technological operations of the initial production processes: monitors the technological process, executes daily maintenance of production equipment. The operator of the bread production works with the equipment used in the production of bread and pastry products: prepares

the dough by mixing the flour with other products, forms the bread and other bakery and pastry products, observes the baking process and ovens, evaluates the quality of the bred and pastry products. He/she has to know and to apply the know-how about the design and operation of the production equipment and to observe the hygienic requirements.

CAREER PROSPECTS

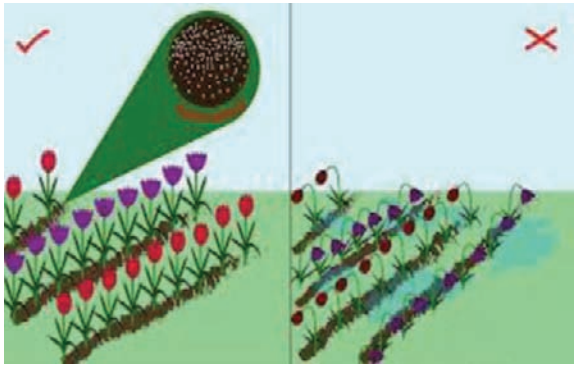
After the completion of vocational education course the person can work as a production operator in the food industry enterprises, dairies, confectionaries, bakeries. Professional skills can be further developed by the on-the-job training and in the specialised training courses. In seeking for a further career, the specialist can apply for higher education studies in the specialised universities and the universities of applied sciences.

DURATION OF STUDY

Three years – after ten years of general education, with the acquisition of secondary education.

One year – after acquisition of secondary education – 12 years.

INDUSTRY	Agriculture	TECHNOLOGY GROUP	Growing of flowers	SPECIFIC TECHNOLOGY	1.1. Growing of tulips
INTRODUCTION	Tulips are amongst the most popular flowers with a fascinating history. Although the Netherlands is recognised as the country with a traditional culture of tulips, tulips were first cultivated in Turkey. The name tulip is believed to be derived from the Turkish word for turbans, "tulbend", because of their resemblance. They gained popularity in Europe in the 17th century, peaking in 1636–1637 with 'Tulipmania', a period when the price of tulips bulbs was higher than the price of a house. Thankfully the price has adjusted and we can all enjoy the bulbs now.				
RELATED KEYWORDS, ABBREVIATIONS	Tulips (*Tulipa*) form a genus of spring-blooming perennial herbaceous bulbiferous geophytes (having bulbs as storage organs). The flowers are usually large, showy and brightly coloured, generally red, yellow, or white. They often have a different coloured blotch at the base of the tepals (petals and sepals, collectively), internally. Because of a degree of variability within the populations, and a long history of cultivation, classification has been complex and controversial. The tulip is a member of the Liliaceae (lily) family, along with 14 other genera, where it is most closely related to *Amana, Erythronium* and *Gagea* in the tribe Lilieae. There are about 75 species, and these are divided among four subgenera. The name "tulip" is thought to be derived from a Persian word for turban, which it may have been thought to resemble. Tulips originally were found in a band stretching from Southern Europe to Central Asia, but since the seventeenth century has become widely naturalised and cultivated.				
PROCESS DESCRIPTION	Tulips need a well drained soil. Sandy soil amended with some organic matter is perfect. They also prefer a slightly acidic soil pH of 6.0 to 6.5. Tulips need a chilling period and are planted in the fall. Planting depth should be about 3 times the bulb's diameter. Add a handful of bulb food or bone meal at planting time and water well. If it doesn't rain, water the bulbs weekly until the ground freezes. Feed again, when the leaves emerge in the spring. The leaves need to be allowed to continue growing, after the petals drop, to feed the bulb. However, the flower stalks can be removed to prevent them from setting seed and stealing energy from the bulb. Once the leaves die back, they will pull easily from the soil. The bulbs prefer to be on the dry side, during summer dormancy. Feed each spring, when the leaves first appear. If it makes a problem getting tulips to come back each year, it could be because the winter is not cold enough, the summer is too wet, or something has eaten the bulbs. Whatever the reason, it is possible to grow your tulips as annuals, replanting each fall. It's a bit more work, but it does not require need holes as deep as perennialized planting.				
EQUIPMENT	**Garden tools: trowels, weeders, showels**		**Watering equipment: pumps, hoses, spraying tools**		
EQUIPMENT PRICE RANGE	5,00–25 EUR		15,00–350,00 EUR		
ECONOMIC FACTS AND DATA	The usual market price of 1 flower is from 0,3 to 0,7 EUR depending on the season. The prices of the tulip bulbs is 0,08–0,2 EUR/piece.				

REFERENCE PICTURES	  
OTHER REFERENCES (LINKS TO VIDEO MATERIALS)	https://www.youtube.com/watch?v=Z_CYJO2rbsg https://www.youtube.com/watch?v=DAOVuSuQ4Ro https://www.youtube.com/watch?v=alzjtnU2PkY https://www.almanac.com/plant/tulips https://www.britannica.com/plant/tulip

INDUSTRY	Agriculture	TECHNOLOGY GROUP	Bee-keeping	SPECIFIC TECHNOLOGY	1.2. Bee-keeping
INTRODUC-TION	Apiculture and bee-keeping are one of the oldest crafts and sectors of agriculture. It has a very strong traditions in Lithuania and other Baltic countries. Besides, apiculture is highly important for the whole agriculture and natural environment. Honeybee colonies are essential for agriculture and environment, ensuring plant reproduction by pollination, while beekeeping partici-pates to the development of rural areas.				
RELATED KEYWORDS, ABBREVIA-TIONS	Api-culture – bee-keeping. Pellen, propolis, beeswax – secondary products of the apiculture (besides honey) widely used in pharmacy, cosmetology, chemical industry and other sectors. Swarming – split and migration of the bee colony for the propagation and increase.				
PROCESS DESCRIPTION	**Honeybees.** Honeybees belong to the order Hymenoptera and one of the Apis species. (For a complete discussion of honeybees, see the article hymenopteran.) Honeybees are social insects noted for providing their nests with large amounts of honey. A colony of honeybees is a highly complex cluster of individuals that functions virtually as a single organism. It usually consists of the queen bee, a fertilized female capable of laying a thousand or more eggs per day; from a few to 60,000 sexually undeveloped females, the worker bees; and from none to 1,000 male bees, or drones. The female of most species of bees is equipped with a venomous sting. Honeybees collect nectar, a sugary solution, from nectaries in blossoms and sometimes from nectaries on the leaves or stems of plants. Nectar may consist of 50 to 80 percent water, but when the bees convert it into honey it will contain only about 16 to 18 percent water. Some-times they collect honeydew, an exudate from certain plant-sucking insects, and store it as honey. The primary carbohydrate diet of bees is honey. They also collect pollen, the dustlike male element, from the anthers of flowers. Pollen provides the essential proteins necessary for the rearing of young bees. In the act of collecting nectar and pollen to provision the nest, the bees pollinate the flowers they visit. Honeybees also collect propolis, a resinous material from buds of trees, for sealing cracks in the hive or for covering foreign objects in the hive that they cannot remove. They collect water to air-condition the hive and to dilute the honey when they consume it. A populous colony in a desirable location may, in a year's time, collect and carry into the hive as much as 1,000 pounds (450 kilograms) of nectar, water, and pollen.				

Bees secrete beeswax in tiny flakes on the underside of the abdomen and mold it into honeycomb, thin-walled, back-to-back, six-sided cells. The use of the cell varies depending on the needs of the colony. Honey or pollen may be stored in some cells, while the queen lays eggs, normally one per cell, in others. The area where the bees develop from the eggs is called the broodnest. Generally, honey is stored toward the top of the combs and pollen in cells around the broodnest below the honey.

The bees maintain a uniform temperature of about 93 °F (34 °C) in the broodnest regardless of outside temperature. The colony can survive daily maximum temperatures of 120 °F (49 °C) if water is available with which they can air-condition the cluster. When the temperature falls below about 57 °F (14 °C), the bees cease flying, form a tight cluster to conserve heat, and await the return of warm weather. They can survive for several weeks in temperatures of -50 °F (-46 °C).

When summer flowers bloom in profusion, the queen's egg-laying is stimulated, the cluster expands, and honey accumulates in the combs. When a large number of young bees emerge, the domicile becomes crowded.

Swarming. When the colony becomes crowded with adult bees and there are insufficient cells in which the queen can lay large numbers of eggs, the worker bees select a dozen or so tiny larvae that would otherwise develop into worker bees. These larvae are fed copiously with royal jelly, a whitish food with the consistency of mayonnaise, produced by certain brood-food glands in the heads of the worker bees. The cell in which the larva is developing is drawn out downward and enlarged to the permit development of the queen. Shortly before these virgin queens emerge as adults from their queen cells, the mother queen departs from the beehive with the swarm. Swarming usually occurs during the middle of a warm day, when the queen and a portion of the worker bees (usually from 5,000 to 25,000) suddenly swirl out of the hive and into the air. After a few minutes' flight, the queen alights, preferably on a branch of a tree but sometimes on a roof, a parked automobile, or even a fire hydrant. All the bees settle into a tight cluster around her while a handful of scouts reconnoitre a new homesite.

When the scout bees have located a new domicile, the cluster breaks, the swarm takes to the air and in a swirling mass proceeds to the new home. Swarming is the bees' natural method of propagation or increase.

Queen bee. Back in the parent colony, the first queen to emerge after the mother queen departs with the swarm immediately attempts to destroy the others. If two or more emerge at the same time, they fight to the death. When the surviving virgin is about a week old, she soars off on her mating flight. To maintain genetic diversity within a colony, a queen frequently mates with more than one drone (called polyandry) while in the air. She may repeat the mating flights for two or three successive days, after which she begins egg laying. She rarely ever leaves the hive again except with a swarm. Usually, sufficient sperm is stored in her sperm pouch, or spermatheca, to fertilise all the eggs she will lay for the rest of her life. The drones die in the act of mating.

The queen can live up to five years, although many beekeepers replace the queen every year or two. If she is accidentally killed or begins to falter in her egg-laying efficiency, the worker bees will rear a "supersedure" queen that will mate and begin egg laying without a swarm emerging. She ignores the mother queen, who soon disappears from the colony.

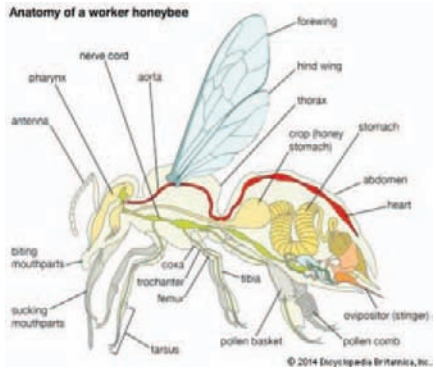
Worker bees. Worker bees live about six weeks during the active season but may live for several months if they emerge as adults in the fall and spend the winter in the cluster. As the name implies, worker bees do all the work of the hive, except the egg laying.

Drones. Drones are reared only when the colony is populous, and there are plentiful sources of nectar and pollen. They usually live a few weeks, but they are driven from the hive to perish when fall or an extended period of adversity comes upon the colony. The only duty of the drone is to mate with the queen.

The queen can lay drone (unfertilized) eggs in the drone cells. If she is not allowed to mate or if her supply of sperm is exhausted, she will lay unfertilized eggs in worker cells. The development of unfertilized eggs into adult drones is known as parthenogenesis. Occasionally a colony may become queenless and unable to develop another queen. Then some of the worker bees begin to lay eggs, often several to a cell, and these develop into drones. A colony that has developed laying workers is difficult to requeen with a laying queen.

Colony manipulation. The yearly work cycle. The beekeeper's year starts in early fall. At that time he requeens the colonies whose queens are not producing adequate amounts of brood and makes sure that each colony has sufficient stores: at least 50 pounds (22 kilograms) of honey and several frames filled with pollen. Some beekeepers also feed the drug fumagillin to reduce possible damage to the adult bees by nosema disease (*see below* Disease and pest control). The colonies need sunny exposure and protection from cold winds. Some beekeepers in northern and mountainous areas wrap their colonies with insulating material in winter. A few beekeepers kill their bees in the fall, harvest the honey, store the empty equipment, then restock with a two- or three-pound (0.8- or 1.4-kilogram) package of bees and a young queen the following spring.

	If the colonies are well prepared in the fall, they need little attention during the winter. However, in early spring an examination of the colonies by the beekeeper is important. Frequently, strong colonies exhaust their food supply and starve only a few days before flowers begin to bloom in abundance. Only a few pounds of sugar syrup, 50–50 sugar water, or a honey-filled comb from another more prosperous colony might save such a starving colony. Again fumagillin may be fed to the colony, and some beekeepers also feed a cake of pollen substitute or pollen supplement. Honey is not fed to the colonies unless the beekeeper is sure about its source. Honey from colonies affected by the brood disease American foulbrood could infect his colonies and cause a serious loss. As the spring season advances, the cluster size increases from the low population of 10,000 to 20,000 bees that survived the winter. To accommodate the increased size of the cluster and broodnest, the keeper adds more supers or boxes of combs. If the combs are so manipulated that the queen can continually expand her egg-laying area upward, the colony is unlikely to swarm. This can be achieved by placing empty combs or combs in which brood is about ready to emerge at the top of the cluster and combs filled with eggs or young brood toward the lower part of the broodnest. The beekeeper wants the colony to reach its peak of population, 50,000 to 60,000 bees, at the beginning of the major nectar flow. The bees in a swarm, having departed the hive with a full stomach of honey, rarely sting. The usual way to capture them is to place a hive or upturned box beneath or nearby, then shake or smoke the bees to force the queen and a majority of the bees into it. The others follow. After the swarm is safely inside the box, it can be removed to a permanent location. Regulations governing the keeping of bees usually require the bees to be kept in hives with movable combs. If the bees are captured in a box, they are generally transferred into a movable-frame hive within a few days so the new honey and comb will not be lost in the transfer. **Requeening a colony.** When a beekeeper requeens a colony, he removes the failing or otherwise undesirable queen and places a new one in a screen cage in the broodnest. After a few days, the colony becomes adjusted to her and she can be released from the cage. A strange queen placed in the cluster without this temporary protection usually will be killed at once by the workers. Queens usually are shipped in individual cages of about three cubic inches (50 cubic centimetres) with about half a dozen attendant bees and a ball of specially prepared sugar candy plugging one end of the cage. When the cage is placed in the hive, the bees from both sides eat the candy. By the time the candy is consumed, and the bees reach each other, their odours have become indistinguishable, and the queen emerges from the cage into the colony and begins her egg-laying duties. **Beekeeping equipment.** Standard tools of the beekeeper are: the smoker to quell the bees; a veil to protect the face; gloves for the novice or the person sensitive to stings; a blunt steel blade called a hive tool, for separating the frames and other hive parts for examination; the uncapping knife, for opening the cells of honey; and the extractor, for centrifuging the honey from the cells. **Bee stings.** The worker bee sting is barbed, and in the act of stinging it is torn from the bee. It has a venom-filled poison sac and muscles attached that continue to work the sting deeper into the flesh for several minutes and increase the amount of venom injected. To prevent this, the sting should be scraped loose (rather than grasped and pulled out) at once. Bee stings are painful, and no one becomes immune to the pain. Immunity to the swelling is usually built up after a few stings, however. Normal reaction to a bee sting is immediate, intense pain at the site of the sting. This lasts for a minute or two and is followed by a reddening, which may spread an inch or more. Swelling may not become apparent until the following day. Occasionally, acute allergic reactions develop from a sting, usually with persons who have other allergic problems. Such a reaction becomes evident in less than an hour and may consist of extreme difficulty in breathing, heart irregularity, shock, splotched skin, and speech difficulty. Such persons should obtain the services of a medical doctor immediately. Source: https://www.britannica.com/topic/beekeeping		
EQUIPMENT	A Hive	**Tools for beekeeping:** a hive tool; the uncapping knife **Safety and protection measures:** the smoker; a veil to protect the face; gloves	The extractor, for centrifuging the honey from the cells.
EQUIPMENT PRICE RANGE	75–150 EUR	35–65 EUR	850–1300 EUR

ECONOMIC FACTS AND DATA	As the world's second most important honey producer after China, the European Union (EU) offers a variety of apiculture products, not just honey, but also pollen, propolis, royal jelly and beeswax. However, the EU is also a net importer of honey from third countries. Bee-keeping is practised in all EU countries and is characterised by a diversity of production conditions, yields and beekeeping practices. EU members with the largest honey production (Romania, Spain, Hungary, Germany, Italy, Greece, France and Poland) are located mainly in the southern part of the European Union where climatic conditions are more favourable to beekeeping. Worldwide amongst biggest producers, EU is also a net importer Despite being the world's second largest honey producer, the **EU** is a net **importer** of honey as domestic production only covers around 60% of consumption. The main supplier of honey imported into the EU is China, followed by Ukraine and countries in Latin America. Costs for beginning the beekeeping. The price of the bee colony is around 70 EUR.The cost of wax plates (12–13) is 10 EUR. Besides the expenses of needed equipment, there are costs of sugar and syrup for feeding the bees, medicines, and other expenses. Therefore the one colony of bees with all equipment; should cost around 325 EUR. It is recommended to start beekeeping from 3 colonies, therefore all the costs should be multiplied by 3 and added the cost of additional hive needed for unexpected cases, such as transfer or separation of the bee colony or accepting a new colony. In total, the beginning of beekeeping should cost about 950 EUR. **Prices of products** The price of honey (1 litre) is from 4,5 to 10,00 EUR depending on the sort and quality. The price of beeswax is about 14–15 EUR/kg. The price of propolis (1 kg) is around 27,00 EUR – 30,00 EUR.
REFERENCE PICTURES	    
OTHER REFERENCES (LINKS TO VIDEO MATERIALS)	https://www.youtube.com/watch?v=3-LfY3tNLug https://www.youtube.com/watch?v=hmgv1NuRFEU https://www.youtube.com/watch?v=Yb11qkmByTo http://www.honeybeecentre.com/learn-about-beekeeping#.Ww0r-cZRWUk

INDUSTRY	Agriculture	TECHNOLOGY GROUP	Gardening	SPECIFIC TECHNOLOGY	1.3. Growing of blueberries
INTRODUCTION	Blueberries are delicious and extremely high in antioxidants which is why it is regarded as a superfood. Plants are easy to grow provided you use an acidic or 'ericaceous' compost. Blueberries bring a unique combination of delicious fruit and striking, year-round ornamental beauty to the garden and landscape.				
RELATED KEYWORDS, ABBREVIATIONS	Blueberries Soil preparation Planting Mulching Pruning Harvesting				
PROCESS DESCRIPTION	**Site Selection and Preparation.** Select a sunny location with well-drained soil that is free of weeds and is well-worked. It is best to locate your blueberry plants in an area where irrigation is readily available as best results will be achieved by keeping the root zone moist throughout the growing season.Where the soil is not ideal or marginally-drained, raised beds are an excellent option. Blueberries also do well in patio containers and offer a great way for apartment and condo dwellers and those with little or no yard to enjoy blueberries. Blueberries prefer acidic soils. A fail-safe way to grow blueberries in almost any soil is to incorporate peat moss into the planting medium. For planting directly in the ground, work up a planting area approximately 75 cm in diameter and 30 cm deep for each plant. Remove 1/3 to 1/2 of the soil. Add an equal amount of pre-moistened peat moss and mix well. (One compressed bale will usually be sufficient for 4–5 plants.) For raised beds mix equal volumes peat moss with bark (not cedar or redwood), compost or planting mix. Talk to your local garden centre. They are experts in your area and can best advise you on soil amendments. **Spacing.** Blueberries can be planted as close as 60–70 cm apart to form solid hedgerows or spaced up to 1,6 m apart and grown individually. If planted in rows, allow 2,4 to 3 m between the rows depending on the equipment used for mowing or cultivating. Planting. In most areas, it is ideal to plant in the fall or spring although in many regions you can plant year round. If you purchased containerised blueberry plants, remove from pot and lightly roughen up the outside surface of the root ball. Mound the plant's topsoil about 1 cm higher than the existing ground and firm around the root ball. Then mound soil up along sides of exposed root mass and water in well. **Mulching.** Blueberries do best with 5–10 cm of mulch over the roots to conserve moisture, prevent weeds and add organic matter. Bark O Mulch, acid compost, sawdust and grass clippings all work well. Repeat every other year. Do not use bark or sawdust from cedar or redwood trees. **Pruning.** It is a good idea to allow blueberries to get established before allowing them to bear fruit. If you start with smaller plants, simply remove most of the flower blooms as they appear. In future years, blueberry plants should be heavily pruned each year to avoid over-fruiting which results in small fruit or poor growth. In our three decades of experience at Fall Creek, we know that one of the biggest mistakes home gardeners make with their blueberries is lack of pruning. We assure you that aggressive, annual pruning will result in healthier, more vigorous plants and more prolific fruit production. Here are some simple tips: Remove low growth around the base. Remove the dead wood, leaving bright coloured lateral branches. Cut out any short, discoloured branches. Continue pruning until you have removed 1/3 to 1/2 of the wood out of your plants each year. Remember, this will promote growth and berry production so prune away! **Fertilizing.** They are once established, blueberries like acid fertilisers such as rhododendron or azalea formulations. (Ask your local garden centre for recommendations.) Take care when fertilising, since blueberries are very sensitive to over-fertilisation. Follow label instructions. It is ideal to fertilize once in early spring and again in late spring. Be sure to always water thoroughly after fertilising. For organic fertilisers, blood meal and cottonseed meal work well. Avoid using manures as they can damage the plants. **A NOTE TO HOME GARDENERS: We regret that we do not have staff available to respond to home gardening questions on the phone or by email. If you have more questions, please contact your local garden center or extension agents. They're the experts in your area.**				

EQUIPMENT:	**Garden tools: trowels, weeders, showels**	**Watering equipment: pumps, hoses, spraying tools**
EQUIPMENT PRICE RANGE	5,00–25 EUR	15,00–350,00 EUR
ECONOMIC FACTS AND DATA	The prices of the blueberry plant range from 4,00 EUR to 12,00 EUR per plant depending on the sort and age. The price of peat for blueberries is about 6,5 EUR for 150 l. The market prices of berries range from 9,00 EUR to 14–15,00 EUR per kg depending on the season.	
REFERENCE PICTURES	  	
OTHER REFERENCES (LINKS TO VIDEO MATERIALS)	https://www.youtube.com/watch?v=rVhvz7vyPHg https://www.youtube.com/watch?v=ipWf0c067xs https://www.youtube.com/watch?v=Mdyq1Dih4e4 https://www.almanac.com/plant/blueberries https://www.burpee.com/gardenadvicecenter/fruit/blueberries/how-to-grow-blueberry-plants/article10389.html	

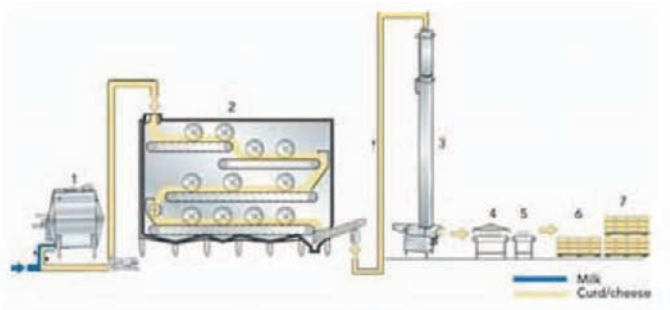
INDUSTRY	**Agriculture**	**TECHNOLOGY GROUP**	**Horticulture**	**SPECIFIC TECHNOLOGY**	1.4. Greenhouse horticulture
INTRODUC-TION	*Greenhouse horticulture* is the production of horticultural crops within, under or sheltered by structures to provide modified growing conditions and/or protection from pests, diseases and adverse weather. In its broadest definition, greenhouse horticulture includes the use of greenhouses and glasshouses, shade houses, screen houses and crop top structures.				
RELATED KEYWORDS, ABBREVIA-TIONS	A greenhouse – a transparent or partially transparent material supported by a structure to enclose an area for propagating or growing plants.				

<table>
<tr><td>PROCESS DESCRIPTION</td><td colspan="3">When looking to develop or expand a greenhouse enterprise, it is important to make sure that the structures are suitable and meet the needs. The shape and design of the structure influences:
▪ the amount of light transmitted
▪ the amount of natural ventilation
▪ the useable internal space
▪ efficient use of structural materials
▪ condensation run-off
▪ heating requirements
▪ the cost.
When deciding on a greenhouse design for commercial production, key factors of the greenhouse need to be considered. It is not possible to provide a definitive priority list to suit everyone, but generally, the height of the structure is critical and will have significant bearing on managing the growing environment in a range of conditions. Ventilation is also at the top of the list and roof ventilation is superior to side wall ventilation. Active ventilation systems can also be considered. Heating is essential for controlled environment horticulture and naturally the computer control systems are critical. Covering materials, screens (thermal and insect) and evaporative cooling systems should also be carefully assessed.</td></tr>
<tr><td>EQUIPMENT</td><td>Greenhouse structure and covering</td><td>Ventilation and heating installations</td><td>Evaporative cooling systems</td></tr>
<tr><td>EQUIPMENT PRICE RANGE</td><td>2000,00–250000,00 EUR</td><td>1500,00–150000,00 EUR</td><td>1500,00–150000,00 EUR</td></tr>
<tr><td>ECONOMIC FACTS AND DATA</td><td colspan="3">Greenhouse farming as a professional family business can be developed in the land area from 0,5 ha.
0,15–1,1 EUR – the price of 1kg of cucumbers.
12–14 kg – the yield of cucumbers from 1 m². It is 3 times lower than in the Netherlands.
80 t – the average volume of pickled cucumbers per one season.
85thousands units – the number of cucumber seedlings planted in 1 ha.
100 m³ – the volume of wood needed to equip 1 ha of the greenhouse.
5–6 years – service duration of the wooden greenhouse.
25 volumes – the average volume of plastic foil for covering of greenhouse per 1 year.</td></tr>
<tr><td>REFERENCE PICTURES</td><td colspan="3">   
    </td></tr>
</table>

OTHER REFERENCES (LINKS TO VIDEO MATERIALS)	https://www.youtube.com/watch?v=KBUGdGp7h4c https://www.youtube.com/watch?v=R9vZx-xRdEI https://www.youtube.com/watch?v=8Fl0RTQinno https://www.youtube.com/watch?v=B5Kcc_7PE2I https://www.youtube.com/watch?v=BuAmOvDtrME https://www.wur.nl/en/Research-Results/Research-Institutes/plant-research/Greenhouse-Horticulture.htm https://www.wur.nl/en/Research-Results/Research-Institutes/plant-research/Greenhouse-Horticulture/about-us.htm

FOOD PROCESSING

INDUSTRY	Food processing	TECHNOLOGY GROUP	Dairy products production	SPECIFIC TECHNOLOGY	1.5. Curd cheese products production
INTRODUCTION	Curd making is at the heart of cheese production. It is where the final composition of your cheese – its moisture, pH, and physical characteristics – is determined. There is a wide variety of curd cheese products which also includes different dessert products, such as glazed curd cheeses.				
RELATED KEYWORDS, ABBREVIATIONS	Curd – a dairy product obtained by coagulating milk in a process called curdling.				
PROCESS DESCRIPTION	The coagulation can be caused by adding rennet or any edible acidic substance such as lemon juice or vinegar, and then allowing it to sit. The increased acidity causes the milk proteins (casein) to tangle into solid masses, or *curds*. Milk that has been left to sour (raw milk alone or pasteurised milk with added lactic acid bacteria) will also naturally produce curds, and sour milk cheeses are produced this way. Producing cheese curds is one of the first steps in cheesemaking; the curds are pressed and drained to varying amounts for different styles of cheese and different secondary agents (moulds for blue cheeses, etc.) are introduced before the desired ageing finishes the cheese. The remaining liquid, which contains only whey proteins, is the way. In cow's milk, 80 percent of the proteins are caseins. The production of glazed curd cheeses is executed by taking the curd into the bunker of the dosing machine, forming the curd cheeses, cutting off the curd cheeses and directing them to the glazing machine, glazing the cheeses and putting them on the conveyor of the cooler, cooling off the glazed cheeses, automatically wrapping up the glazed cheeses into biaxially orientated laminated polypropylene film, putting on the manufacture date and removing them with the help of removing transporter.				
EQUIPMENT	**Curd production equipment: curd cheese vats.**	**Glazed curd cheese production line** composed of the following machines: – lift; curd dosing machine; filling and dosing machine; glazing machine; melting kettle for the production of glaze; cooler; transportation guidance system; wrapping up the machine.			
EQUIPMENT PRICE RANGE	80000,00–200000,00 EUR	600000–1200000 EUR			
ECONOMIC FACTS AND DATA	There are 5 biggest dairies in Lithuania that dominate in this sector: AB Pieno žvaigždės, AB Rokiškio sūris, AB Žemaitijos pienas, AB Vilkyškių pieninė and UAB Marijampolės pieno konservai. These dairies process about 94 percent of the all milk in Lithuania. The annual turnover of all dairies of Lithuania reaches about 1 billion EUR. About half of the products are sold in the internal market, another half-exported. Dairies of Lithuania produce a wide range of products: fresh milk products, cheeses, butter, milk powder, condensed milk, lactose, whey powder etc. The main products are cheeses, whose export in 2016 made about 43% of the total export of dairy products. The price of glazed curd cheeses varies from 0,20 to 0,80 EUR.				

REFERENCE PICTURES	       
OTHER REFERENCES (LINKS TO VIDEO MATERIALS)	https://www.youtube.com/watch?v=HOtC2Fexqdk https://www.youtube.com/watch?v=-G0UIu84nnY https://www.youtube.com/watch?v=dQ6LZ6MgSek https://www.youtube.com/watch?v=dYWKOntNoqI https://www.youtube.com/watch?v=YjRiDhyIjvo https://www.youtube.com/watch?v=eOhO0bhLndw http://www.suris.lt/ http://www.suris.lt/ http://www.szes-la.cz/stat/projekty/erasmus/vystupy/cz_08_list02_quark.pdf http://dairyprocessinghandbook.com/chapter/cheese

INDUSTRY	Food processing	TECHNOLOGY GROUP	Bakery	SPECIFIC TECHNOLOGY	1.6. Lithuanian Dark Rye Bread Baking

INTRODUCTION

One of the oldest and most fundamental Lithuanian food products was and is rye bread. Rye bread is eaten every day for breakfast, lunch and dinner. Two kinds of bread are traditional, plain fermented and scalded. Plain fermented bread has been baked from earliest times, while scalded bread has only been baked since the start of the 20th century. Plain bread ferments overnight but needs to be kneaded for a long time, while scalded bread fermentation takes almost three days.

RELATED KEYWORDS, ABBREVIATIONS

Fermentation – a metabolic process that consumes sugar in the absence of oxygen.

PROCESS DESCRIPTION

There can be distinguished home-made and industrial baking of dark rye bread. In the case of traditional home-made baking, the starter is used to leaven black rye bread. The starter is usually a leftover of dough from the last bread baking. Just before baking, the saved piece of dough is dissolved in warm water and is added to the newly mixed dough. Should there be no starter a new starter is prepared before mixing the new dough by mixing all starter ingredients, keeping in a warm spot to ensure maximum fermentation. This starter should be ready in 24 hours. Starter gives the bread an agreeable, pleasant sour taste. Every starter has its particular taste. Some homemakers add sour milk in place of water. To make dough, the water is heated to 40–45 C, poured half of the flour, starter and mixed well. Sough is sprinkled with flour and set in a warm spot to ferment. During fermentation the volume of dough will almost triple. Fermentation is complete after about 14 hours. Then the dough is beaten, added remaining flour, salted and kneaded well. Then the top of dough is smoothed, dampened with wet hands, covered and set in warm spot to rise for about 3 hours. The baking pans are prepared by lining them with maple or cabbage leaves or dust with flour. Oblong loaves are formed, smoothened tops with damp hands. Bread is baked in the preheated oven at 200 C, for about 2–3 hours. Bread is done when it gives off a solid sound.

The industrial baking of dark rye bread is also prepared in a traditional Lithuanian way, without using any preservatives and food additives. There are used the same core ingredients – rye meal and flour, water, sugar, fermented rye malt, yeast, iodised salt, caraway seeds. The above described processes of preparation of dough are executed in the industrial vats, the loaves can be formed by hands of machines and the bread is baked by using industrial ovens, afterwards can be sliced and pre-packed.

EQUIPMENT	**Vats and mixers for the preparation and fermentation of the dough**	**Oven (for hand-made traditional baking)**	**Industrial ovens and packing lines**
EQUIPMENT PRICE RANGE	Home-made baking: 50,00–150,00 EUR Industrial: 80000,00–200000,00 EUR	5000–20000,00 EUR	300000,00–1500000,00 EUR

ECONOMIC FACTS AND DATA

In the food industry of Lithuania bread production is the second branch after the dairy industry.

The biggest industrial bakeries in Lithuania include “Vilniaus duona”, “Fazer Lietuva” and “Klaipėdos duona”.

In the last years the consumption of bread products, especially dark bread is decreasing.

However, there can be noticed an increase in demand for other bread products, including the light bread.

There is increasing market possibilities for the small bakeries supplying fresh and home made bread.

Average cost-effectiveness of the bread bakery is about 15–20 percent. Cost-effectiveness of the wheat bread, cake and confectionery bakery can reach up to 40 percent.

Dark formed bread

Starter			**Raw materials 1 kg/EUR**	**Price of raw materials**
1	Flour	0,15	0,29	0,04
2	Caraway seeds	0,03	1,16	0,03
3	Water	0,35		0

Dough			Raw materials 1 kg/EUR	Price of raw materials
1	Mix “Promyk”	2	1,45	2,9
2	Water	1,1		0
3	Liquid malt	0,1	1,16	0,12
4	Starter	0,5		0,08
5	Salt	0,01	0,14	0,00
6	Yeast	0,06	0,68	0,04
7	Starter pate “Ritesa”	0,015	3,18	0,05
8	Sugar	0,06	0,52	0,03
Total		**3,845**		**3,22**
Price of 1 kg, EUR		**0,84**		

1.	Liquid dough			
2.	The temperature of dough t °C about 24–26 °C			
3.	Dough fermentation lasts 30–40 minutes			
4.	The dough can be formed (split) mechanically – requires more flour, or manually by putting the dough into forms.			
5.	Final fermentation at 34–36 °C, lasts 40–60 min			
6.	Baking at 260 °C (with steam), baking at 210 °C about 30–40 min			

REFERENCE PICTURES

	  
OTHER REFERENCES (LINKS TO VIDEO MATERIALS)	https://www.youtube.com/watch?v=iUuKstAWof4 https://www.youtube.com/watch?v=Bl85pCb2UEU https://www.youtube.com/watch?v=3UjUWfwWAC4 https://www.youtube.com/watch?v=swn8W0iyoko https://www.thespruceeats.com/top-lithuanian-bread-recipes-1136748 https://www.thespruceeats.com/lithuanian-dark-rye-bread-recipe-rugine-duona-1136744 http://www.lnkc.lt/eknygos/eka/food/bread.html

INDUSTRY	Food industry	TECHNOLOGY GROUP	Processing of herbs, herbal tea production	SPECIFIC TECHNOLOGY	1.7. Processing of herbs
INTRODUCTION	Herbal tea is a healthy and tasty drink which increasingly gains the popularity amongst the consumers worldwide. It presents a healthy alternative to the traditional coffeine containing hot drinks what makes it an attractive choice for the people who choose a healthy and environmentally friendly and sustainable lifestyle. Besides, herbal tea is also considered as a medicine helping to treat many diseases and facilitating recovering from them. The herb industry is also one of the key suppliers for the perfume industry which uses oils that are obtained from herbs to make perfumes. The pharmaceutical industry also derives significant raw product from herbs, and the food industry obtains flavourings of all types from herbs. Even the mint that flavours our toothpaste comes from herbs. Many alternative therapies attribute medicinal properties to plants – aromatherapy, flower therapy, herbal medicine, to name but a few. Cultivation and especially the processing of the herbs is a complex, challenging and exciting technological process. Processing of herbal tea can be executed not only at the industrial level, but also on a small scale in the home conditions.				
RELATED KEYWORDS, ABBREVIATIONS	Herbal tea, drying and dehydrating, cutting, threshing, mixing, blending.				
PROCESS DESCRIPTION	**Cultivation of medicinal herbs and plants** Mass-production of herbs and plants comes first from mechanisation in cultivation and is an important phase for the preparation of the green product. In this step it is highly important to ensure that all the natural properties of the product are preserved and enhanced and that, at the same time all the useless and noxious parts are eliminated. **Drying and Dehydrating.** Drying or Dehydrating high quality freshly picked herbs and medicinal plants is also a critical technological process. In order to preserve the natural properties it is important to ensure a short time at low temperatures of drying. To attain it there are used stainless steel bulk barns with drying systems and silica gel dryers equipped with the with stainless steel loading trays and PLC system to memorize and control different cycles of drying for different herbs. **Cutting, threshing, classification.** A dried product is processed by cutting, threshing, screen separation and air blow classification. These processes can be executed separately or can be integrated into one production line. During these processes heavy elements are separated from light (seeds from husks), long from short (leaves from stems), little from big (teacut from teabag cut). **Mixing, blending** is executed with belt mixers that accurately blend different products (herbal teas) or make uniform batches of the same product. Such technologies also allow reducing considerably the volume of the product, preserving only the active compounds and eliminating all undesired parts such as dirt, sand, dust and stones. A metal detector can also be installed to prevent iron particles going into the product. **Packing of the product** is executed by automatic packing machines, that execute the dosing of herbal tea, packing into teabags or loose tea packings, putting into labelled boxes.				
EQUIPMENT	**Drying and Dehydrating** Dryer containers Stainless steel bulk barns with drying systems and silica gel dryers equiped with the with stainless steel loading trays and PLC system	**Cutting, threshing, classification** Production line for cutting, threshing and classification Mills for dried plant mass Jagged roller mills Centrifugal mills Vibrational sieves and conveyors Sieves and conveyors Pneumatic separators	**Mixing, blending** Belt mixers	**Packing of the product** Packaging machines for packing into tea bags Packaging machines for bulk packaging	
EQUIPMENT PRICE RANGE	20000–600000 EUR	50000–3000000 EUR	100000–300000 EUR	500000–1500000 EUR	

ECONOMIC FACTS AND DATA	The world production of herbs is now estimated at more than 0.5 million tons per year and consists mainly of dried herbal raw materials produced for pharmaceutical purposes. The turnover of medicinal and aromatic plants includes approximately 2000 species. The European market is one of the most important consumers of this production. In Europe, due to the climate and soil conditions Mediterranean as well as Central and East European countries are the best localisations for growing herbs. The total area occupied by the species of plants is approximately 70,000 hectares. The largest suppliers of herbal material are France, Poland, Spain, Germany and Austria. European herbal industry processes approximately 200 species, mainly from field crops. Gathering from natural habitats is marginal today, as obtaininga uniform mass product from this source is difficult. Source: https://pdfs.semanticscholar.org/154f/7c2abdc8ab1186b7e1ddcbd68597d0cf7a3c.pdf
REFERENCE PICTURES	     
OTHER REFERENCES (LINKS TO VIDEO MATERIALS)	https://www.youtube.com/watch?v=KU2_wMYBXrk https://www.youtube.com/watch?v=uuI_RDiZPi4 https://www.youtube.com/watch?v=uVXGVV_rLIA https://www.youtube.com/watch?v=GUQ24wgYvfw https://www.youtube.com/watch?v=GUQ24wgYvfw https://www.ricola.com/en/experience/processing http://www.wildnesswithinliving.com/blog/2016/3/28/the-process-of-processing-herbs

INDUSTRY	Food industry	TECHNOLOGY GROUP	Food processing	SPECIFIC TECHNOLOGY	1.8. Smart food production

INTRODUCTION

Smart foods are those that have been developed through the invention of new or improved processes, for example, as a result of man-made materials/ingredients or human intervention; in other words, not naturally occurring changes.

Smart foods may:

- have a function, other than that of providing energy and nutrients;
- perform a particular function never achieved by conventional foods;
- have had a significant investment of intellectual property;
- have been developed for specialised applications, but some eventually become available for general use.

The British Nutrition Foundation (BNF) and the Design and Technology Association (DATA) classify smart foods as:

- foods with novel molecular structures, e.g. modified starches, fat replacers and sweeteners
- functional foods, e.g. cholesterol-lowering spreads, probiotic yogurts, fortified eggs
- meat analogues, e.g. textured vegetable protein (TVP), myco-protein and tofu
- encapsulation technology, e.g. encapsulated flavours in confectionery
- modern biotechnology e.g. soya bean, tomato plant, particular enzymes

Source: http://www.foodafactoflife.org.uk/attachments/26596934-b2e7-4c1c0b32122b.pdf

Natural food scarcity amid the exponentially growing population of the planet questions the future of agriculture and challenges food manufacturers, engineers and bioscientists to discover new sustainable solutions.

Metalworks, the R&D branch of the media agency Maxus predicts that in the next decade's technology will redefine the food and drinks industry as well as our attitude to nutrition. Among the biggest challenges of humanity, the researchers name growing of biotech/engineered food with modified characteristics and smart food-waste management. Other trends to watch will include the creation of new food experiences, new types of interaction with the "Internet of food", as well as innovative concepts of ready-to-consume and 3D-printed foods. None of these challenges and trends is new as such, most of them were analysed and predicted by the Popsop team back in 2013.

Nevertheless, here are the highlights from the Metalworks food trends report, as follows:

1. Lab-grown foods and smart tools for personalized healthy nutrition are already a reality and they will be further developing. First engineered beef was cultivated from muscle cells of livestock in a London lab in 2013. As an alternative to real meat, two California-based innovative companies Beyond Meat and Hampton Creek produce plant-based substitutes of meat with the same nutritional value. Their produce is available in local supermarkets.

2. As conscious food consumption grows, numerous food-related platforms, apps and tools will appear massively. Some are designed to minimise food waste, such as LeftoverSwap, others inform consumers on GMO content, such as Fooducate. There are also electronic devices like Tellspec that analyses the chemical composition of food and detects harmful ingredients such as nitrates or potential allergens.

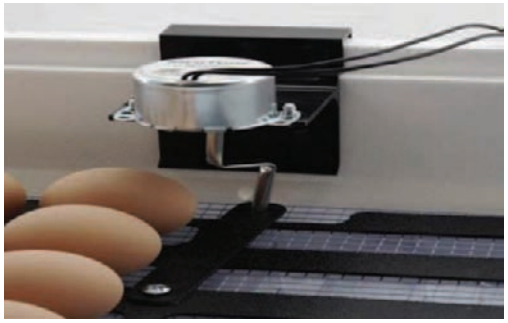
3. Bars and restaurants will use technology to provide customers with fast data-based services or immersive emotional experiences beyond the taste of food and drinks. A handful of restaurants in Asia already uses robotic wait and cooking staff to save on wages. A San Francisco-based chain of smart restaurants Momentum uses a robo-cook that makes 360 deli burgers per hour.

4. The 'Internet of Things' – app-connected smart devices – will find their places in the kitchen too. Samsung has already presented a WiFi-connected refrigerator; GE has partnered with an outsourcing incubator Quirky to fund the development of a smart jar that informs a user when the milk will go bad. Some start-ups also experiment with the 'Internet of Food', creating smart frying pans, such as Pantelligent, or Bluetooth-enabled thermometers to measure the temperature of the cooked food, such as iGrill mini for grilled meat.

5. Food 3D-printers and nano packaging may revolutionise the way the dishes are cooked and how the ingredients are stored. This year, Hershey's created a chocolate machine CocoJet that 'printed' dark, milk or white chocolate.

	The use of nano packaging will give a longer shelf life to products without any preservatives, which results in less food waste, healthier nutritional options and lower costs for both manufacturers and consumers. Source: http://popsop.com/2015/05/how-technology-changes-the-future-of-food-5-trends-to-watch/
RELATED KEYWORDS, ABBREVIA-TIONS	Smart foods Modified Starches Low-fat products Sweeteners Encapsulation technology Biotechnology
PROCESS DESCRIPTION	The transition of food production from domestic to industrial contexts has resulted in new problems regarding product consistency and quality. Although the variation of quality would be tolerated on a domestic level, consumers expect consistently high standards in the food products that they purchase. Also, health concerns and advances in scientific understanding have presented new possibilities in ingredient technology. Novel molecular structures may focus on (for example): ▪ modified starches, e.g. pre-gelatinised starch; ▪ fat replacers, e.g. olestra; ▪ sweeteners, e.g. aspartame. Modified Starches Starch consists of two types of glucose polymers: amylose and amylopectin. They occur together in starch granules, with approximately 20–25% usually being amylose. However, 'waxy' varieties of starch, e.g. maize, have very little amylose. When gelatinised starch solutions are allowed to stand for a few hours, they begin to show changes in their rheological properties. For example, dilute solutions lose viscosity, and concentrated gels become rubbery and exude water. Both types of change are due to a phenomenon called retrogradation, which involves the amylose molecules. This is because, within the gelatinised solution, amylose acts to bind together the expanded granular structure of amylopectin molecules. Understanding this natural phenomenon has led to the production of modified starches, which can be altered to provide consistent results, tailored to the needs of the product. Starch may be modified by physical means (e.g. heating and shearing) or chemical treatment (e.g. oxidation, derivatisation). Demand for low-fat products has been driven by consumer interest in health, in general, but particularly by a concern about energy intake and, in some cases, fat. In the UK, 45% of men and 33% of women are overweight; 17% and 21%, respectively, are obese. Fat replacers can be a useful tool in reducing fat intake and can help reduce total energy intake. Examples of fat replacers are: Carbohydrate and protein-based ▪ Modified glucose polymers ▪ Modified starches, e.g. maize, potato and rice ▪ Native proteins, e.g. gelatine, maize protein, whey-protein concentrate Lipid-based ▪ Fatty acid esters of sugar or sugar alcohols ▪ Medium-chain triacylglycerols ▪ Emulsifiers, e.g. polyglycerol esters, lecithin. Sweeteners are classed as either intense or bulk. Intense sweeteners, e.g. saccharin and aspartame, are many times sweeter than sugar and so are only used in tiny amounts. This makes them suitable for use in products such as diet drinks, which are very low in energy. Bulk sweeteners, e.g. sorbitol, have a similar sweetness to sugar so are used in similar amounts. They are used in sugar-free confectionery. Encapsulation technology is applied in many industries, including food, medicines, fragrance and scratch-n-sniff products. Within food technology, encapsulation is used to: ▪ act as a vehicle for the addition of yeast in brewing or lactic acid starter cultures in dairy fermentation

	▪ enhance the appearance or flavour of food through natural and artificial flavours and colours ▪ fortify food products with additional nutrients, e.g. functional foods ▪ aid preservation ▪ ensure consistency. What is encapsulation? Encapsulation involves the coating of a fine particle of an active core with an outer shell into small capsules. Encapsulation can be applied to any scale, micro-encapsulation will be dealt with, i.e. capsules ranging from 1 to 1000 micrometres (1 micro = 1,000th mm), although smaller capsules can be manufactured, which are known as nano-capsules (1 nanometre = 1,000,000th mm). Essentially, encapsulation is a barrier technology, preventing ingredients from reacting prematurely with their environment or degrading during processing or storage. Why encapsulate? Encapsulation technology can: ▪ achieve a controlled release of a core material, e.g. sustained release of the core material over a period of time at a constant rate ▪ mask the taste of a capsule's core ▪ reduce the reactivity of core material, e.g. to oxygen and water ▪ ease the handling of the core, e.g. by prevent lumping, converting a liquid to a solid and by being easy to mix ▪ dilute the core material, when used in small amounts, but achieve a uniform dispersion How are the core materials released? ▪ Core materials within capsules may be released through the shell by: ▪ mechanical compressive force ▪ dissolving in liquid (e.g. flavour capsules in a powder being diluted) ▪ melting during baking ▪ breaking and opening due to the shear in a blender ▪ diffusing at a slow rate due to water or temperature increase. What is modern biotechnology? Traditional breeding methods involve many generations of livestock or crops, which takes considerable amounts of time for desirable traits to be achieved, e.g. cross breeding pigs to produce pork with less fat. Newer modern biotechnology techniques allow scientists to identify individual genes that control particular characteristics. The selected gene can be transferred to another plant or animal to bring about the desired change more rapidly. This technique is quicker than traditional methods and is more exact. Its primary advantage is the ability to introduce or remove selected genetic material to an existing species. However, the benefit must be carefully assessed and will be subject to rigorous safety assessment. Conventional breeding can also be used with modern biotechnology to improve varieties and will still be used where possible. Genes, DNA and traits All plant and animal cells contain genes, which determine their individual characteristics, e.g. the colour of a plant's leaves. Genes are composed of specific lengths of deoxyribonucleic acid (DNA). DNA is made up from two strands intertwined in a spiral – this is known as the double helix. Each strand is made up from four nucleotide bases; the amounts of these bases vary. The bases are put together in different sequences to create a unique code. Each code carries a particular instruction which the cells follow to reproduce individual traits, e.g. height and colour. Understanding the nature of DNA has led the way to modern biotechnology, sometimes referred to as genetic modification. Modern biotechnology allows specific sequences of DNA to be manipulated to modify the characteristics in plants and animals. Source: http://www.foodafactoflife.org.uk/attachments/26596934-b2e7-4c1c0b32122b.pdf	
EQUIPMENT	High-pressure homogenization equipment for processing beverages, sauces and other fluid products; separators for producing ESL extended shelf-life) milk by reducing the bacterial count prior to pasteurization; freeze dryers helping to prolong the shelf-life of food by drying deep-frozen food in a vacuum to vaporize the ice; refrigeration technologies providing innovative freezing and chilling technology throughout the production, transport and storage of food.	Modified atmosphere packaging for powdered bulk products is extending their shelf-life to several years.

EQUIPMENT PRICE RANGE	–	–
ECONOMIC FACTS AND DATA	–	
REFERENCE PICTURES	     	
OTHER REFERENCES (LINKS TO VIDEO MATERIALS)	https://www.youtube.com/watch?v=ezNYkz9a0XI https://www.youtube.com/watch?v=ja0UOi8VlvQ https://www.youtube.com/watch?v=4xFH2CZ5pAI https://www.youtube.com/watch?v=hw321SwC6kA http://www.fao.org/docrep/014/i2454e/i2454e00.pdf	

REFLECTION/ CONSOLIDATION PHASE

PRODUCTS COSTS CALCULATIONS.

Questions like:

Is it worth to become expert in this field?

What benefits can I get if I enter this industry?

I am using of product costs calculations in technology cards.

SELF CHECK OF SENSUAL IMPRESSIONS DURING A COMPANY VISIT

Sense	Attitude	Comments
Smell	Like Mostly like Mostly don't like Don't like	
Sound	Like Mostly like Mostly don't like Don't like	
Touch	Like Mostly like Mostly don't like Don't like	
Visual	Like Mostly like Mostly don't like Don't like	
Temperature	Like Mostly like Mostly don't like Don't like	
Wet	Like Mostly like Mostly don't like Don't like	

Dust	Like Mostly like Mostly don't like Don't like	
Safety	Like Mostly like Mostly don't like Don't like	
Staff attitude	Like Mostly like Mostly don't like Don't like	

The end of reflection phase counselor ask students to answer to questions
Do You want to participate in paid works in this industry?
Do You want to participate in summer works in this industry?
Do You want to participate in voluntary works in this industry?
Do You want to visit this or another company in this industry?
Do You have a plan after school graduation?

- Yes, I know what I'll do
- I have to decide between two choices
- I have several choices
- I don't know
- I did not think about that

CAREER GUIDANCE IN METAL AND MACHINERY SECTOR OF INDUSTRY

EVOCATION/ANTICIPATION PHASE

At the beginning of group counseling session counselor collect students answers to questions:

Did You know about Food processing and Agriculture sectors of industry from

- media (newspapers, magazines, TV, radio)
- internet (social networks, youtube,…)
- industry company web page
- family members
- friends
- neighbours
- other

Did You participate in paid works in this industry?
Did You participate in summer works in this industry?
Did You participate in voluntary works in this industry?
Did You visit a company in this industry?
Do You have a plan after school graduation?

- Yes, I know what I'll do
- I have to decide between two choices
- I have several choices
- I don't know
- I did not think about that

Based on analysis of results the most important Design Field competencies are:

- Navigating and managing used materials, to analyse their improvement and development trends, and to be able to use them at work.
- Developing of projects by using computer-assisted design and computer-aided manufacturing technologies.
- Creative and independent development of existing and new products.
- Creating long-term product: innovative, functional, produce in a rational and cheaper way, convenient and easy to use, with aesthetically high-quality forms, colours, and textures
- Setting products' manufacturing restrictions and choosing a set of possible solutions (possible material usage and compatibility as wells as possible constructive solution options).
- Analysis and definition of logistical, functional, aesthetical, and ergonomic set of qualities.

Presentations of the companies design of the products, technologies and economics. Pictures of real products of nearby companies.

From the overall results of IMATEII project questioner it can be seen that EE enterprises are mostly consistent with suggested results (the mostly important competencies for EE also have the overall importance. The design competencies that are important but were not included in the questioner are Custom made products design, Standardisation, Design for Manufacturing and Assembly (DFMA), ability to generate working drawing from SolidWorks, knowhow of reliability tools (DFEA, FMEA), Quality management.

In order to give a better representation of the industry three companies/ products were selected:

a. Norma / Safety Belt, b. E-Profiil (contract manufacturing of offshore oil & gas, energy equipment), BLRT.

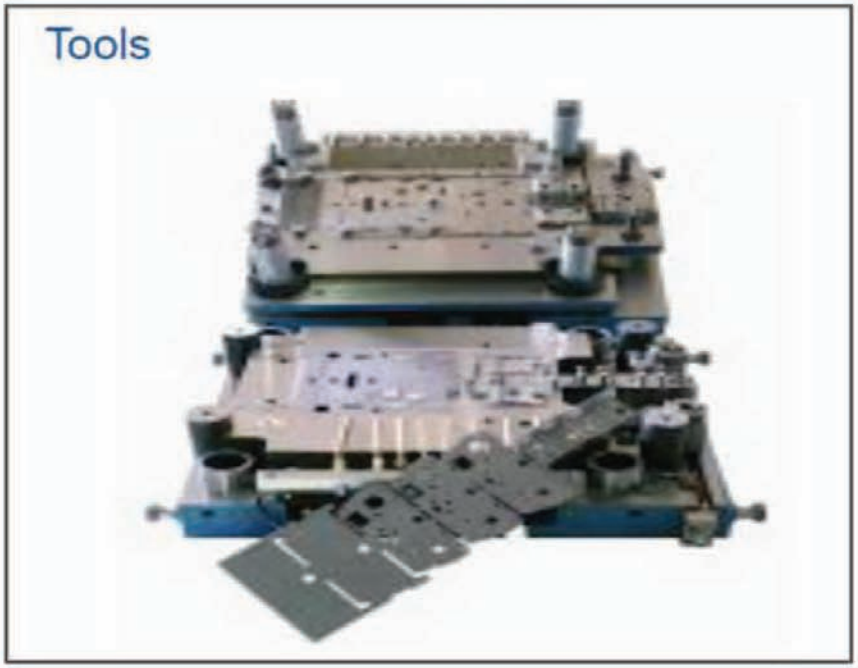
AUTOLIV NORMA (NRC)

MILESTONES OF NORMA

- 1891 Established in Paldiski, Estonia
- 1950–1980 Leading Toy Manufacturer in USSR
- 1972 Safety Belt Design & Production Start-Up
- 1973–1990 Sole Supplier of Seat Belts in USSR
- 1992 Sales of Components for GM (Saab)
- 1996 Listed on Tallinn Stock Exchange
- 1999 Autoliv AB Acquired 49,5% of Shares of AS Norma
- 2000 Autoliv AB Ownership 51%
- 2001 Assembly of Seat Belts for VCC, GM (Saab)
- 2003 Retractor Assembly for VCC, GM (Saab)
- 2007 Components' External Sales Growth
- 2010 Autoliv Ownership 100%
- 2011–2012 ALV Stakupress operations transfer
- 2014 Height Adjuster Assembly and Components production
- 2016–2017 Customer audits (VW group, Ford) and Potential audits (Daimler, BMW) – status Green.

SAFETY BELT PRODUCTION IN NORMA IN NUMBERS PRODUCT GROUPS NRC 2017 IN PIECES.

Steel consumption – 11 thousand tonnes yearly



NORMA IN BRIEF

- NRS – Assembly
- NRC – Component Manufacturing
- Toolshop
- High Vertical Integration
- Product Development
- Toolmaking
- Metal Processing
- Heat Treatment
- Surface Treatment
- Plastic Injection Moulding
- Assembly
- Quality Control and Testing

THE COMPANY COVERS THE FOLLOWING TECHNOLOGICAL PROCESSES:

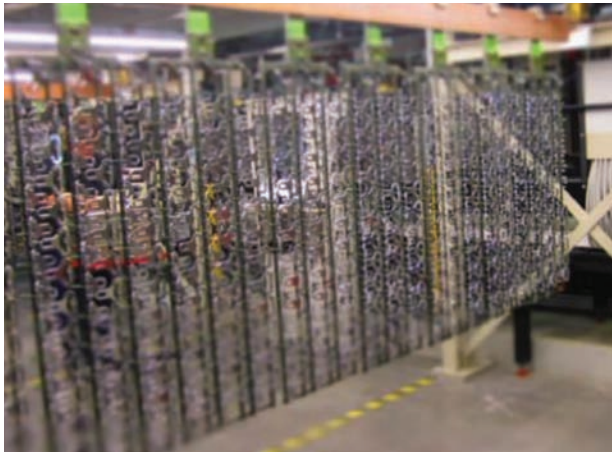
	ESTONIA
Normal Stamping	✓
Fine Blanking	✓
Assembly Operations	✓
Heat Treatment	✓
Coating	OUT SOURCED
Electro-plating	✓
Plastic Over-moulding	✓
Toolshop	✓
Total Area	41.000 m²
Covered Area	14.100 m²

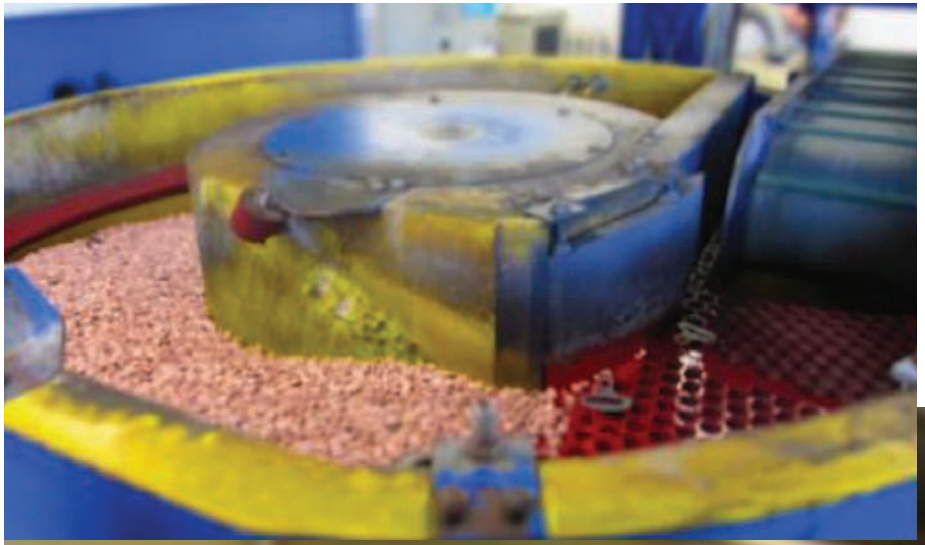
METAL PROCESSING

- ☐ Conventional Stamping 125–650 T
- ☐ Fine blanking (Feintool) 160–450 T
- ☐ Isothermal Hardening
- ☐ Metal Stamping Commodity
- ☐ Locking Tongues/CLT(crash locking tongues)
- ☐ Pillar Loops
- ☐ Lock-dogs
- ☐ HA Rails, fineblanking components
- ☐ Quick-fix Assay Components
- ☐ Retractor Frames
- ☐ Buckle Latch, Channel
- ☐ End Brackets
- ☐ Sheet Metal Springs
- ☐ Plastic Injection Molding/Overmolding Commodity
- ☐ Spring Cassette Components
- ☐ Sensor Components
- ☐ HA components
- ☐ Mech Covers, Buckle Covers
- ☐ Push Button
- ☐ Webbing Sleeve

STAMPING DEPARTMENT NRC

DEBURRING / HEAT TREATMENT / GALVANIC NRC





Surface Treatment

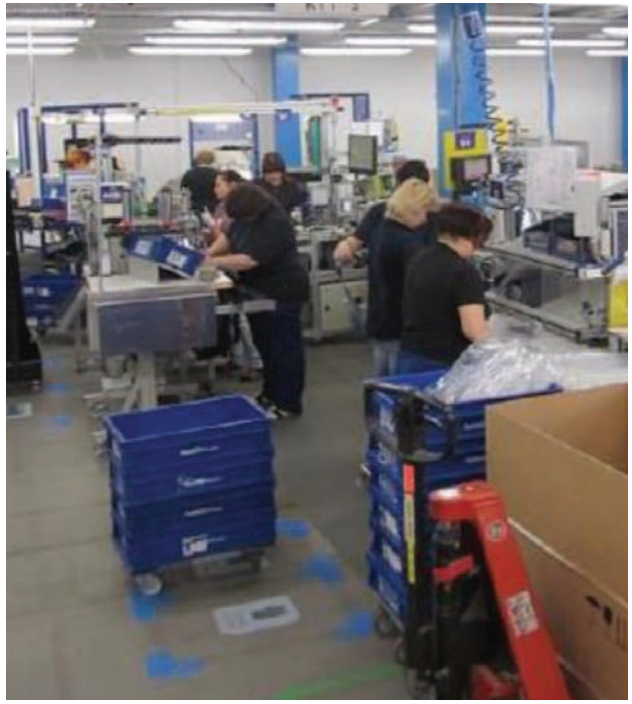
- ☐ Vibro Deburring & Centrifugal Disc Finishing
- ☐ Electroplating
  - NiCr Plating On Racks
  - Zn Plating On Racks
  - Zn Plating In Barrels

Plastic Injection/Overmolding

- ☐ Plastic Injection Moulding (21 presses in total)
- ☐ Overmolding (Manual+Robots) (18+28 presses in total)
  - 81 colours (9 blacks)

Assembly Processes (NRS)

- ☐ Seatbelt assembly
- ☐ Retractor assembly
- ☐ HA assembly
- ☐ PLP assembly
- ☐ Buckle assembly
- ☐ Clutch assembly and wire cutting
- ☐ Spring cassette assembly
- ☐ Spare part seatbelt assembly
- ☐ Other assembly processes



Testing Centre

- ☐ Seat belt testing Since 1973
- ☐ Dynamic (crash) test Since 1982
- ☐ Component testing Since 2007
- ☐ Performing
- ☐ ECE R16 and customer specific tests
- ☐ ECE R16 certification tests for Estonian Homologation Service (E29)
- ☐ R&D tests for seat belts and components
- ☐ Accredited to ISO/IEC 17025
- ☐ by Estonian Accreditation Centre since 2005.

Accreditation scope covers all ECE R16 tests

E-PROFIIL COMPANY

E-Profiil AS is the contract manufacturer of complex, big and heavy steel structures, equipment and solutions for offshore oil&gas, energy, marine and machine-building industry.

E-Profiil has own ice-free deepwater quay in Paldiski Northern Port.

E-Profiil offers customers turn-key products including the fabrication, mechanical-, electrical-& hydraulical assembly, installation & testing.

MILESTONES OF E-PROFIIL

Established:	1997
Ownership:	Estonian private capital
Employees:	310
Location:	Tallinn & Paldiski
Total Production and storage area	18 400 m^2.

HIGHLIGHTS OF THE HISTORY ...

1997 –	E-Profiil AS was founded
1999 –	Manufacturing of different steel structures;
2004 –	The first order from the offshore industry (74 storage tanks nad 10 pressure vessels);
2005 –	Expansion of production area;
2005–2008 –	Manufacturing of cranes, winches, sheaves and frames;
2009 –	Significant investments in new equipment; implementation of Microsoft Dynamics Navision (enterprise resource planning software);
2010 –	Certification according to ISO 9001:2008; Implementation of SolidWorks (3D CAD design software);
2011 –	Certification according to ISO 3834-2:2005 and ISO 14001:2004. Installation of CNC (Fermat 160);
2012 –	Renovation of the workshop;
2013 –	Certification according to Occupational health and safety management system.

PRODUCTION CAPABILITIES AND CAPACITY

Tallinn Factory

Production & storage area total 17 200 m^2

Cranes 5–80 t, one lift max 160 t

Paldiski Factory

Assembly hall of 1200 m2 (next years up to 8000 m2)

CAPACITY OF STEELWORK AND ASSEMBLY:

In-house capacity:	350 000 + manhours/year
With approved contractors:	500 000 + manhours/year

E-PROFILE OFFERS THE FOLLOWING SERVICES

Engineering

Project Management

Quality Assurance

Supply Chain Management

Purchasing

FastTrack & Prototype Business Unit

On-site machining services

Production Services:

Preparation

Assembly & Welding

The survey, Measuring Services & NDT

PWHT

Machining

Surface Treatment

Mechanical Assembly

Hydraulical & Electrical Assembly

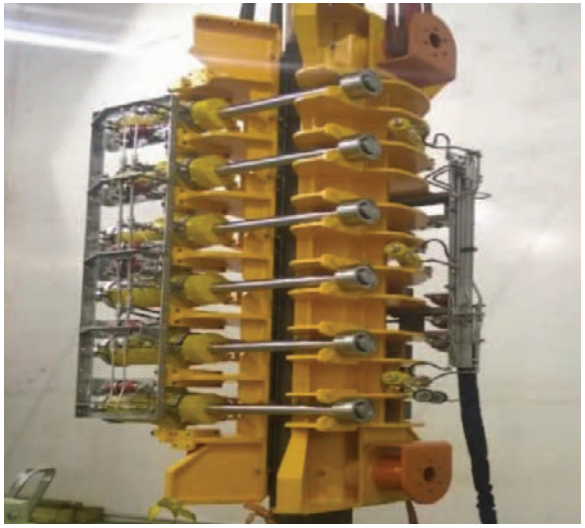
Testing (FAT)

Packing

Logistics (Large & Heavy), Storage

PRODUCTS:

- Offshore cranes
- Fabrications and turn-key products for machine building industry
- Hydro-energy equipment – turbine housings, stay-rings
- Marine equipment – azipods
- Fabrications for wind generators – stators, rotors
- Offshore and marine winches including anchor, mooring and towing winch systems and other deck equipment
- Subsea equipment
- Drilling equipment – such as wireline tensioners, catwalks.



For current project is it suggested to use Hydroturbine stay-ring / housing

Equipment and capabilities

E-Profiil have a unique equipment for Baltic States.

Capabilities highlights:

CNC Horizontal Boring Mills

(max travels X=24.000; Y=8.000 mm)

On-site machining equipment Climax

Large robot welding station

SAW welding portals

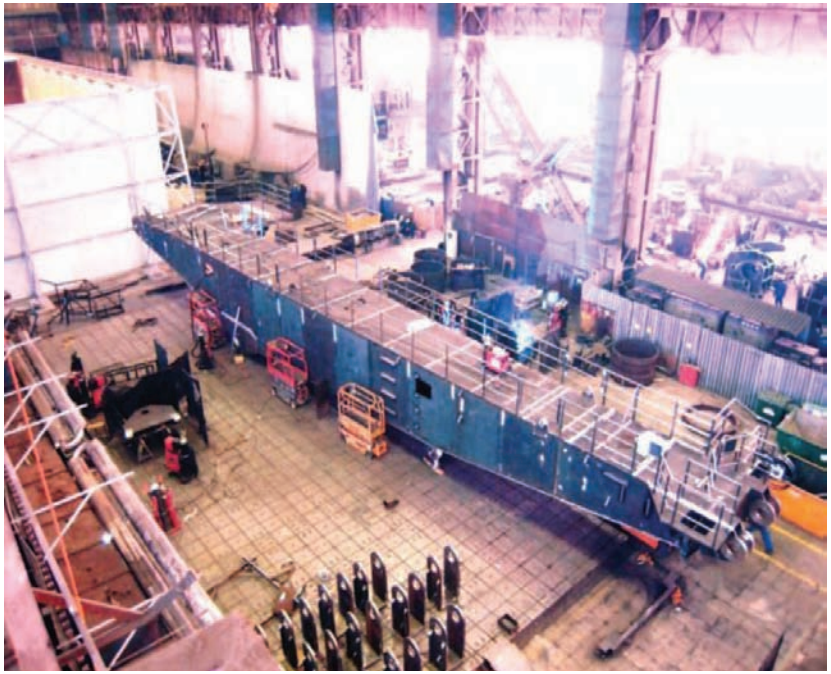
Preheating & PWHT equipment

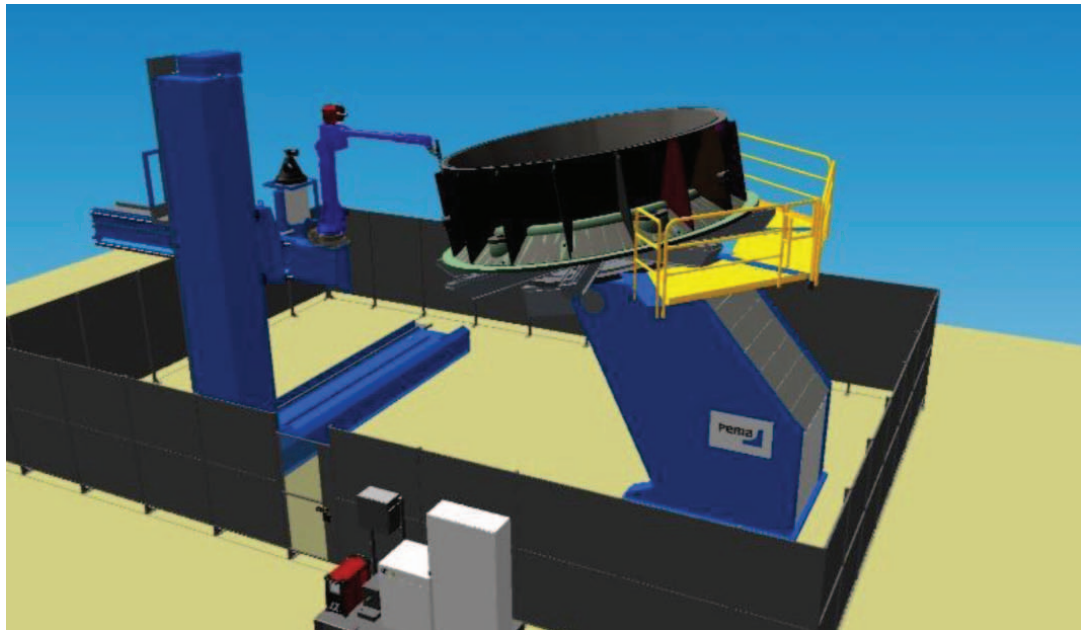
Laser Trackers Faro

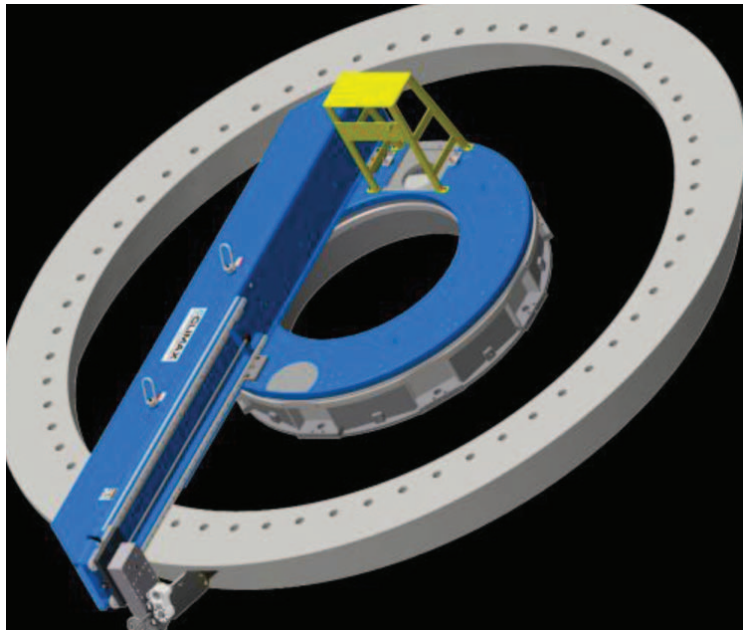
Surface Treatment:
Blasting & Painting halls

with size 10 x 10 x 35 m

TWO HYDRAULIC & ELECTRIC ASSEMBLY HALLS







On-site machining circular mill with max D6200 mm

Large robot welding station with rotator 50 tons

New Skoda CNC horizontal boring mill

Travels Y=8000 mm, X= 24.000mm

Rotary table 160 tons

BLRT GROUP COMPANY MARKETEX MARINE

One of the largest industrial holdings in the Baltic States

Incorporates 58 companies

Operates in 7 European countries: Estonia (headquarters), Latvia, Lithuania, Ukraine, Russia (Kaliningrad), Finland, Poland

More than 4000 employees

MARKETEX MARINE MEMBER OF BLRT GRUPP

Marketex Marine is a solely owned company operating as a separate identity within the BLRT Grupp. Marketex Marine core competence is in providing solutions from steel, stainless steel and aluminium for the small shipbuilding and fish farming industries.

Marketex Marine operates in 2 workshops with the total estimated area of 7000 m^2 and employs over 120 highly skilled employees including indirect labour.

Marketex Marine has extensive experience in manufacturing mono and multihull vessels for offshore wind farm services, fish farming and port services.

SMALL SHIPBUILDING AND ALUMINUM CONSTRUCTIONS

Marketex Marine is a reliable manufacturer in producing all kinds of aluminium constructions for marine markets. The product range includes:

- Class approved newbuilds tailored as per customer needs;
- Aluminium roof structures for Holiday Cruise ships;
- Aluminium superstructures for fish trawlers and passenger ferries.

Lightweight, high strength, good anti-corrosion properties in saline environments and its high fire resistance makes aluminium very suitable for various applications including mechanical, chemical, civil and marine engineering disciplines.

COMPREHENSION/THE BUILDING KNOWLEDGE PHASE.

Based on analysis of results the most important Technology Field competencies are:

- Choosing the most rational technique and technology.
- Contributing to the introduction of new technologies.
- Developing technological planning of production
- Managing the production technology of Products and Services
- Forming a safe workplace in complying with fire safety regulations in the production facility.
- Adjustment of production regimes by applying knowledge of the production process.

From the overall results table, it can be seen that EE enterprises are mostly consistent with suggested results (the most essential competencies for EE also have the overall importance. The technology competencies that are important but were not included in the questioner are: Custom made technological solutions development for customer requested functionality, ability to perform scientific research overview and implementation in today's business, Poka-Yoka, 8D, Improvements, Ability to study from mistakes, Ability to generate project plans, analysis of dimensional system.

The survey disclosed high importance of rational selection of production technique and related technological work processes and skills for the sector of metal and machinery industry. Therefore the phase of comprehension and building of the knowledge base can be strongly related with the introduction and analysis of the technological processes of production used for the particular product. The introduction to the technological processes of the sector could start in the school by identifying particular products and the technological process used for their production. There is a wide availability of different information materials that can be applied for this purpose (such as videos of the production processes, simulation of the production process in software, 3D printing of final product.

The second step could be organising the visits to the companies, where the students could see the technological processes in live environment. Having in mind the specificity of the technological and work processes of this sector that limit the access of work processes for the observation (e.g. safety issues in the heavy metal and machinery, noise, smell, heat which related to selected technological processes of production of many metal products). In some cases it could be hard to access directly these production processes, especially in shipyards. In this case the observation of simulated or smaller scale technological process can successfully replace the observation of real and big scale production. For example, visiting of metal lab which accepts the visitors and even offers the possibility to have "hands-on" some production processes (to try out some technological processes by own hand) could be of much higher value for the understanding of technological process and metal product manufacturing than the visit of a large company and observation of selected technological processes from the distance.

BLRT GROUP

Aluminum Catamaran Production Process https://player.vimeo.com/video/79977416

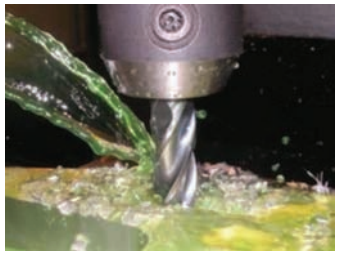
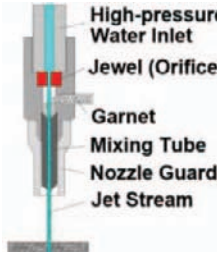
Machines and cranes

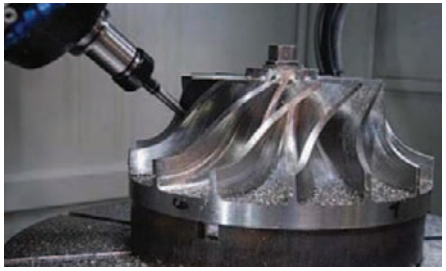
NAME OF MACHINE	Location	lenght, mm	height, mm	depth, mm	Max weight, kg	C to C distance, mm	Machining accuracy, µm pm	Max grinding Ø, mm	Round detail max. Ø, mm
MILLING MACHINES									
TOS Varnsdorf WRD 150 Q	Tallinn	14 000	4 000	1 800	25 000				
TOS Varnsdorf WRD 130 Q	Tallinn	7 000	3 500	2 500	25 000				
TOS Varnsdorf WHQ 13	Tallinn	5 000	3 000	1 800	20 000				
LATHE MACHINES									
Heavy horizontal lathe	Tallinn	6 000			17 000				2 300
Heavy horizontal lathes Oerlikon DM6	Tallinn	12 000			20 000				1 500
SHAFT PROCESSING MACHINES									
Hydraulic Grinding CNC Machine Gioria RU/PN	Tallinn					3 500	1	500	

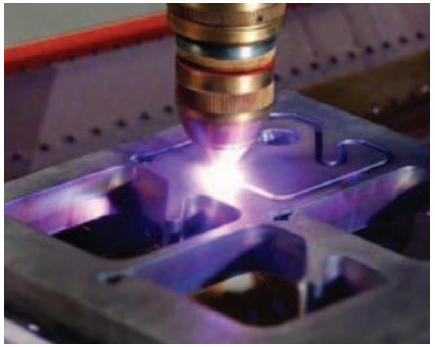
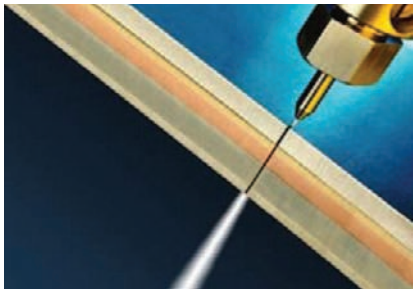
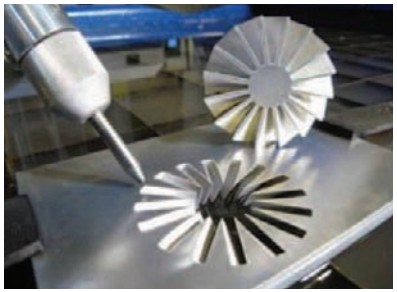
Facilities in details

LIFTING	18 Trolley type cranes in Workshops	Lifting capacity 2–120 Ton.
	10 Portal Cranes	Lifting capacity 10–32 Ton.
	2 Floating Cranes	Lifting capacity 35–100 Ton.
	Cutting:	
	Plasma Cutting	Up to 30 mm thickness, max sheet dimensions 3500 X 20 000
	GasCutting	Up to 200 mm. Max sheet 3500 X 20 000
	Laser Cutting	Up to 20 Max sheet 8 000 X 2 400
BENDING	Hydraulic Press	P = 630 Ton, L = 7 000 P = 180 Ton
SHEET ROLLING	Rolling Machines	S max = 95 mm, B = 608 mm, S max = 71 mm, B = 4050 mm (355 NL)
WELDING MACHINES	MMA	Welding machines up to 200 & 400 A (Kemppi, ESAB)
	MIG/ MAG	Welding machines up to 400 A (Kemppi, ESAB, Migattronic, Lincoln)
	TIG	Welding machines (AC/DC) up to 350 A (Kemppi)
	SAW	Tractors A2 up to 800 A (ESAB)
	SAW	Welding gantry Walltrac 2 head x 1000 A (ESAB)
		Welding robot Motoman (MAG welding) up to 450 A
TRANSPORTATION EQUIPMENT	Hydraulic transportation platform	210 Ton KAMAG

METAL PROCESSING

INDUSTRY	Metal processing	TECHNOLOGY GROUP	Metal cutting	SPECIFIC TECHNOLOGY	2.1. Turning, Milling, Drilling, Laser cutting, Waterjet cutting
INTRODUCTION	Metal cutting process is an industrial process in which metal parts are shaped by removal of unwanted material. In traditional chip-forming processes, such as turning, drilling, and milling metal is removed as a plastically deformed chip of appreciable dimensions. Metal cutting is one of the most widely used methods for metal parts forming allowing to get parts with defined dimensions and shapes and required surface roughness. Sheet metal cutting most widely is used by the help of lasers or water.				
RELATED KEYWORDS, ABBREVIATIONS	CNC – computer numerical control. Tool bit – a non-rotary cutting tool. Milling cutter – a rotary cutting tool. Cutting fluid-fluid for cooling and lubrication during the metal cutting. Lasers – a narrow single colour beam of light. Abrasive jet – a jet of fine abrasive particles, usually about 0.025 mm in diameter.  Tool bit  Milling cutter  Drill  Cutting Abrasive fluid jet 				
PROCESS DESCRIPTION	**Turning** is a machining process in which a non-rotary tool bit describes a helix toolpath by moving more or less linearly while the workpiece rotates. Turning can be done manually, in a traditional form of lathe, which frequently requires continuous supervision by the operator, or by using an automated lathe, which does not. Today the most common type of such automation is CNC. https://www.youtube.com/watch?v=8EsAxOnzEms **Milling** is a cutting process that uses a milling cutter to remove material from the surface of a workpiece. The milling cutter is a rotary cutting tool, often with multiple cutting points. As opposed to drilling, where the tool is advanced along its rotation axis, the cutter in milling is usually moved perpendicular to its axis. https://www.youtube.com/watch?v=Ef59DogwLrI **Drilling** is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool. The bit is pressed against the workpiece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the workpiece, cutting off chips from the hole as it is drilled. https://www.youtube.com/watch?v=KYfAjakKO5w **Laser cutting** is a technology that uses a laser to cut materials and is typically used for industrial manufacturing applications. Laser cutting works by directing the output of a high-power laser most commonly through optics. The laser optics and CNC are used to direct the material or the laser beam generated. The focused laser beam is directed at the material, which then either melts, burns vaporises away, or is blown away by a jet of gas, leaving an edge with a high-quality surface finish. https://www.youtube.com/watch?v=PlF_oXvbu4s **Waterjet cutting** is a technology that uses a very high-pressure jet of a mixture of water and abrasive substance for metal cutting. https://www.youtube.com/watch?v=XfGkLsUm92Q https://www.youtube.com/watch?v=lMSGHJ8GJ1A				

EQUIPMENT	**Turning machine**	**Drilling/Milling machine**	**Laser metal cutting machine**
EQUIPMENT PRICE RANGE	1000–40 000 EUR … > 100 000 EUR	600–20 000 EUR … > 100 000 EUR	> 8000 EUR … > 100 000 EUR
ECONOMIC FACTS AND DATA	Metal price depends on metal type, sizes and quality. Low-carbon steel. Sheet metal and standard profiles – 1.5 … 2.5 EUR/kg. Stainless steel. Sheet metal – 3.5 … 6.5 EUR/kg.		
	Aluminium alloys. Sheet metal and standard profiles: > 3.5 EUR/kg. Instrument price depends on design and application. Turning: tool holders – 300 … 500 EUR/ps, inserts – 10 … 20 EUR/ps. Milling: tool holders – 300 … 3000 EUR/ps, inserts – 10 … 20 EUR/ps. Drilling: solid carbide drills – 40 … 300 EUR/ps. Metal cutting service price depends on tchnology and equipment. Turning (CNC) – 35 … 50 EUR/h. Milling (hand/CNC) – 25 … 35 EUR/h. Drilling – 15 … 20 EUR/h. Laser cutting – 25 … 35 EUR/h.		
REFERENCE PICTURES	    Turning		
	    Milling		

	    Laser cutting
	    Water cutting

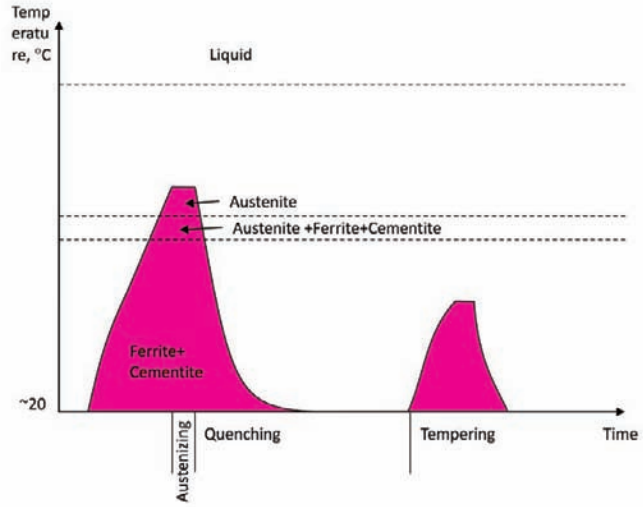
INDUSTRY	Metal production and processing	TECHNOLOGY GROUP	Heat treatment	SPECIFIC TECHNOLOGY	2.2. Heating and cooling
INTRODUC-TION	As long ago as Greek and Roman times it was known that the sharpness of a sword could be improved by rapidly cooling it after heating it up to forging temperature. The reasoning for that was not known though. The term heat treatment in most people's mind associates with hardening – making material harder, increasing its strength. It is not so much known, however, that the processes for making the material purposely softer are also covered with this term. Moreover, heat treatment is not constrained with metals only; even some glass grades are heat treatable. For example, car windows are made from heat-treated glass (called tempered glass) because if it really breaks then only to safe tiny pieces.				
RELATED KEYWORDS, ABBREVIA-TIONS	Hardening, heating, cooling, quenching, stress relief, heat treatment cycle, tempering, annealing, process anneal,				
PROCESS DESCRIPTION	The term heat treatment is used to describe the controlled heating and cooling of materials to alter their structures and properties. The same material can be made weak and ductile for ease in manufacture and then retreated to provide high strength and good fracture resistance. Whether you want to make a ductile machine shaft or a hard file – anything is possible! Because both physical and mechanical properties can be altered by heat treatment, and these changes can be induced with no concurrent change in product shape, heat treatment is one of the most important and widely used manufacturing processes. More than 90% of the heat treatment is performed on steel and ferrous metals. Other heat treated alloys are Al-, Cu-, Ti- or brass alloys.				

Heat treatment is not always for increasing strength or hardness. Sometimes it is necessary to make the materials purposely softer – reveal internal stresses, make the material more or again plastic for bending, stretching, etc. Such heat treatment is called processing heat treatment as it prepares the material for fabrication.

Steel, composed primary of iron (mostly over 95%) and carbon, is clearly the most important of the engineering materials. It is thermally treatable because iron can exist in different crystal structures: in room temperature, it exists as ferrite but in higher temperatures as austenite. In steels, ferrite can contain only a fraction of carbon, which forces the creation of two-phase mixture. The rest of the carbon is in another phase called cementite. Heating to austenite forming temperature is called austenising. Austenite can accommodate around 10 times more carbon, and two-phase structure transforms into one phase structure. If such structure were slowly cooled, it would change again to two-phase room structure. By fast cooling (quenching) carbon has no time to transform to two phases yet cannot stay in high temperature only existing austenite. Another phase called martensite will be formed. Basically, martensite is a ferrite where all excessive carbon atoms are entrapped inside. This increases the hardness considerably. Increased hardness means increased strength and wear resistance but the toughness is very low https://www.youtube.com/watch?v=fLvZkZxiXnE. Such material is not practically usable. In order to have better toughness values we have to do heat treatment cycle called tempering. Hardening is always followed by tempering and tempering is not done without hardening! By changing the tempering temperature we can balance between hardness/strength and toughness. There is always a mutual sacrifice: either we have high hardness and tensile strength but low toughness or vice versa. Low tempering temperature is for former and high tempering temperature for a later case. For example, a file has to maintain its filing properties for a long time, and its impact resistance is not so important. In order to achieve that, its tempering temperature must be from the lower end. A chisel is working in impact conditions. By making low-temperature tempering only, its cutting edge would be sharp for a long time but would break under dynamic loads. The tempering temperature should be higher.

Another good example is cutting dried spruce branches with an heat treated axe. If the hardness is too low (high temperature tempering) the cutting edge will be plastically deformed and obtains “S” shape in contact area. If the hardness is too high (low tempering temperature) the cutting edge would crack.

The most classical heat treatment is heating in air containing furnace and cooling in water.



Heat treatment of nonferrous materials is very different phenomena. The principal difference lies in the mechanisms by which hardening and strengthening are achieved. The process itself might be similar that first stage is heating to an elevated temperature, holding and followed by quick cooling. However, after heating and quenching the hardness decreases and formability increases on the contrary. The hardness along with strength starts to increase after a certain period. This period is so-called incubation period when the material is easily formable. It has high technological importance. As the hardness increases with time, the process is often called ageing. Ageing time can be shortened by heating to moderate temperatures.

EQUIPMENT	**Simple batch type furnace**	**Vacuum furnace**	**Continuous heat treatment line**
EQUIPMENT PRICE RANGE	800–1500 EUR	~ 800000 EUR	> 800000 EUR
ECONOMIC FACTS AND DATA	Heat treatment costs only a fraction of final product price but extends many times its life		
REFERENCE PICTURES			

Figure 1. Load removal from a furnace hold in austenizing temperature. Heat treatment temperature can be evaluated by parts glow

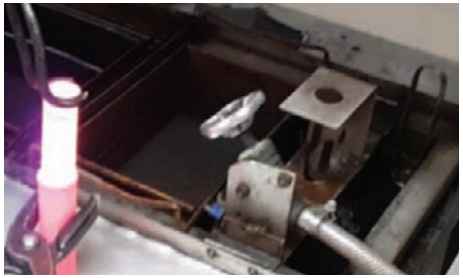


Figure 2. Cylindrical part removal form protective case for quenching

Figure 3. Quenching the same cylindrical part by cooling its one end with flowing water. Cooled end can be distinguished by colour

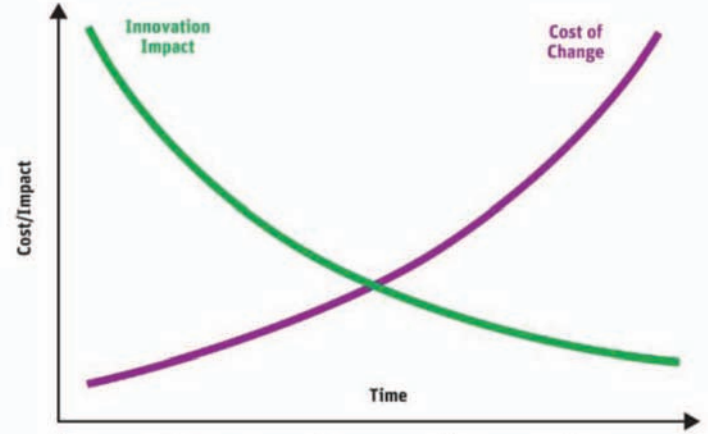
Figure 4. Car window heat treated glass

Figure 5. Hardening influence to the mechanical properties. 1 – soft and ductile part without hardening, easily bendable; 2 – hardened part without tempering, really fragile and breaks already applying minor force; 3 – hardened and high temperature tempered, bendable only by applying bigger force; 4 – hardened and tempered with optimum tempering, bendable only slightly and when by applying big force

MACHINERY

INDUSTRY	Machinery	TECHNOLOGY GROUP	Engineering Design	SPECIFIC TECHNOLOGY	2.3. Engineering Design
INTRODUC-TION	The general objective of Engineering Design (as compared to Design) is to “make” mechanical systems perform as we expect. Good engineering design gives you objects, that are functional, reliable, safe and cost effective. If some product or thing around you often breaks, quickly wears off, badly rusts or fails in some other way or cannot due the job in normal use – this is usually due to bad engineering design.				
RELATED KEYWORDS, ABBREVIA-TIONS	Machine design, GrabCad, CAD, how things work, amazing robots, engineering design				
PROCESS DESCRIPTION	The engineering design process is a series of steps that guidesguide engineering teams as they solve problems. All possible aspects, that the product quality depends on, must be considered in detail. EngineeringThe engineering design process is mostly a teamwork. https://www.youtube.com/watch?v=bipTWWHya8A&index=23&list=PLyGJI5XXNa5SxyMYuFUWP4d0nx5DC6sgP Good engineering design is based on the understanding of how things work and, more imporatantlyimportantly, what may go wrong if not addressed properly. Engineering design heavily relies on engineering knowledge and experience. https://www.youtube.com/watch?v=EXP58ykBhEg Fascinating engineering designs https://www.youtube.com/watch?v=F9_m2xvwxpk Fascinating engineering designs https://www.youtube.com/watch?v=ZjzXWr1rhdQ Car engine design and operation principles explained https://www.youtube.com/watch?v=N7lWM_yDxU0 Door lock design and operation principles explained https://www.youtube.com/watch?v=WX8NG0275R4 Door handle design and operation principles explained https://www.youtube.com/watch?v=3MUL65-vZHY Watch movement design and operation principles explained https://www.youtube.com/watch?v=HMROEMSc-Kk Innovative technological solutions for car parking Engineering design is always a problemsolving.problem-solving. The first step of it is understanding the basic problem being addressed and its solution requirements. For example, shall the device be operated by a motor or manually, used indoors or outdoors, what perform-ance is expected, etc..? Any engineering problem can be solved in many ways. Next important step is data collection and solution ideas brainstorming. **“If you have just one idea for the solution, it is probably a bad one. If you have 100 ideas, there is probably one good among them”.** After that, the collected ideas must be evaluated with all known advantages and disadvantages considered. The most promessingpromis-ing one must be predicted for future development to the more detailed level. The best conceptual solution is then refined based on engineering calculations and testing in an iterative manner. The whole engineering design process is iterative, meaning that the steps above are repeated as many times as needed, making improvements as the amount of engineering data increases or by learning from failures.				
EQUIPMENT	**Meccano systems, LEGO sys-tems, robot building kits, mate-rials, workshop tools**	**SimpleThe simple basic 3D CAD software**		**3D printer + testing equipment**	
EQUIPMENT PRICE RANGE	a 100.- EUR + …			6000.- + 6000.-	

ECONOMIC FACTS AND DATA	https://www.ansys-blog.com/engineering-simulation-the-10x-multiplier-to-top-line-growth/
REFERENCE PICTURES	https://reader.paperc.com/books/Materials-Selection-in-Mechanical-Design/605626/Contents

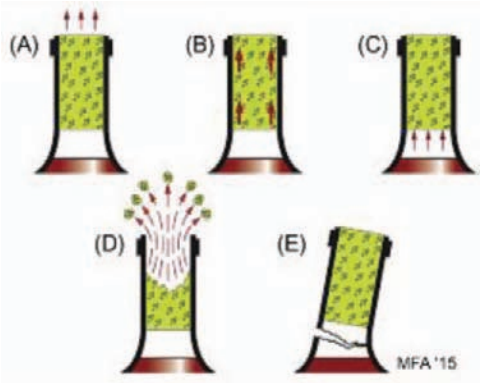


	Concept Design	Detailed Design	Prototyping	Evaluation	Production Ramp-Up
Cost/Resolution	1X	10X	100X		1000X
Innovation Impact	1000X	100X	10X		1X

It is vital in engineering design to realise the importance of the **procedure' first phases**, where the basic solution ideas are generated with minimum cost. It would be much more difficult and costly, if this wasn'twas not done properly and we have to change things atin the later stages of the engineering design procedure.

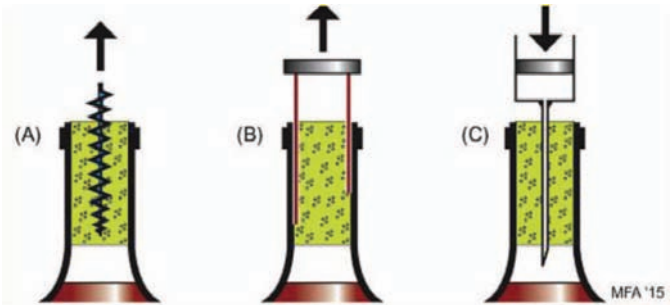
An example below of engineering design procedure from the need to final solution in order to illustrate the variety of engineering design options in all stages of product development.

Market need = engineering problem: " The liquid in the corked bottle must be effectively accessed".

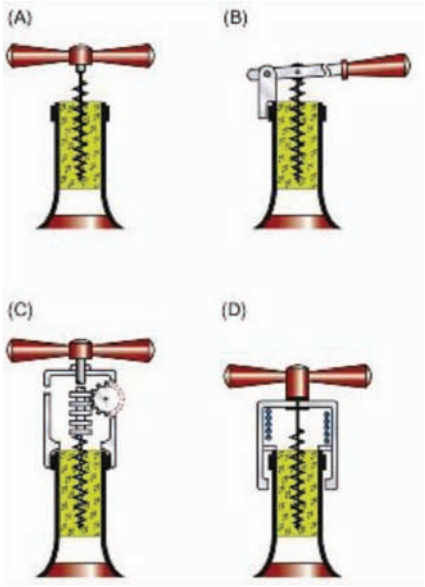


Five possible conceptual ideas, how it could be done, each having certain advantages and disadvantages.

(A): axial pull; (B): shear assisted pull; (C): pressure push from inside; (D): cork destruction; (E): bottle neckbottleneck removal.



There are technologies and tools available on the market in order to use the first three ideas. The last two ideas are considered obsolete due to prevailing disadvantages.



Four possible methods in order to use the first technology: axial pull.

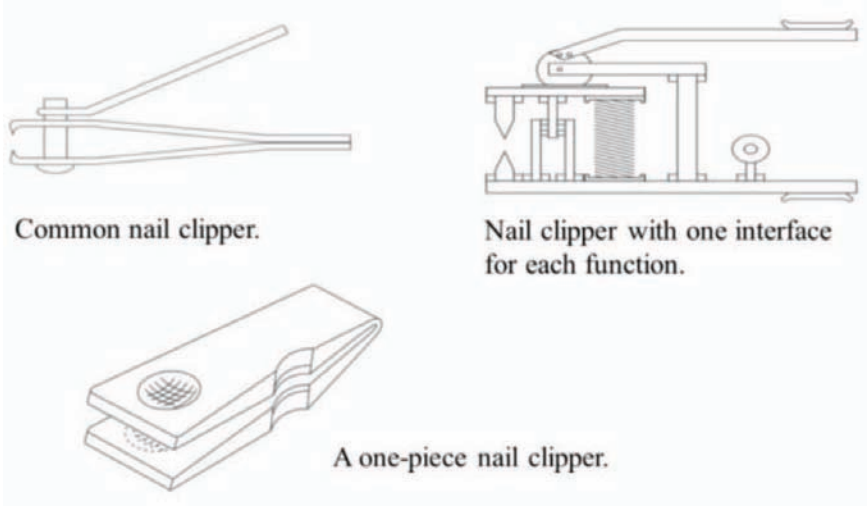
(A): direct pull; (B): lever assisted pull; (C) gear assisted pull;
(D) spring assisted pull

The final engineering design solution for method (B): lever assisted pull

Final engineering design solution for method (C): gear assisted pull

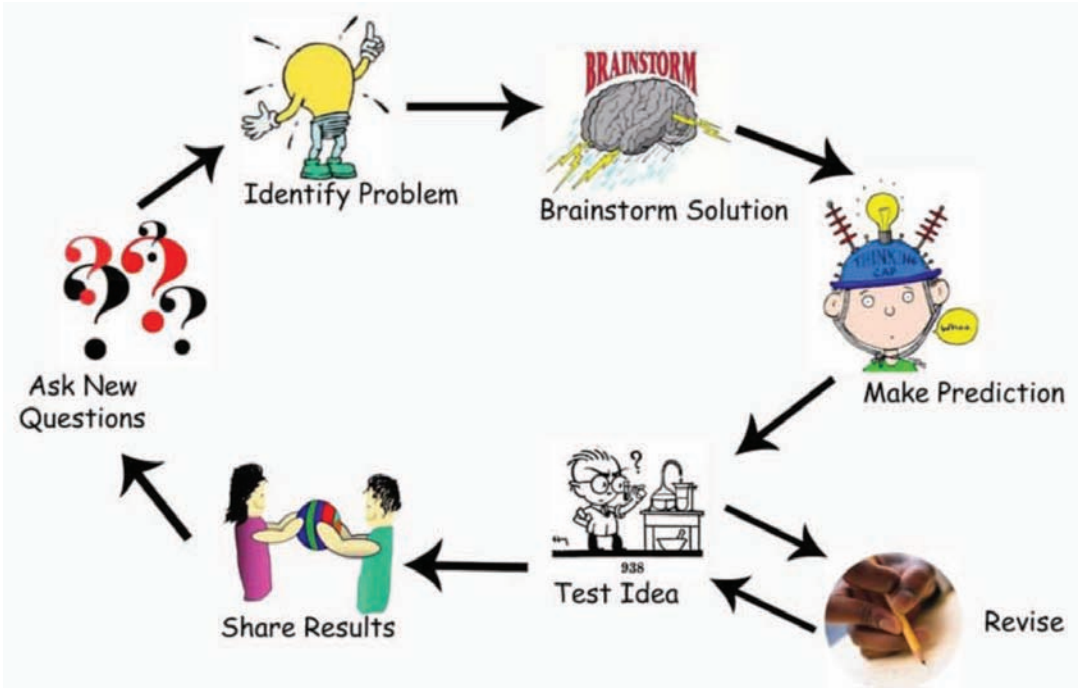
The final engineering design solution for method (D): spring assisted pull

http://www.omerohome.com/product/handcrafted-italian-spring-assisted-corkscrew-cow-horn

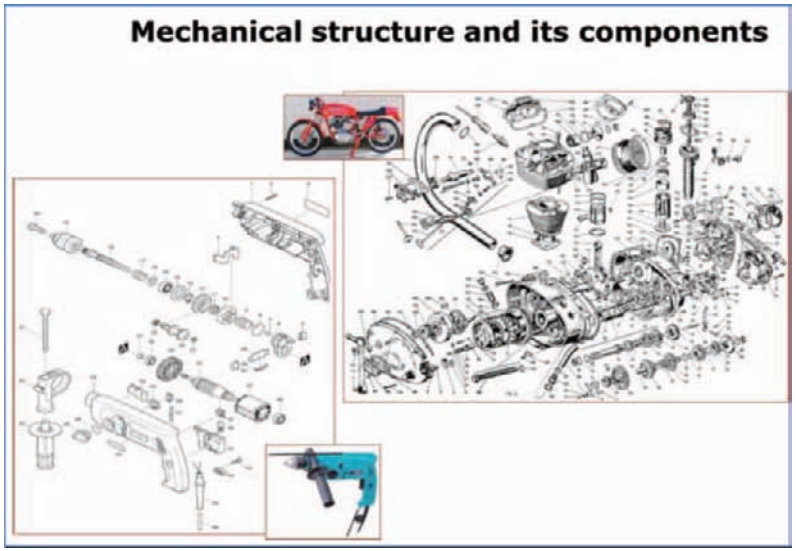


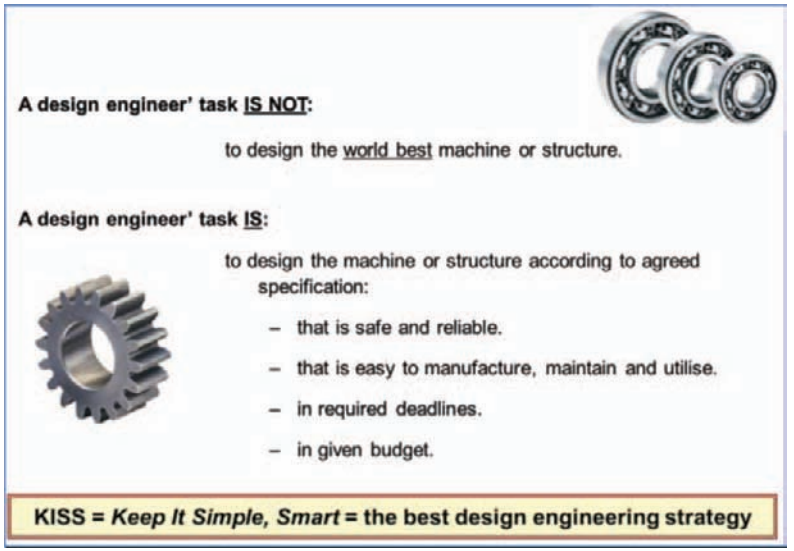
Different engineering solutions for nail clipper design

https://www.slideshare.net/illuminationgroup/ch-11-ull-man-the-mechanical-design-process-4th-edition-75691873



http://compscienceedu.blogspot.com.ee/2013/07/engineering-design-process.html Adequate engineering design process





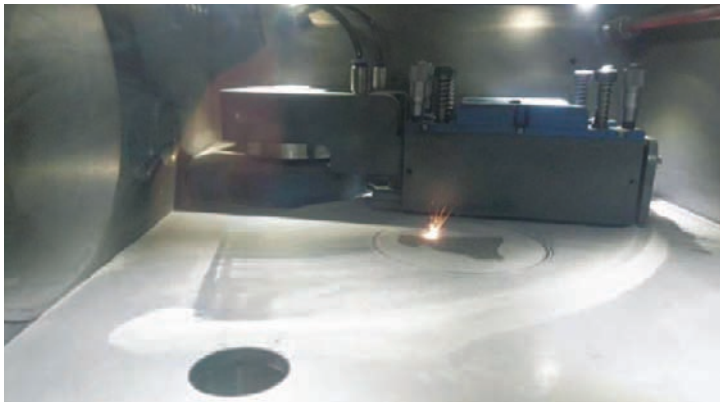
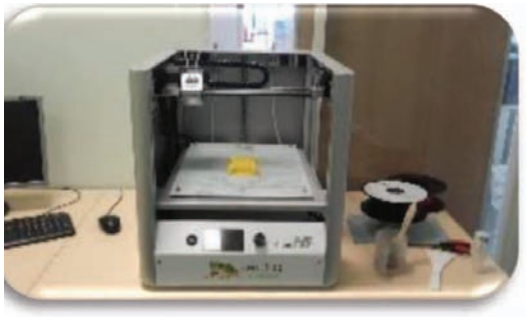
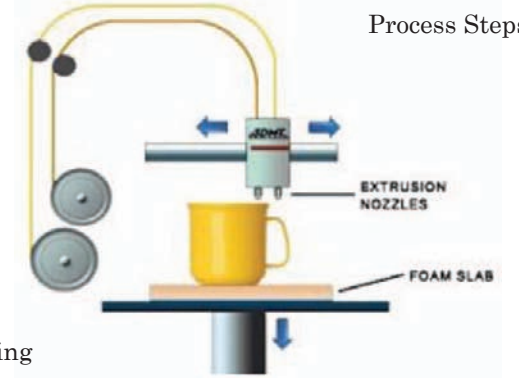
Broken laptop hinge (sign of bad engineering design) due to unadequateinadequate strength and durability

Corroded door (sign of bad engineering design) due to unadequateinadequate assessment of environmental conditions or wrong surface treatment

http://www.scooterresource.com Broken scooter wheel (sign of bad engineering design) due to poor material choice or poor loads assessment.

https://en.wikipedia.org/wiki/Tacoma_Narrows_Bridge_(1940) Collapse of Tacoma Narrows Bridge due to bad engineering design and poor engineering skills in order to provide the reliable design.

INDUSTRY	Machinery	TECHNOLOGY GROUP	Additive Manufacturing and Rapid Prototyping	SPECIFIC TECHNOLOGY	2.4. Rapid Prototyping
INTRODUCTION	3D Printing is the form of a formalised term additive manufacturing and uses in the rapid prototyping process. The 3D printing process is used to rapidly create a system or part representation before the final release or commercialisation. It highlights the fact to producing something quickly, and the output is a prototype or basis model from which further models and ultimately the final product will be derived. Initially, polymer (plastic) materials are utilised in 3D printing such as ABS, Starch (powder) and Resin. However, recently the material domain has extended, and today different metals and composites are used to form a shape (part). The additive manufacturing technology (3D printing) is relatively new regarding material development, feature sizes and faster throughput. Moreover, this technology leads to the cleaner production concept as it contributes to the reduction of production process wastes because of its layer by layer addition of material to produce a product rather the removal of material as in conventional machining process.				
RELATED KEYWORDS, ABBREVIATIONS	AM – Additive Manufacturing, RP – Rapid Prototyping, 3D – three dimensional, CAD/CAM (Computer Aided Design & Manufacturing), CAD (solid modelling) software, STL file format, SLA – Stereo Lithography, FDM – Fused deposition modelling, SLS – Selective laser sintering				
PROCESS DESCRIPTION	The 3D printing technique mainly works on the principle of SLA, FDM and SLS to produce a part or feature, consist of following steps: 1. **CAD Model** – A solid software model of the part that fully describes the external geometry. 2. **Conversion to STL file** – Convert the CAD model into STL file format to use in 3D printer equipment. 3. **STL file transfer and Manipulation** – STL file must be transferred into the 3D printer and do the necessary adjustment in size, position and orientation for the building. 4. **3D Printer (equipment) Setup** – Properly setting up of parameters for building process such as material constraints, energy source, layer thickness, timings. 5. **Building (forming)** – It is an automated process; only monitoring is needed to ensure no errors. 6. **Removal** – Once the printer has completed the building step, the part must be removed. 7. **Post Processing** – It may include the cleaning up of the part before it is ready to use. 3D printing mainly applied for creating prototypes, physical proof of concept, mock-ups, educational opportunities (health care also) and many more. https://www.youtube.com/watch?v=8z-iebHRxJk (3D printed home) https://www.youtube.com/watch?v=nk_8IcBVkRA (3D printed Beautiful Deer model) https://www.youtube.com/watch?v=fVg1rIT-J34 (3D printed coolest creations) https://www.youtube.com/watch?time_continue=119&v=31i6jFgeGY8 (3D Printed Illidan Stormrage – World of Warcraft) https://www.youtube.com/watch?v=5rrpQnnGC6E (Metal 3D Printing)				
EQUIPMENT:	**3D Printer (FDM – plastic filament)**	**3D Printer (SLA)**		**3D Printer (SLS and SHS)**	
EQUIPMENT PRICE RANGE	Depends on size (600–7000 EUR)	1500–6000 EUR		15 000–500 000 EUR or more	
ECONOMIC FACTS AND DATA	3D printing is one of the advanced manufacturing technology and considered to be future manufacturing in the digital world. R&D in this technology progressing incredibly along with the 4th industrial revolution. The technology of 3D printing starts with the small scale prototypes, size and speed limitation but today one can buy 3D-printed shoes, 3D printed jewellery, 3D printed pens, and even 3D printed vehicles spare parts. The automotive industry, aeroplane manufacturer use 3D printed parts in their industrial production. Even healthcare and life science industries influenced by 3D printing applications. It is also getting the hype at the school level and among secondary school students. In the global market, the economic impact is projected up to the hundreds of billion euros by the year 2025. Many start-ups companies open their businesses by providing 3D printing services, and they are also executed in the Baltic States.				

	Economic benefits of 3D Printing may include: It allows the new complex shape to be created, Business opportunity (shops) where anyone can get their design printed, prototypes can be fabricated easily without significant investment, Reduction of wastages regarding materials (plastic and metal) leftover [Madame Eureka 2012].  3D Metal Printing at TTÜ (http://bit.ly/2oqer2A)
REFERENCE PICTURES	  3D printers (Equipment)  Process Steps  3D printed parts  Processing

3D Printed Life-Sized Castle

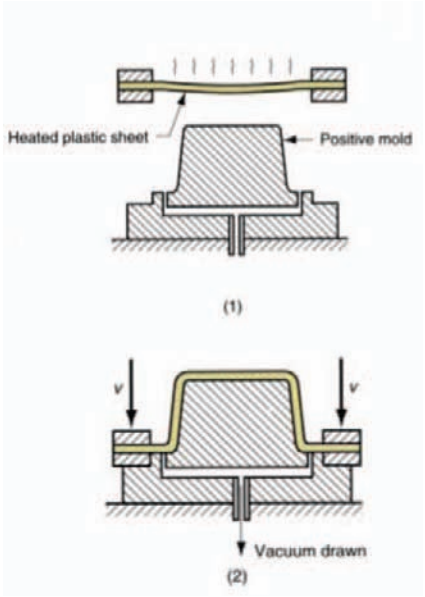
3D Printed Strati Car

3D Printed Lawn Mower

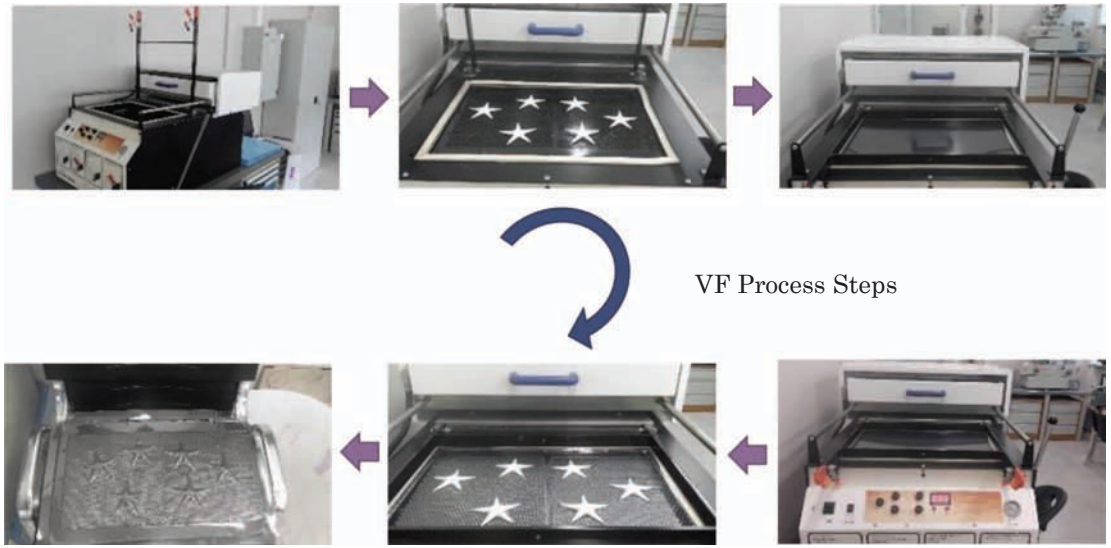
3D Printed Guitar

INDUSTRY	Machinery	TECHNOLOGY GROUP	Manufacturing Processes (Shaping or Moulding Process)	SPECIFIC TECHNOLOGY	2.5. Injection Moulding and Vacuum Forming (Plastic)
INTRODUCTION	The growing importance and applications of plastics during the last several years have increased at a much faster rate than metals. It leads to the commercial and technological importance of the shaping processes such as injection moulding and vacuum forming. The reasons behind the importance of plastic-shaping processes are not only technological but commercial also as everyone come across and uses plastics moulded products in daily life. These shaping techniques increase the variety of part geometries, cut-down the energy and handling efforts. Due to their broad applications, it is worth to know how those processes are carried out and can be further improved.				
RELATED KEYWORDS, ABBREVIATIONS	Heat, mechanical force, solidification, part geometry, metallic mould, thermoforming, thermoplastics, deformation, VF – Vacuum Forming.				
PROCESS DESCRIPTION	The main process steps are: product design, mould design and production process Injection Moulding: ▪ Feeding of plastic granular or powder into the injection moulding machine barrel via a hopper. ▪ Barrel consists of a screw and heaters that mix and melt the plastic into molten form. ▪ The screw also acts as a ram rapidly moves forward to inject molten plastic into the mould. ▪ Mould clamping forces are applied for a while to setting-up the shape of the moulded part. ▪ Cooling and removing of the moulded part. Vacuum Forming: ▪ Inserting of the mould into the vacuum forming machine. ▪ Placing and clamping of the plastic sheet. ▪ Heating of plastic sheet through the heater. ▪ Stretching of mould towards semi-melted (soften) plastic sheet via a lever. ▪ Creating of vacuum via vacuum pump to draw the sheet onto the mould and forming the part. ▪ Release, cooling and removing of the part. https://www.youtube.com/watch?v=ypxWHOtRG3g (Vacuum Forming Machine Process demo) https://www.youtube.com/watch?v=-tAhCtlF3uo (Vacuum Forming by using the home appliances) https://www.youtube.com/watch?v=b1U9W4iNDiQ (Injection Moulding Process Animation) https://www.youtube.com/watch?v=y1Zhpdx-XtA (LEGO production by injection moulding) https://www.youtube.com/watch?v=Ens_f2eSXYU (Injection moulding with 3D printed mould)				
EQUIPMENT	**Vacuum Forming Machine (Desktop)**	**Vacuum Forming Machine (Commercial)**		**Injection Moulding Machine**	
EQUIPMENT PRICE RANGE	2500–7000 EUR	5000–60000 EUR		8000–90000 EUR or more	
ECONOMIC FACTS AND DATA	All around the world, billions of goods are produced every year through those processes with huge turn-over to the plastic industry. Applications of vacuum forming are widespread in the consumer goods packaging such as confectionery (chocolate and candy) packaging, and food packaging. It is also used in the manufacturing of refrigerator interior, baths tub and shower tray, car interior, and children toys etc. The injection moulding process is more suitable for high volume production and use in the manufacturing of bottles, packaging, automotive parts and components, some musical instrument, small chair and tables.				

REFERENCE PICTURES



VF Process

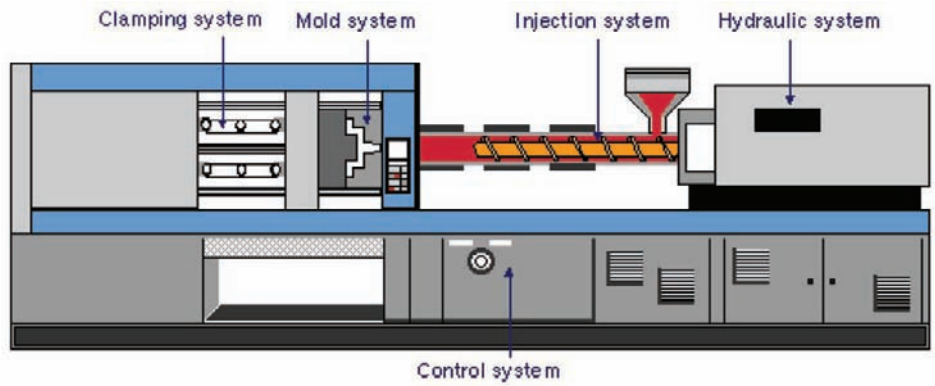


VF Process Steps

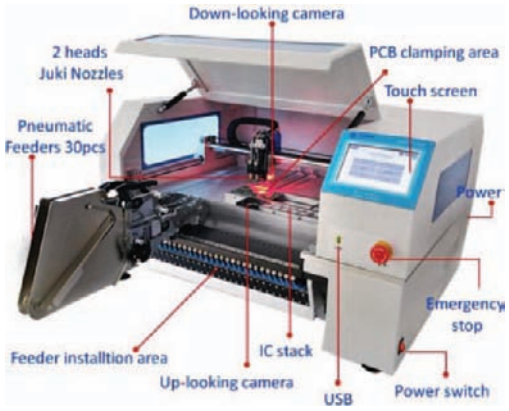
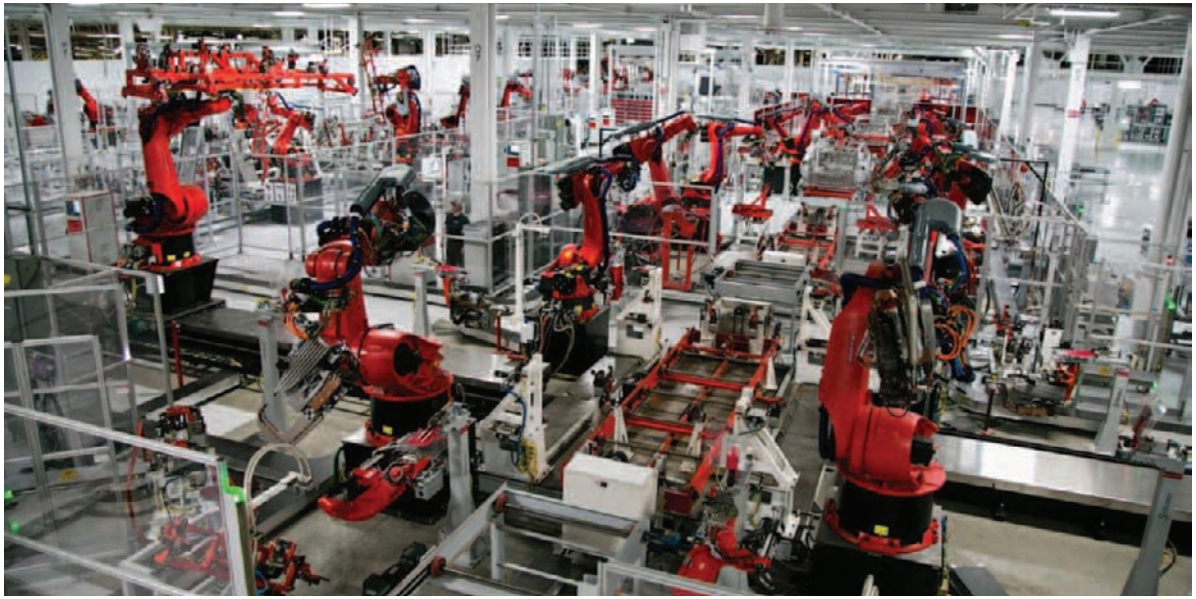
VF Equipment

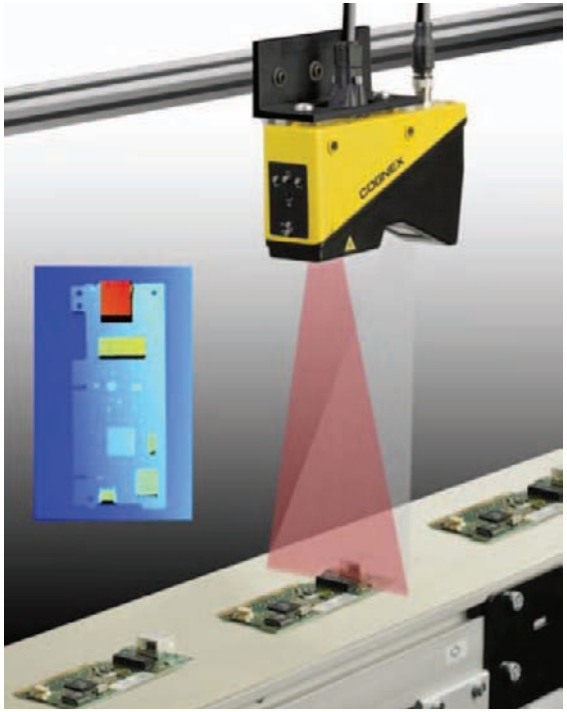
Different

Injection Moulding



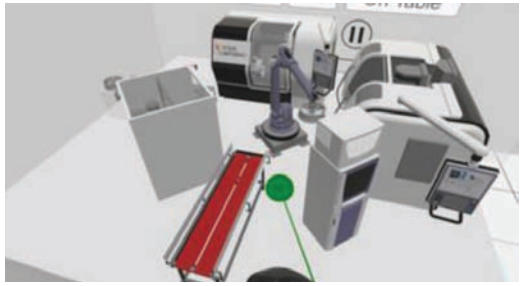
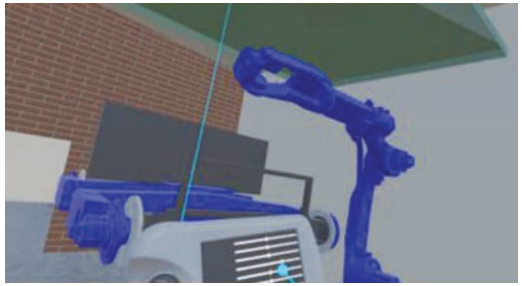
INDUSTRY	Machinery	TECHNOLOGY GROUP	Assembling	SPECIFIC TECHNOLOGY	2.6. Automated Assembling
INTRODUC-TION	**Automated assembly is a process where part feeding, detection, verification, orientation, mating, fixing and testing is done fully automatically. Sometimes human testing or packaging is run parallelly to ensure process quality.**				
RELATED KEYWORDS, ABBREVIA-TIONS	DFMA – Design for Manufactory and Assembly, DFAA: Design for Automated Assembly, SMT – Surface-mount Technology, VPM: Virtual Product Model, MV – Machine Vision, Robot Welding				
PROCESS DESCRIPTION	The Automated Assembly process mainly consists of the following steps: ▪ **Feed the parts** – depending on part size and shape different feed methods are used. ▪ **Detect the parts present in the pickup position** – confirm, that part is in the position. ▪ **Check the part** – Confirm, that part is genuine and suitable for assembly. ▪ **Orientate the part** – If needed, part is turned around, or pick-up system is informed to turn part around after pick-up. ▪ **Pick the part** – Grab the part and remove it from the feeder. ▪ **Mate the part in its position** – Put part on its position in the assembly. ▪ **Fasten the part** – one by one or all details together are fixed to the assembly. ▪ **Check the assembly** – Ensure that assembly is well-assembled and all parts are put incorrect positions. ▪ **Packaging** – if product or sub-assembly is transported to the other location. Automated assembly is mainly applied for mass production, but flexible production lines allow us to assembly also smaller series. https://www.youtube.com/watch?v=2_R8oYQh4Uo (mobile phone screen protector application) https://www.youtube.com/watch?v=GDNAy6qYIi4 (Fully automated motor assembly line) https://www.youtube.com/watch?v=8_lfxPI5ObM (assembling TESLA automobile) https://www.youtube.com/watch?v=pGqPjYALB50 (BMW X2 production) https://www.youtube.com/watch?v=BepAMlrJwXI (Pick and place introduction)				

EQUIPMENT	**Assembly station for small parts**	**Assembly line for bigger parts**	**Full factory with human assistance**
EQUIPMENT PRICE RANGE	Depends on size: 10 000–1 000 000 EUR	Depends on size: 100 000–10 000 000 EUR	Depends on size: up to 1 000 000 000 EUR
ECONOMIC FACTS AND DATA	Automated assembly gives us a perfect, exact and fast set of repeated actions to complete part handling, mating and inspection for final production process – assembly. By using automated assembly the process speed and quality is increasing remarkably, and cost of the assembly process is usually lower and predictable. Human work power is the weakest link because of health and mood variations. In case of automated assembly line, the reliability and continuous working are guaranteed by the wellorganized service plan. Pick and Place device for Printed Circuit Board assembly (fine electronics), details are put in their positions, but fastening (welding) took place in the different device.		
REFERENCE PICTURES	  Surface Mounting Device (SMD) with pick and place system  TESLA Car assembly		



JOT V4 assembly cell and visual assembly quality control by Cognex camera

INDUSTRY	Machinery	TECHNOLOGY GROUP	Digitalisation. VR/AR, Simulations	SPECIFIC TECHNOLOGY	2.7. Digital twin
INTRODUCTION	The concept of Digital Twin (DT) is creating and maintaining a digital representation of the real world of the factory and supporting its management and reconfiguration by means of optimisation and simulation tools, which are fed with real and updated factory data. This concept is not new as it was first used by NASA research in 1957 when the satellite Vanguard was sent into orbit. More than half a century later, recent advances in ICT are offering new opportunities to fully exploit the potential of the DT in the manufacturing field.				
RELATED KEYWORDS, ABBREVIATIONS	VR – Virtual Reality DT – Digital Twin AR – Augmented reality				
PROCESS DESCRIPTION	The digitalisation of existing manufacturing equipment and products in 3D CAD software. Transfer of digital models to the game engine platform Unity3D and enabling interactions in Virtual Reality. ▪ System architecture creation (draft) ▪ 3D models preparation ▪ Interaction enabling – scripting ▪ Integration				

	Some videos and tutorials: https://unity3d.com/learn/tutorials/s/interactive-tutorials https://unity3d.com/learn/tutorials/s/roll-ball-tutorial https://youtu.be/f8PRUE0ERO8		
EQUIPMENT	**Unity3D software**	**HTC Vive VR set**	**High-end PC**
EQUIPMENT PRICE RANGE	0–100 EUR per month	700–900 EUR	1000–2000 EUR
ECONOMIC FACTS AND DATA	Game engine base version is free. The main cost is hardware.		
REFERENCE PICTURES	http://ivar.ttu.ee/     		

REFLECTION/ CONSOLIDATION PHASE

PRODUCTS COST CALCULATIONS.

Questions like:

Is it worth to become an expert in this field?

What benefits can I get if enter to this industry?

Using product costs calculations in technology cards.

ECONOMICS FIELD

Based on analysis of results the most important Economics Field competencies are:

- Handling problem situations adequately and timely adopting necessary decisions.
- Evaluating the calculations of the cost of services, the necessary investments and workforce consumption.
- Development and management of projects.
- Using the necessary technical and normative documentation, carrying out applied and professional documents
- Defining of strategic objectives.
- Development of the most cost-effective technology solutions.
- Development and management of projects.

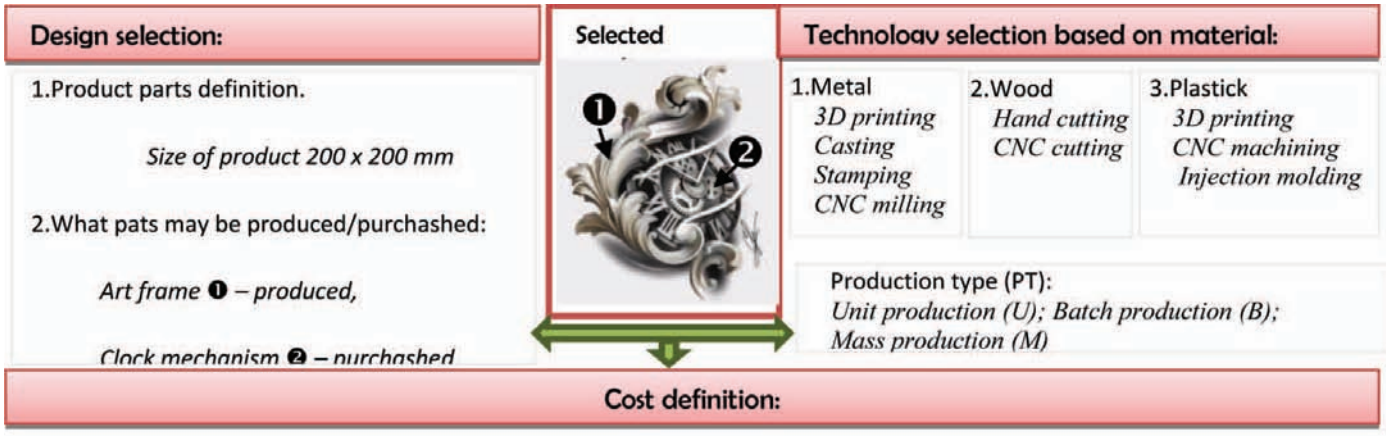
From the overall results table, it can be seen that EE enterprises are mostly consistent with suggested results (the most important competencies for EE also have the overall importance. The economy competencies that are important but were not included in the questioner are: defining of most cost-effective solutions, analyse the production processes by cost-intensive processes, connections between different functions and departments, ability to see the whole picture of Value Chain from Sales till Support processes, Risk analysis, control plans, process mapping.

In the metal industry, the number of items produced depend on the type of manufacturing; mass and batch production, serial production or project-based production. Instructor presents the metal and machinery technologies, which is followed by practical exercise and company visit.

Tasks for working with project material on the metal and machinery industry.

Professions in the sectors of metals and machinery	40 min. work in groups (2–3 Pupils)	Pupils learn about the profession in the metal and machinery field	Instuctor introduce the product to students. Student are working in groups. The task is to review the product, select the material for production, based on material select the manufacturing technology and after that to calculate the product unit cost.
Products from wood and companies	1 h min. work in pairs	Pupils prepare for a visit to a metal and machinery company or research lab.	Pupils participate in company or research lab visit and after that filling in the form "Self check of sensual impressions during a company visit". It is followed by discussion in the class

PRACTICAL WORK FOR SCHOOLS



METAL										
Material	Machining type	PT	Qnt	1 part material cost (1pcs/EUR)	Preparation time (hours)	Preparation cost (h/EUR)	Processing time (hours)	Processing cost (h/EUR)	Comments	1 pcs direct cost (EUR)
Copper	3D	U	1	200	3	20	4	50	Programming cost 60 EUR	460
Copper	Casting	B	6	23	1	0.5	0.5	10	Mould cost 1000 EUR	190
Copper	CNC machining	B	5	40	3,25	20	1	40	Programming cost 60 EUR + machine setup 5 EUR	141
Titanium	3D	U	1	200	3	20	4	50	Programming cost 60 EUR	460
	Casting	B								200
Stainless steel	CNC machining	B	5	10	3,25	20	1	40	Programming cost 60 EUR + machine setup 5 EUR	111
Stainless steel	3D	U	1	10	3	20	4	50	Programming cost 60 EUR	270
…										
WOOD										
Wood	Hand made	U	1				25	20		500
Wood	CNC machining	B			3				Programming cost 60 EUR	110
…										
PLASTIC										
Plastic	3D	U	1	5	3	20			Programming cost 60 EUR	42
Plastic	Stamping	M							Stamp cost 10 000	5

SELF CHECK OF SENSUAL IMPRESSIONS DURING A COMPANY VISIT

Sense	Attitude	Comments
Smell	Like Mostly like Mostly don't like Don't like	
Sound	Like Mostly like Mostly don't like Don't like	
Touch	Like Mostly like Mostly don't like Don't like	
Visual	Like Mostly like Mostly don't like Don't like	
Temperature	Like Mostly like Mostly don't like Don't like	
Wet	Like Mostly like Mostly don't like Don't like	
Dust	Like Mostly like Mostly don't like Don't like	
Safety	Like Mostly like Mostly don't like Don't like	

Staff attitude	Like Mostly like Mostly don't like Don't like	

At the end of reflection phase counselor ask students to answer to questions
Do You want to participate in paid works in this industry?
Do You want to participate in summer works in this industry?
Do You want to participate in voluntary works in this industry?
Do You want to visit this or another company in this industry?
Do You have a plan after school graduation?

- Yes, I know what I'll do
- I have to decide between two choices
- I have a several choices
- I don't know
- I did not think about that

WOODWORKING AND FORESTRY SECTOR OF THE INDUSTRY

EVOCATION/ANTICIPATION PHASE

At the beginning of group counseling session counselor collect students answers to questions:

Did You know about Wood working and Forestry sectors of industry from

- media (newspapers, magazines, TV, radio)
- internet (social networks, youtube, …)
- industry company web page
- family members
- friends
- neighbours
- other

Did You participate in paid works in this industry?
Did You participate in summer works in this industry?
Did You participate in voluntary works in this industry?
Did You visit a company in this industry?
Do You have a plan after school graduation?

- Yes, I know what I'll do
- I have to decide between two choices
- I have several choices
- I don't know
- I did not think about that

Presentations of the companies design of the products, technologies and economics. Pictures of real products of nearby companies.

Founded in 1999, 1021 employees, JSC “Latvijas valsts meži” (LVM) “Latvia’s State Forests” pursue state interests in forestry by sustaining and increasing the forest value, while gaining maximum possible value from forest management. One of Baltics’ leaders in efficient and innovative forestry

Recreation. One hundred fifty thousand visitors per year. Hunting services (in hunting sections) Park management (Tērvete and Pokaiņi). Licensed fishing services (Kaņieris, Lielauce, Gulbju lakes and Tērvete Reservoir). Lodging services, conferences, seminars (TRC Ezernieki and Spāre). Wood-carving workshop services

Questions like: How it is made? Where this company located? How to reach a company? Is it produced by hand made or advanced technology? What materials needed for the product? Where can it be used? What should I be able to do for producing such product?

COMPREHENSION/THE BUILDING KNOWLEDGE PHASE

Company visits. To think about content and information what we need to find out in time of this visit; where in this company we can see the process of technology, design, economics; to think about potential tasks what will be included in other subjects at school.

Questions like: Where in the company I can see this technology? Who in the company can answer my questions? How can I collect all the necessary information to find an answers? Is it possible to make it better?

Before company, visit counselor invites students to select a product which is produced in the company and introduce students with technology how the product is made. Students introduce with technology cards and prepare questions for company staff to get more information about technology

Operational Planning of Felling Area. Final cutting **15 108 ha** per year. Commercial thinning 16 134 ha per year

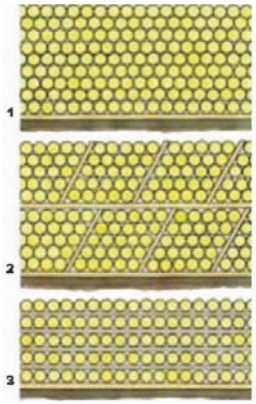
Forest Tree Plant Production

LVM Real Estate. On average 184 thousand m^3 of gravel and 374 thousand m^3 of sand are sold.

FORESTRY

INDUSTRY	Forestry	TECHNOLOGY GROUP	Arboriculture	SPECIFIC TECHNOLOGY:	3.1. Reforestation
INTRODUCTION	Forest regeneration decisions are made by the forest planner before the development of the felling area, and by re-surveying the felling area after development, and assessing whether there has been a change, for example, the birch is much transported (absorbing much water). The forest typology is assessed, and a decision is taken to restore the forest (natural/mechanical).				
RELATED KEYWORDS, ABBREVIATIONS	Skidder – a heavy-duty vehicle used in the forestry process to pull out trees out of the forest, called "rails", in which logs are transported from cutting to loading; GPS – Global Positioning System; Typology – local classification of forest ecosystems. I tumbled mung agglomeration of wood. Forest soil preparation is carried out mechanically by removing the ground vegetation to ensure that the tree plants grow better in the ground. Mechanical processing takes place in two ways – with the help of a heavy cutter, also known as a disk plow. The cutter is powered by a special forestry tractor – a skidder. Alternatively, with the help of a digger, you can create micro elevations – high (wet soil). Additional technology also reads the landing GPS data for planners. The maintenance of a young forest is divided into agrotechnical care; it is up to 3 years old, and composition care for 15–20 years of age. The essence of agrotechnical care is lawn mowing, allowing the plants to grow above the grass. Separate a row around the plants, seamlessly. The service price is around 100,- EUR/ha. A person manages about 0.6 ha a day – very hard physical work. Composition care takes care of the most useful felling composition when reaching the cutting age. Depending on the height of trees, there is a standard for one tree density (number of trees) of 1 ha. On average, the number of trees should be reduced by half the number of trees to be planted. In the process of rarefaction, it is evaluated, which trees to leave. The price of the service is about 100,- EUR/ha – very hard physical work. In the coming years, high-speed cared care with special equipment could be introduced. There is not yet Latvia. Pruning In the 7th year, trees are mechanically pruned to produce wood without branches. It is difficult to predict demand for 50–70 years, the pruning of trees is limited to 500 trees per ha. Protection against damage. Different chemical materials are used for protection of trees against insects, mutton, gnats and trout. Ferramon traps – Chives for insects.				
EQUIPMENT:	**Skidder**	**Disk Plow**		**Tree planting bar**	
EQUIPMENT PRICE RANGE					
ECONOMIC FACTS AND DATA	The price of the service is approximately 110,- EUR/ha with Skider and 450,- EUR/ha with excavator. Tree planting is mainly done by hand using Tree planting bar. Service price 98,- EUR/ha. One person per day set an average of 0,3–0,5 ha of forest. This is hard work, when planting spruce between rows should leave 2 meters, between plants of 1.6 mercy. In rare cases, a special excavator with a planting head is used instead of a cup (not in Latvia).				
REFERENCE PICTURES	    				

INDUSTRY	Forestry	TECHNOLOGY GROUP	Logging	SPECIFIC TECHNOLOGY	3.2. Trees cutting
INTRODUCTION	The beginning of tree felling is planning, which is led by the logging master and the sales department, which has been preparing and giving a job to the Work Manager for the area, boundaries, assortment of felling area already a year ago.				
RELATED KEYWORDS, ABBREVIATIONS	A **harvester** is a type of heavy forestry vehicle employed in cut-to-length logging operations for felling, delimbing and bucking trees. A forest harvester is typically employed together with a forwarder that hauls the logs to a roadside landing. **Felling head** – typical harvester head consists of: chain saw, curved delimbing knives, feed rollers, diameter sensors, measuring wheel. Trees are sawn, pruned and grazed using a high-powered forest machine – Harvester. When starting the felling works, the Harvester operator receives the file FILE.APT, which indicates the assortment of specifications: species, length, diameter and quality requirements. The operator enters the felling area, drives the jacket with a joystick and grasps the tree with a cutting head and introduces the tree species to your computer. The rest is done by the forest machine automatically: cut, cut and girth the tree according to the entered APT file. The operator's task is to follow the assortment of quality requirements and to manually stop the process if a non-standard situation is followed – wood twist, truppe or dry matter and other cases.				
EQUIPMENT	**Harvester**	**Felling head**			
EQUIPMENT PRICE RANGE	300.000,-	100.000,-			
ECONOMIC FACTS AND DATA	The price of harvester averages 300,000,- EUR, cutting head costs 100,000,- EUR, service price is calculated from felling area, 6–8 EUR/m^3. The machine is operated 24 hours a day, with three operators working on it. During the day, cut and gobble from 150–250 m^3 of a different assortment of wood. Operators earn from 1 to 1.5 euros per m^3, depending on the amount of work, the average salary can range from 1000 to 2000 per month net, on hand. Usually starting a career as a Forwarding Operator, after 3–4 years, switch to Harvester Management.				
REFERENCE PICTURES	 				

INDUSTRY	Forestry	TECHNOLOGY GROUP	Logging	SPECIFIC TECHNOLOGY	3.3. Assortment stacking
INTRODUCTION	The selection of the assortment begins with the felling planning; the logging master determines the stacking area (4 m^3 = 1 meter) and the optimal location. On the other hand, based on the task, Harvester's operator slips logs or branches into a technological corridor, or twigs, to later turn them into chips, or to make them easier to collect.				
RELATED KEYWORDS, ABBREVIATIONS	Forwarder – a forestry vehicle that transports logs and moves on the road; Manipulator; a stack of long timber (trunks, half bumps and long assortment); Cracking – Taking timber in different types of stairways and slopes. Stacking timber in different types of stairways and slopes. The assortment is delivered and stacked after the delivery of the forest assortment with the assistance of a forwarder. The Forwarder's operator drives with the technique and, with the help of a manipulator, puts the assortment on the pillars and takes it to the place of loading and unloads. The stacking of the assortment is carried out by the work order in the assortment (7–9 main assortment types). The forwarder's operator marks the group of assortments (assortment, customer) with leaflets. Both Harvester and Forvarder's computer records the amount of development and sends data to planners. Forwarder data is used to track the stock of wood assortment in shavings. Felling residues are not developed in all cases. If the conditions are favourable, the removal does not exceed 700–400 meters, the branches are individually stacked, arranging tree felling so that the branches form piles. The remnant of the felling area is measured in MWh (megawatt hours), evaluating quality, humidity, etc. factors.				
EQUIPMENT	**Forwarder**				
EQUIPMENT PRICE RANGE	150.000,-				
ECONOMIC FACTS AND DATA	Forwarder's price is an average of 150,000,- EUR. Service price 4–6 EUR/m^3, the operator's profit from development is from 0.7 to 1 EUR per m^3. For one forwarder there are 2–3 people. During the day, 100 to 150 m^3 are exported.				
REFERENCE PICTURES	  				

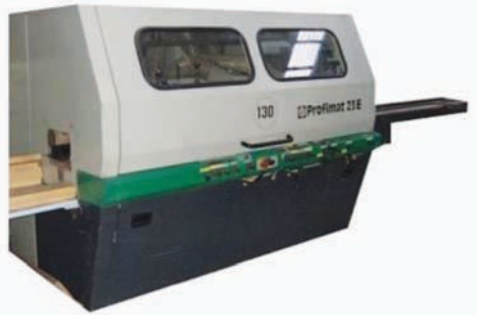
INDUSTRY	Forestry	TECHNOLOGY GROUP	Logging	SPECIFIC TECHNOLOGY	3.4. Timber logistics
INTRODUC-TION	The main technological processes are assortment loading, assortment transportation and assortment unloading at the customer.				
RELATED KEYWORDS, ABBREVIA-TIONS	Forwarder – a forestry vehicle that transports logs and moves on the road; Manipulator; Stacking timber in different types of stairways and slopes. Dryland forest edaphic row, which combines the types of forest growing conditions in well-aerated mineral plants; Tumbled mung agglomeration of wood. Transportation. Forwarder data is the basis for the logistics department to know and plan the assortment balances and their transportation to the customer. The logistics department plans routes for timber workers and sends a job assignment via e-mail. The chef's operator finds the relevant assortment, loads in compliance with the safety requirements, assesses the amount of wood and sends the data to the department, prints the bill of lading and sends the assortment of wood to the client according to the received route. Unload and return the bill of lading to the client by the instructions. Timber assessment. Different standard methods are used to measure the wood assortment, based on the species, diameter and length of the wood. There are several methods for assessing the assortment, for example, a group method that is more commonly used for firewood, pulpwood, bulk or individual, each tree separately. Independent certified valuation companies (SIA LVF) are used to evaluate the assortment, in large companies (RSEZ Ltd. Verems, AS Gaujas Koks, etc.). The equipment is used for measuring – a measuring line, which determines the wood quantity in cubic meters and the quality requirements of another customer (screw, twist, the height of branches, frequency, the diameter of billets, crumbles, stains, chips, etc.) every 10 cm by scanning wood diameter. Particular attention is paid to insects, which often deny the quality of wood.				
EQUIPMENT:	**Log carrier vehicle**	**Timber assesment authomatic line.**			
EQUIPMENT PRICE RANGE	200.000,-	1.500.000,-			
ECONOMIC FACTS AND DATA	The price of the car is approximately 200,000, – the service price is 5 EUR/m^3, the operator receives approximately 1200,- EUR per hand, the net salary per month				
REFERENCE PICTURES	 Log carrier				

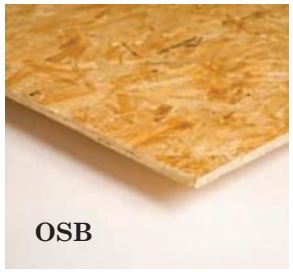
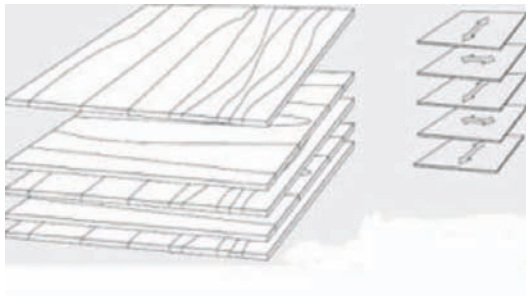
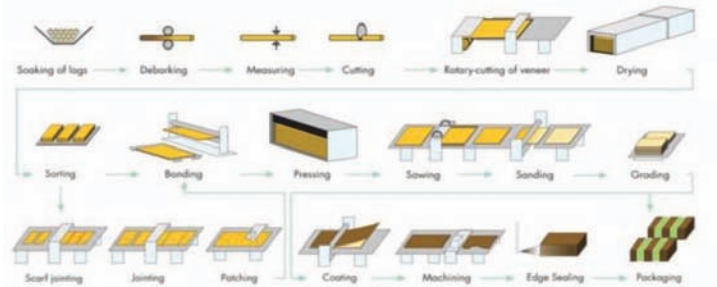
Populārākie sortimentu veidi dalījumā pa koku sugām prioritārā secībā

Priede	A klases zāģbaļķis	zāģbaļķis	sīkbaļķis	papīrmalka	malka
Egle		zāģbaļķis	sīkbaļķis		
Bērzs	elites (A klases) finierklucis	B klases finierklucis	taras klucis	papīrmalka	malka
Apse, melnalksnis u.c. lapu koki		zāģbaļķis	taras klucis		malka

WOODWORKING

INDUSTRY	Woodworking	TECHNOLOGY GROUP	Lumber production	SPECIFIC TECHNOLOGY:	3.5. Lumber
INTRODUCTION	Sawn timber is produced from the relevant timber assortment (wood species, log length, diameter and quality requirements, for example, the number of branches per meter, etc.), which are prepared by felling the forests and evaluated accordingly in the company. Next, the round logs are placed on a ramp, where they fall on rectangular beams or planks when they reach the corresponding saws. The adjacent product of this process is peel, sawdust, and perennials.				
RELATED KEYWORDS, ABBREVIATIONS	Ramp – Outsides –; Brushes – Timber, of a thickness and width of 100 mm or more, are made of logs or glued boards. They are used in house building, furniture industry, packaging industry, etc. ; Multi-saw – a saw that is specially designed to cut parallel to the length of the tree; Band saw – it's a long saw blade that consists of a continuous metal band of a tooth stretched between two or more wheels to cut the material. Sawing is carried out in a sawmill with circular saws (large saws) or Bandsaws (horizontal or vertical). The moisture content of the sawn material is 30 % when the lumber material changes, it dries, shrinks deforms and cracks. Under the influence of the environment, the material so to say – "breathes", becomes wetter or swells and deforms. The deformation takes place on wooden fibres that are circular, trying to straighten. This lumbering property limits the use of wood as a material for the manufacture of precision parts and also in high-quality interiors. A special problem can be the branches that can render it to fall (especially to the spruce), or bend. Branch place is hard and does not work; it can be torn off. Consequently, the lumber is dried and glued to reduce the strength of the internal wood and the tendency to deform and to avoid the branches. Long-standing saw timber is "dead" (about 5 years) and deforms much less. After obtaining lumber, they must be dried to a certain humidity, depending on their further application, for the joinery 8–12%, for construction 18%. The humidity is determined by a special meter. Sawn timber is dried in special drying rooms – in hangars. In domestic conditions, it can dry under natural conditions in a barn or under sheds (2–3 months).				
EQUIPMENT	**Multi saw**	**Bandsaw**	**Drying equipment**	**Moisture meter**	
EQUIPMENT PRICE RANGE	6.000–100.000 EUR	4.000–80.000 EUR	50 m^3 aprox. 100.000 EUR		
ECONOMIC FACTS AND DATA	Service price to staff team: 10–20 EUR/m^3 Lumber costs: 50–150–1000 EUR/m^3 From 1 m^3 of logs is produced 0.4–0.55 m^3 of lumber Salary: 460–560 per month Production equipment line approximate price – high volume 1.000.000–5.000.000 EUR Bandsaws saws made in Latvia – http://www.tehnika.lv/lat/prod.htm Impregnation of sawn timber depending on the processing specification starting from 17 EUR/m^3 Drying of sawn timber from 15 EUR/m^3 Lumber planning services starting from 10 EUR/m^3				
REFERENCE PICTURES	 Lumber production	 Daudzzāģis	 Lentzāģis		

INDUSTRY	Woodworking	TECHNOLOGY GROUP	Lumber Processing	SPECIFIC TECHNOLOGY	3.6. Profile materials
INTRODUC-TION	To further use the obtained lumber for the production of the finished product, for example, made furniture, building elements – stairs, shelves or decked floors, they must be processed. First of all, select and cut the size.				
RELATED KEYWORDS, ABBREVIA-TIONS	Grooves-joints, grooves; Slats – timber used to enclose the gap between floor and wall; Chariot – used for turning timber into various incisions; Production of profiled materials. Dry boards are treated from all sides by milling the joints grooves. The profiled materials are floorboards, terraced boards, cladding boards, flooring trims. The profiled material is produced on a four-sided planer, whereby a rotating knife produces a smooth, pleasant surface in the required size. If the material requires rounded edges or specific shapes, the so-called profile, it is obtained with the appropriate shape of the milling machine – the rotary knives of the required shape (the hammers can make any type of milling cutter) such as baroque skirting, window laths or door shaping elements. Also, joining sites, such as floor or cladding boards, are moulded. In turn, the turning parts are produced on the turning edges, where a rotating piece of wood is used to produce a cutter or forge to obtain the required shape and size, for example, stair racks or a simple broom shaft. To give the product a pleasant look, in the end, the material is sanded using home-made, sandpaper, which is applied to rotogravure or rotary instruments.				
EQUIPMENT	**Planer**	**Milling machine**	**Lathe**	**Jigsaw**	**Grinder**
EQUIPMENT PRICE RANGE:					
ECONOMIC FACTS AND DATA					
REFERENCE PICTURES	 Milling	 4 side planer	 Grinder		

INDUSTRY	Woodworking	TECHNOLOGY GROUP	Slab materials production	SPECIFIC TECHNOLOGY	3.7. Slab materials
INTRODUC-TION	There is a distinction between different types of board materials that are manufactured from lumber-related products or wood that can not be used in lumber production or pure wood. The slab materials have better durability, they do not deform and do not change their size and are relatively resistant to climatic conditions.				
RELATED KEYWORDS, ABBREVIA-TIONS	Faction – KSP – particle board, OSB-oriented particle board; Finierkluči (LV) – birch logs; Plywood board – A thin veneer sheet made of plywood Particle board production is mainly made up of coniferous and deciduous logs that can not be used in the production of lumber and also from the production of sawmill residues in sawdust, cuttings or chips, splitting the material up to a certain fraction. Further, the chips are dried and glued to obtain material of different sizes. A slab consisting of finely chopped wood particles (chips and wood dust divided by fractions – exterior fine fractions, a middle layer of coarse fractional wood particles), compressed together with glue. This yields particle board (CSP) or Oriented Particleboard (OSB). The latter are more resistant to higher loads. Plywood is mainly used for the production of birch logs or plywood, and as by-product chips are formed. From the beginning, the log is soaked, then the plywood is peeled off (the plywood is treated with hydrothermal treatment, and then the plywood tape is then dumped.) It is then dried continuously in sliding dryers, after which the veneer is glued by applying glue and pressed in a hot press. The resulting ply-wood top coats are laminated with different materials, colours and textures as needed.				
EQUIPMENT	**Chipping production machine**	**Drying machine**	**Glueing machine**	**Pressing machine**	
EQUIPMENT PRICE RANGE					
ECONOMIC FACTS AND DATA	service price not available Product price varies of quality and thickness and other dimensions of materials 2–6 EUR/m^2; 300–500 EUR/m^3				
REFERENCE PICTURES	 **OSB**  **KSP**  **Plywood**   **MDF** 				

INDUSTRY	Woodworking	TECHNOLOGY GROUP	Slab materials production / CNC processed	SPECIFIC TECHNOLOGY	3.8. Furniture production
INTRODUCTION	The resulting plate material is widely used in construction as a constructive element, for example, laying a floor covering, or a finishing material for walls and cut, or widely used in the manufacture of furniture, making tables, shelves, cabinets, etc. Furniture production combines the use of Precious woods				
RELATED KEYWORDS, ABBREVIATIONS	Spindle – Rotary heads; Natural or Precious woods – dried lumber; Reclaimed wood – old wooden parts refinished for furniture, MDF is a slab made of wood by-products of both hardwood and hardwood, glued together with wax and resin at high temperatures and pressures; these boards are more durable and denser than plywood; CNC – a tool runs by a computer; CAD – computer design programs; CAM – production process monitoring and control programs; 3D – three – dimensional object;				
PROCESS DESCRIPTION	Furniture production is divided into dried lumber, also known as Natural wood and Slab materials. For the production of wooden furniture, dry joinery lumber is used for pine, fir or hardwood (part, oak, birch). Laminated particle board and MDF slabs, less plywood, are used for the production of slab furniture. Wooden furniture is made from dry lumber, sawn in strips and glued shades, then cut them, cut in precise sizes and varnishes. The board furniture is made from laminated particle board, cutting it in precise sizes. The cutting of slabs takes place on a cutting board, but if the required shape is not straight line then milling. As a rule, flatbed milling machines are automated, which makes it easier to produce several identicals required copies. Automated equipment necessary to operate a computer and special programme, in a variety of controllers controlling the rotating head (flies), which strengthened various tools gaining the necessary forms. Sophisticated devices are also able to automatically replace the tool by performing several operations and significantly reducing the production cycle of one component. An automated device head can also be a laser cutting or engraving, water jet, knife, and the like.				

	CNC production is the process by which the material is used for the processing of a computer-controlled process which is widely used in metal processing, wood processing and other automated production processes. Its main elements are the coordinating table, the processing head, and the computer with the corresponding processing program. The necessary material appears on the coin table and attached. By coordinates, table caliper moves the processing head with necessary tools and guided by a computer program into the desired coordinate point (X.Y.Z.) with the cutting instrument parameters. To run such a port, you need the necessary part of the output file FILE.STL. Such files to develop special programs for vector graphics, where each point, line or shape has its koordinātnes (3D) three-dimensional. Such programs are called CAD programs (AutoCAD, CorelDRAW, Illustrator, etc.), they are a relatively expensive to license, but there is also a simple free alternative (Google Sketch-up). When the output file is available in the required format, which is a requirement of all individual facilities (there is a possibility the file or files to convert, but not always it happens accurately, without loss of data), the following may be necessary parts processing or production process modelling. This stage also happens computerised with CAM programs aid, making it possible to modify, set or change the various treatment processes, coordinates, processing settings or the order. Woodworking has a wide range of different CAM programs, most often provided by the machine manufacturer. Both processes are interconnected, so they are called CAD / CAM production.		
EQUIPMENT	**CNC milling table**	**CAD Programmes**	**Hand tools**
EQUIPMENT PRICE RANGE:	5000,-	Free – 10 000,-	100–5000,-
ECONOMIC FACTS AND DATA			
REFERENCE PICTURES	 **CNC miling table**	**Grīdas pārsedze**  **Frēze ar rotējošu galvu**	

INDUSTRY	Woodworking	TECHNOLOGY GROUP	Construction	SPECIFIC TECHNOLOGY	3.9. Construction
INTRODUCTION	Wood is traditional and ecological materials are widely used in the construction industry, from ancient times. As technology evolves, the use of wood is made easier by achieving faster, more high-value, more cost-effective construction.				
RELATED KEYWORDS, ABBREVIATIONS	Calibrated – planed; Brushes – Timber, with a thickness and width of 100 mm or more, are made of logs or glued boards; they are used in house building, furniture industry, packaging industry, etc .;				
PROCESS DESCRIPTION	**Log houses** are wooden houses, which are made from logs, which are selected in the woods straight, rough and the same diameter. Log houses are made from gravel or twisted logs, following the logging and joining of logs. There are a number of traditional types of tree joints, with the advent of new technologies, joining solutions improve. If the rolled logs are used, then a bulky lathe is required, which, with a special knife, will make the log round. With the help of a special cutter, the grooves of the log joints will be created. If a non-walled tree is used, then the logs are peeled with a horse or a special hand tool, cut by electric or chainsaw, a graph with a curved axe or grooved with hand tools. **Stationary buildings** are wooden houses, in which the tree is used mainly for construction (frame) construction and insulation of layers. Wooden panels are made from dried lumber, which is calibrated, grooved in length and glued together, combining heat insulation, various vapour compensating films and board materials. **Multi-storey modular homes.** In the world, wood is becoming increasingly recognised as a building material, especially popular in Scandinavia. The wooden houses have a particularly pleasant aura, air, which means that the tree is used as building material for the construction of multi-storey houses (currently the tallest building with 26 floors in Norway). The technology is similar to standing buildings; many storey houses consist of separate modules, which will strengthen each other building several storeys. **Glued beams** are glued together and used to glued high-conductivity busbars (beams), providing great overlaps by building sports halls, manufacturing complexes (verems) or cultural objects such as concert halls.				
EQUIPMENT					
EQUIPMENT PRICE RANGE:					
ECONOMIC FACTS AND DATA					
REFERENCE PICTURES	    				

REFLECTION/ CONSOLIDATION PHASE

PRODUCTS COST CALCULATIONS.

Questions like:

Is it worth to become an expert in this field?

What benefits can I get if enter to this industry?

USING PRODUCT COSTS CALCULATIONS IN TECHNOLOGY CARDS.

To calculate how many hectares of the forest should be worked out on average per month, to reimburse for new forest machinery – Harvesters, taking into account that the service with Harvesters at Latvian State Forest Auctions costs on average EUR 6 per cubic meter of wood. Harvesters' forest machinery prices and technical specifications can be found on the web or by contacting dealers (johndeere.com or ponse.com or others). Three people are working on a single unit of technology, with an average salary of 1500–2000 euros per month on hand (salary calculator to find out the employer taxes – www.vid.gov.lv). On average, one hectare of forest is 800 cubic meters of wood (LVM) and 400 private forests. Depreciation of the machine is 5 years, maintenance and maintenance costs (fuel, oil, running costs 0.1 euro per 1 cubic meter of wood).

TASKS FOR WORKING WITH PROJECT MATERIAL ON THE FOREST AND WOOD INDUSTRY

<table>
<tr><th>Lesson theme</th><th>Duration of the lesson and type</th><th>The aim of the lesson</th><th colspan="5">Activities and Tasks</th><th>References to the Material</th></tr>
<tr><td rowspan="5">Technology in forestry</td><td rowspan="5">20 min.
work in pairs</td><td rowspan="5">Pupils learn about the technologies used in the forestry sector</td><td>The teacher selects the photos of the project with the forestry technology, arranged them in a mixed order and numbered them. Pupils get a picture, a worksheet and fill it with the technology of the project material: summarise the key information about the technology according to the picture. Picture number</td><td>Name of Technology</td><td>Keywords describing technology</td><td>The result (final product)</td><td>Costs</td><td rowspan="5"></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Pupils arrange pictures and information in the order of technology.
Teacher and pupils discuss the results obtained: what technologies are used, what are their specifics, what result is obtained, what is the sequence of technological developments, and so on.
Recommendation. The next training phase could be a sequential transition to competencies and professions in these technologies (see Activity in the Forestry and Woodworking Industries). Or go to the topic of wood processing and production of wood products.</td></tr>
</table>

Professions in the sectors of forestry and woodworking	40 min. work in groups (4–5 Pupils)	Pupils learn about the profession in the forestry and woodworking sector	Pupils get acquainted with the presentation material on the forestry and woodworking sector and select information about professions. Using the information and web brochures to get the material, they prepare a collage of pictures, including key information about the professions, and present them. Teacher and pupils discuss types of occupations and key functions, emphasising the competencies required for each profession. Recommendation: If pupils have acquaintances or relatives working in one of these professions, their information about the profession can also be included in the presentation.	
Products from wood and companies	25–30 min. work in pairs	Pupils get to know woodworking products and their producers, companies in the neighbourhood and country. Pupils prepare for a visit to a woodworking company.	Option 1. Pupils receive the task in one column of the page to record their own selected five products (furniture, doors, floors, garden furniture, etc.), but opposite Latvian companies (preferable to choose geographically closer producers in Rezekne, Daugavpils etc.). If necessary, Internet resources can be used. The teacher and the pupils discuss the results obtained – what products and articles of wood are produced in which companies. Depending on the manufacturers and products you choose, you can analyse product types, designs, service costs. The conversation focuses on the wide and varied usability of wood in everyday life (Wood is ubiquitous. It produces furniture, floors, houses, roofs. Wood is sawn on boards or beams or used as particle board, laminate veneers and the like). Option 2. The teacher shows a collage of pictures on a computer with different products (products) from wood (furniture, decorative carvings, toys, etc.). Pupils choose five products, and the task is continued as option 1. During the conversation, the questions that will be answered during the company visit will crystallise. Recommendation. If a visit to a particular company is planned after the lesson, the teacher prepares pictures with the types of products that this company produces. In doing so, pupils will find out if other products are produced by other companies. The next lesson can be planned and conducted for professions in a woodworking company (by analogy in the Forestry and Woodworking sector).	
Forest management projection	40–50 min. work in groups (3–4 Pupils)	Pupils learn about forest management technologies and costs. Pupils project forest management by sequentially planning activities and calculating costs and benefits.		

SELF CHECK OF SENSUAL IMPRESSIONS DURING A COMPANY VISIT

Sense	Attitude	Comments
Smell	Like Mostly like Mostly don't like Don't like	
Sound	Like Mostly like Mostly don't like Don't like	
Touch	Like Mostly like Mostly don't like Don't like	
Visual	Like Mostly like Mostly don't like Don't like	
Temperature	Like Mostly like Mostly don't like Don't like	
Wet	Like Mostly like Mostly don't like Don't like	
Dust	Like Mostly like Mostly don't like Don't like	
Safety	Like Mostly like Mostly don't like Don't like	

Staff attitude	Like Mostly like Mostly don't like Don't like	

An the end of reflection phase counselor ask students to answer to questions

Do You want to participate in paid works in this industry?
Do You want to participate in summer works in this industry?
Do You want to participate in voluntary works in this industry?
Do You want to visit this or another company of this industry?
Do You have a future plan after school graduation?

- Yes, I know what I'll do
- I have to decide between two choices
- I have a several choices
- I don‘t know
- I did not think about that

REFERENCES

21st Century Skills for Students and Teachers. (2010). Honolulu: Kamehameha Schools, Research & Evaluation Division. Retrieved from http://www.ksbe.edu/_assets/spi/pdfs/21_century_skills_full.pdf

Boden, M. A. (2004). *The Creative Mind: Myths and Mechanisms*. London: Routledge.

Brooks, J. G., & Brooks, M. G. (1994). In search of understandings: *The case for constructivist classrooms*. Alexandria: Association for Supervision and Curriculum Develoment.

Collin, A. (2009). Multidisciplinary, interdisciplinary, and transdisciplinary collaboration: implications for vocational psychology. *International Journal for Educational and Vocational Guidance*, 9(2), 101–110.

Crawford, A., Saul, W., Mathews, S., & Makinster, J. (2005). *Teaching and Learning Strategies for the Thinking Classroom*. New York: International Debate Education Association. Retrieved from http://www.xaricidil.com/wp-content/uploads/2017/07/Teaching-learning-strategies-for-the-thinking-classroom.pdf.

David, L. (2015). Constructivism. Learning Theories. Retrieved from https://www.learning-theories.com/constructivism.html

Erasmus+ Strategic Partnership Project "Implementing Interdisciplinarity in Career Counselling" No.016-1-LV01-KA201-022681. (2017). Retrieved from http://www.rta.lv/uploads/source/projects/citi%20projekti/2017/Recommendations.pdf

Fleming, G. (2018). Introduction to Critical Thinking. Retrieved from https://www.thoughtco.com/introduction-to-critical-thinking-1857079

Karjeras izglītība skolā [Career Education at School]. (2010). Rīga: Valsts izglītības attīstības aģentūra, Retrieved from http://viaa.gov.lv/files/news/727/karjeras_izgliitiiba_skolaa_2010.pdf.

Kenneth, B. H. (2001). Career Education and Education Reform: Time for a Rebirth. *Phi Delta Kappan International*, 83(4), 327–331. Retrieved from http://journals.sagepub.com/doi/pdf/10.1177/003172170108300413

Marshall, N. (1999). The Students. Who are they and how do I reach them? *Reading and writing for critical thinking*, 5(3), 45–47.

Meredith, K. S., Steele, J. L., & Kikusova, S. (2001). Critical Issues: Democracy, Community, Self, Literacy, and the Value of Global Conversation. *Journal of Literacy Research*, 33(1), 169–202.

Rethinking Education: Investing in skills for better socio-economic outcomes. (2012). Strasbourg: European Comission. Retrieved from file:///C:/Users/user/Downloads/com669_en.pdf

Trilling & Fadel (2009). *21st Century Learning Skills*. San Francisco, CA: John Wiley & Sons.