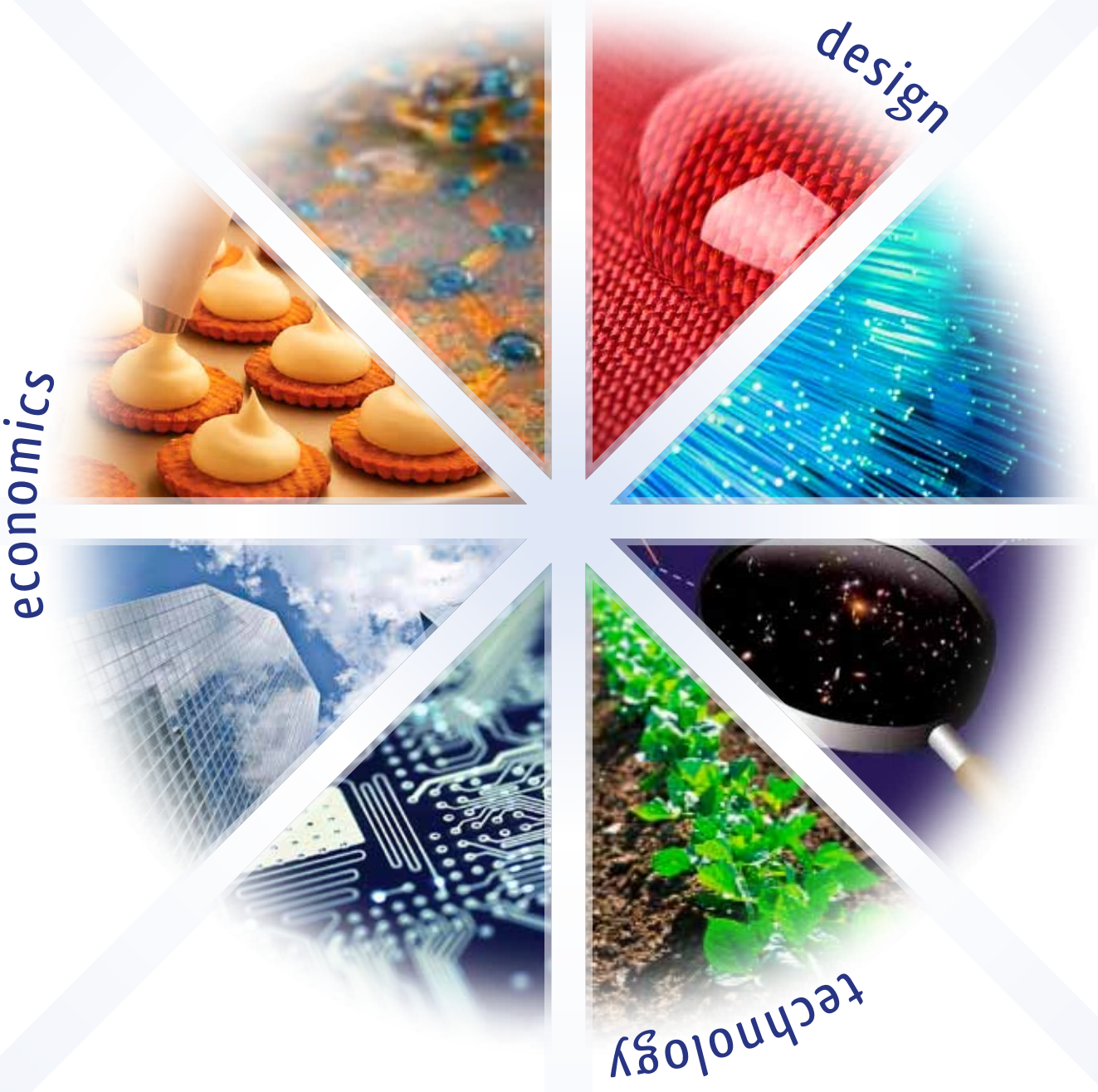
#Career Baltics

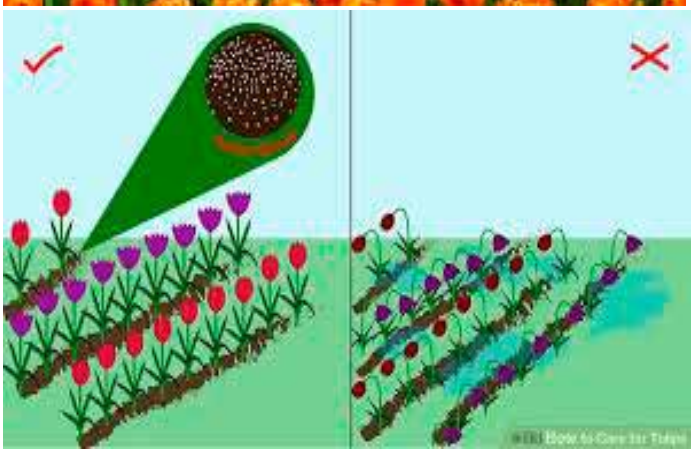


METHODOLOGY FOR NEW STUDY COURSE – IMPLEMENTING INTERDISCIPLINITY IN CAREER QUIDANCE

Content

Food processing and Agriculture

1. **INDUSTRY:**	Agriculture	**TECHNOLOGY GROUP:**	**Growing of flowers**	**SPECIFIC TECHNOLOGY**	1.1. Growing of tulips
INTRODUCTION:	Tulips are amongst the most popular flowers witha fascinating history. Although the Netherlands are recognised as the country with 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 KEY WORDS, 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 have 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€		15,00 € - 350,00 €		

ECONOMIC FACTS AND DATA	The usual market price of 1 flower is from 0,3 to 0,7 € depending on the season. The prices of the tulip bulbs is 0,08-0,2 € / 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
INTRODUCTION:	Apiculture and bee-keeping is one of the oldest crafts and sectors of the agriculture. It has avery 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 participates to the development of rural areas.				
RELATED KEY WORDS, ABBREVIATIONS:	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.				

<table>
<tr><td>PROCESS DESCRIPTION:</td><td colspan="3">Honeybees. Honeybees belong to the order Hymenoptera and to 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. Sometimes 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.

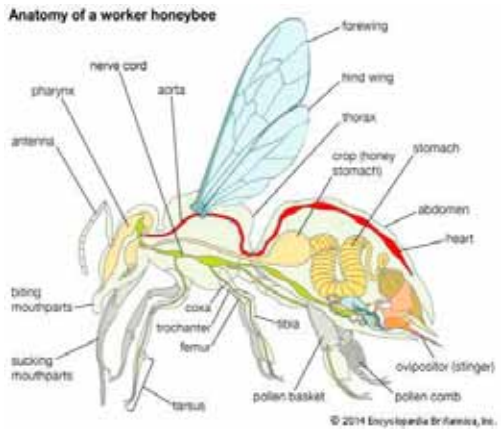
The bees maintain a uniform temperature of about 93 °F (34 °C) in the broodnest regardless of outside temperature. The colony can survive daily maximum temperatures of 120 °F (49 °C) if water is available with which they can air-condition the cluster. When the temperature falls below about 57 °F (14 °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 the 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</td></tr>
<tr><td>EQUIPMENT:</td><td>A hive</td><td>Tools for beekeping: a hive tool; the uncapping knife

Safety and protection measures: the smoker; a veil to protect the face; gloves</td><td>The extractor, for centrifuging the honey from the cells.</td></tr>
</table>

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. Beekeeping 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 beekeping. The price of the bee colony is around 70 €.The cost of wax plates (12-13) is 10 €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 €.** It is recommended to start beekeping from 3 colonies, therefor all the costs should be multiplied by 3 and added the cost of additional hive neded for unexpected cases, such as transfer or separation of the bee colony or accepting a new colony. In total, the beginning of beekeping should cost about 950 €. **Prices of products** The price of honey (1 liter) 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:**	**Gardenning**	**SPECIFIC TECHNOLOGY**	1.3. Grov

INTRODUCTION:	Blueberries are delicious and extremely high in antioxidants which is why it is regarded as a easy to grow provided you use an acidic or 'ericaceous' compost. Blueberries bring a unique cious fruit and striking, year round ornamental beauty to the garden and landscape.
RELATED KEY WORDS, 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 worked. It's best to locate your blueberry plants in an area where irrigation is readily availa be achieved by keeping the root zone moist throughout the growing season.Where the soi ally-drained, raised beds are an excellent option. Blueberries also do well in patio containe 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 inc into the planting medium. For planting directly in the ground, work up a planting area app diameter and 30 cm deep for each plant. Remove 1/3 to 1/2 of the soil. Add an equal amou peat moss and mix well. (One compressed bale will usually be sufficient for 4-5 plants.) For volumes peat moss with bark (not cedar or redwood), compost or planting mix. Talk to you They're 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 apart and grown individually. If planted in rows, allow 2,4 to 3 m between the rows depend for mowing or cultivating. **Planting. I**n most areas, it is ideal to plant in the fall or spring although in many regions you If you purchased containerized blueberry plants, remove from pot and lightly roughen up t of the root ball. Mound the plant's top soil about 1 cm higher than the existing ground and 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, organic matter. Bark O Mulch, acid compost, sawdust and grass clippings all work well. Rep Do not use bark or sawdust from cedar or redwood trees. **Pruning.** It's a good idea to allow blueberries to get established before allowing them to be with smaller plants, simply remove most of the flower blooms as they appear. In future yea should be heavily pruned each year to avoid over-fruiting which results in small fruit or poo In our three decades of experience at Fall Creek, we know that one of the biggest mistakes with their blueberries is lack of pruning. We assure you that aggressive, annual pruning wil 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 colored lateral branches. Cut out any short, discolor Continue pruning until you have removed 1/3 to 1/2 of the wood out of your plants each ye promote growth and berry production so prune away! **Fertilizing.** Once established, blueberries like acid fertilizers such as rhododendron or azal your local garden center for recommendations.) Take care when fertilizing, since blueberrie over-fertilization. Follow label instructions.
EQUIPMENT:	**Garden tools: trowels, weeders, showels** / **Watering equipment: pumps, h**
EQUIPMENT PRICE RANGE	5,00 € - 25€ / 15,00 € - 350,00 €
ECONOMIC FACTS AND DATA	The prices of the blueberry plant range from 4,00 EUR to 12,00 EUR per plant depending on 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

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:**		1.4. Greenhouse horticulture

INTRODUCTION:	*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 KEY WORDS, ABBREVIATIONS:	A greenhouse - a transparent or partially transparent material supported by a structure to enclose an area for propagating or growing plants.	
PROCESS DESCRIPTION:	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.	
EQUIPMENT:	**Greenhouse structure and covering**	**Evaporative cooling systems**
EQUIPMENT PRICE RANGE	2000,00€-250000,00€	1500,00€ - 150000,00€

ECONOMIC FACTS AND DATA	Greenhouse farming as professional family business can be developed in the land area from 0,5 ha. 0,15– 1,1 € – the price of 1kg of cucumbers. 12–14 kg – the yield of cucumbers from 1 m^2. It is 3 times lower than in the Netherlands. 80 t – average volume of pickled cucumbers per one season. 85thousands units – the number of cucumber seedlings planted in 1 ha. 100 m^3 – the volume of wood needed to equip 1 ha of greenhouse. 5–6 years – service duration of wooden greenhouse. 25 volumes – the average volume of plastic foil for covering of greenhouse per 1 year.

REFERENCE PICTURES	   

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=8FI0RTQinno 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

INDUSTRY:	Food processing	**TECHNOLOGY GROUP:**		**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 the curd cheese products which also includes different dessert products, such as glazed curd cheeses.				
RELATED KEY WORDS, 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 pasteurized 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 (molds for blue cheeses, etc.) are introduced before the desired aging finishes the cheese. The remaining liquid, which contains only whey proteins, is the whey. 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 machine.
EQUIPMENT PRICE RANGE	80000,00 – 200000,00 €	600000€- 1200000€
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 the all dairies of Lithuania reach 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 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=-G0Ulu84nnY 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.szes-la.cz/stat/projekty/erasmus/vystupy/cz_08_list02_quark.pdf http://dairyprocessinghandbook.com/chapter/cheese

INDUSTRY:	**Food processing**	**TECHNOLOGY** **GROUP:**	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 3 days.		
RELATED KEY WORDS, 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 case of traditional home-made baking, the starter is used to leaven black rye bread. 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 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 bread an agreeable, pleasant sour taste. Every starter has its own particular taste. Some homemakers add sour milk in place of water. To make dough, the water is heated to 40-45C, 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 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 preheated oven at 200C, 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, iodized salt, caraway seeds. The above described processes of preparation of dough is 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 dough**		**Industrial ovens and packing lines**
EQUIPMENT PRICE RANGE	Home -made baking: 50,00 €-150,00€ Industrial: 80000,00 – 200000,00 €		300000,00€ - 1500000,00€

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 increase of demand of 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**
1	Flour	0,15	0,29
2	Caraway seeds	0,03	1,16
3	Water	0,35	
	Dough		**Raw materials 1 kg/EUR**
1	Mix "Promyk"	2	1,45
2	Water	1,1	
3	Liquid malt	0,1	1,16
4	Starter	0,5	
5	Salt	0,01	0,14
6	Yeast	0,06	0,68
7	Starter pate "Ritesa"	0,015	3,18
8	Sugar	0,06	0,52
	Total	**3,845**	
	Price of 1 kg , EUR	**0,84**	

1. Liquid dough
2. Temperature of dough t°C about 24 - 26°C

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 healthy alternative to the traditional coffeine containing drinks wht makes it attractive choice for the people who choose healthy and environmenta friendly and sustainable lifestyle. Besides, herbal tea is also considered as a medicine helpin to treat many diseases and facilitating recovering from them. The herb industry is also one the key suppliers for perfume industry which uses oils that are obtained from herbs to mak perfumes. The pharmaceutical industry also derives significant raw product from herbs, and food industry obtains flavourings of all types from herbs. Even the mint that flavours our to paste comes from herbs. There are many alternative therapies that attribute medicinal prop ties to plants – aromatherapy, flower therapy, herbal medicine, to name but a few. Cultivation and especially processing of the herbs is a complex, challenging and very intere technological process. Processing of herbal tea can be executed not only at the industrial l but also on the small scale in the home conditions.				
RELATED KEY WORDS, 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 mechanization in cultivation and is a important phase for the preparation of the green product. In this step it is highly important ensure that that all the natural properties of the product are preserved and enhanced and t 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 t are used stainless steel bulk barns with drying systems and silica gel dryers equiped with th with stainless steel loading trays and PLC system to memoprize and control different cycles drying for different herbs. **Cutting, threshing, classification.** A dried product is processed by cutting, threshing, scre separation and airblow classification. These processes can be executed separately or can be grated in one production line. During these processes heavy elements are separated from l (seeds from husks), long from short (leaves from stems), little from big (teacut from teabag **Mixing, blending** is executed with belt mixers that accurately blend different products (he teas) or make uniform batches of the same product. Such technologies also allow to reduce considerably the volume of the product, preserving only the active compounds and elimin all undesired parts such as dirt, sand, dust and stones. A metal detector can also be installe prevent iron particles going into the product. **Packing of the product** is executed by automatic packing machines, that execute the dosi herbal tea, packing into teabags or loose tea packings, putting into labeled 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 pro** Packaging machine packing into tea b Packaging machine bulk packaging
EQUIPMENT PRICE RANGE	20000 – 600000 EUR	50000-3000000 EUR	100000-300000 EUR	500000 – 1500000 EU
ECONOMIC FACTS AND DATA	The world production of herbs is now estimated at more than 0.5 million tons per year and sists mainly of dried herbal raw materials produced for pharmaceutical purposes. The turnc of medicinal and aromatic plants includes approximately 2000 species. The European market is one of the most important consumers of this product In Europe, due to the climate and soil conditions Mediterranean as well as Central and East ropean countries are the best localizations for growing herbs. 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. Eur an herbal industry processes approximately 200 species, mainly from field crops. Gathering natural habitats is marginal today, as obtaining a 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.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 pro

INTRODUCTION:

Smart foods are those that have been developed through the invention of new or improve
es,

for example, as a result of man-made materials/ingredients or human intervention; in othe
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 significant investment of intellectual property;
- have been developed for specialised applications, but some eventually beco
able for general use.

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

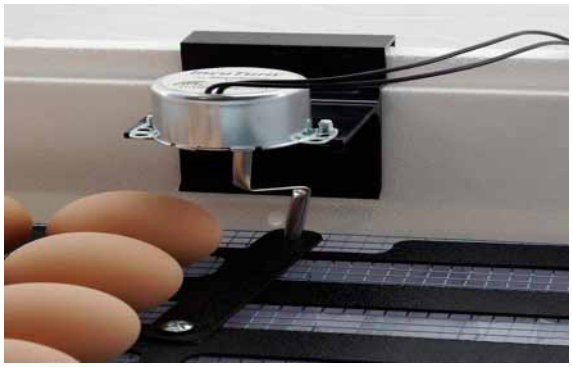
- foods with novel molecular structures, e.g. modified starches, fat replacers a
eners
- functional foods, e.g. cholesterol - lowering spreads, probiotic yogurts, fortifi
- meat analogues, e.g. textured vegetable protein (TVP), myco-protein and tof
- encapsulation technology, e.g. encapsulated flavours 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
ture and challenges food manufacturers, engineers and bioscientists to discover new sustainable so

Metalworks, the R&D branch of the media agency Maxus predicts that in the next decades technology
define the food and drinks industry as well as our attitude to nutrition. Among the biggest challeng
humanity, the researchers name growing of biotech/engineered food with modified characteristics
food-waste management. Other trends to watch will include creation of new food experiences, new
interaction with the "Internet of food", as well as innovative concepts of ready-to-consume and 3D-p
foods. None of these challenges and trends are new as such, most of them were analyzed and predicted by the Po

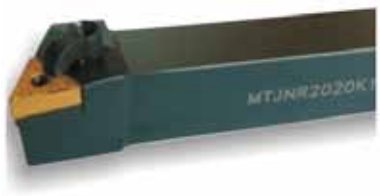
RELATED KEY WORDS, ABBREVIATIONS:	Smart foods Modified starches Low-fat products Sweeteners Encapsulation technology Biotechnology
PROCESS DESCRIPTION:	The transition of food production from domestic to industrial contexts has resulted in new in terms of product consistency and quality. Although variation of quality would be tolerate domestic level, consumers expect consistently high standards in the food products that the chase. In addition, health concerns and advances in scientific understanding have presente 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 amylopec occur together in starch granules, with approximately 20-25% usually being amylose. Howe varieties of starch, e.g. maize, have very little amylose. When gelatinised starch solutions are to stand for a few hours, they begin to show changes in their rheological properties. For exa dilute solutions lose viscosity, and concentrated gels become rubbery and exude water. Bo change are due to a phenomenon called retrogradation, which involves the amylose molecules. This is because, within the gelatinise tion, amylose acts to bind together the expanded granular structure of amylopectin molecu derstanding this natural phenomenon has led to the production of modified starches, whic altered to provide consistent results, tailored to the needs of the product. Starch may be m physical means (e.g. heating and shearing) or chemical treatment (e.g. oxidation, derivatisa Demand for low-fat products has been driven by consumer interest in health, in general, bu ticularly by a concern about energy intake and, in some cases, fat. In the UK, 45% of men ar women are overweight; 17% and 21%, respectively, are obese. Fat replacers can be a useful 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

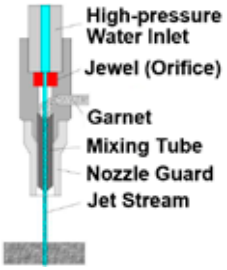
EQUIPMENT:	High-pressure homogenization equipment for processing everages, sauces and other fluid products; separators for pruducing ESL extended shelf-life) milk by reducing the bacterial count prior to asteurization; freeze dryers helping to prolong the shelf-life of food by drying deep-frozen food 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 powder products by extending their shelf-life to seve
EQUIPMENT PRICE RANGE	-	-
ECONOMIC FACTS AND DATA	-	
REFERENCE PICTURES	     shutterstock · 724838887  shutterstock · 537712447	

OTHER REFERENCES (LINKS TO VIDEO MATERIALS)	https://www.youtube.com/watch?v=ezNYkz9a0XI https://www.youtube.com/watch?v=ja0U0i8VIvQ https://www.youtube.com/watch?v=4xFH2CZ5pAI https://www.youtube.com/watch?v=hw321SwC6kA http://www.fao.org/docrep/014/i2454e/i2454e00.pdf

Metal Processing and Machinery

INDUSTRY:	Metal processing	**TECHNOLOGY GROUP:**	**Metal cutting**	**SPECIFIC TECHNOLOGY**	2.1. Turning, Milling, Drilling ser cutting, Waterjet cutting
INTRODUCTION:	Metal cutting proces is an industrial proces in which metal parts are shaped by removal o wanted material. In traditional chip-forming processes, such as turning, drilling, and milling al is removed as a plastically deformed chip of appreciable dimensions. Metal cutting is one of the most widely used method for metal parts forming allowing to parts with defined dimensions and shapes and required surface roughness. Sheet metal cu most widely is used by help of lasers or water.				
RELATED KEY WORDS, ABBREVIATIONS:	CNC – computer numerical control. Tool bit – a non-rotary cutting tool. Milling cutter – a rotary cut tool. Cutting fluid – fluid for cooling and lubrication during the metal cutting. Lasers – a narrow single color beam of light. Abrasive jet – jet of fine abrasive particles, usua about 0.025 mm in diameter.				





Tool bit Milling cutter Drill Cutting fluid
Abrasive jet

PROCESS DESCRIPTION:	**Turning** is a machining process in which a non-rotary tool bit describes a helix toolpath by mo more or less linearly while the workpiece rotates. Turning can be done manually, in a traditi form of lathe, which frequently requires continuous supervision by the operator, or by usin automated lathe, which does not. Today the most common type of such automation is CNC https://www.youtube.com/watch?v=8EsAx0nzEms **Milling** is a cutting process that uses a milling cutter to remove material from the surface workpiece. The milling cutter is a rotary cutting tool, often with multiple cutting points. As posed to drilling, where the tool is advanced along its rotation axis, the cutter in milling is us 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 terials. The drill bit is usually a rotary cutting tool. The bit is pressed against the workpiece rotated at rates from hundreds to thousands of revolutions per minute. This forces the cu 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 indus manufacturing applications. Laser cutting works by directing the output of a high-power most commonly through optics. The laser optics and CNC are used to direct the material o laser beam generated. The focused laser beam is directed at the material, which then e melts, burns, vaporizes away, or is blown away by a jet of gas, leaving an edge with a high-qu surface finish. https://www.youtube.com/watch?v=PIF_oXvbu4s **Waterjet cutting** is a technology that uses a very high-pressure jet of a mixture of water abrasive substance for metal cutting. https://www.youtube.com/watch?v=XfGkLsUm92Q https://www.youtube.com/watch?v=IMSGHJ8GJ1A		
EQUIPMENT:	**Turning machine**	**Drilling/ Milling machine**	**Laser metal cutting machi**
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. Laser and water cutting: different sizes (for example sheets 4000x2000x20 mm). 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**  

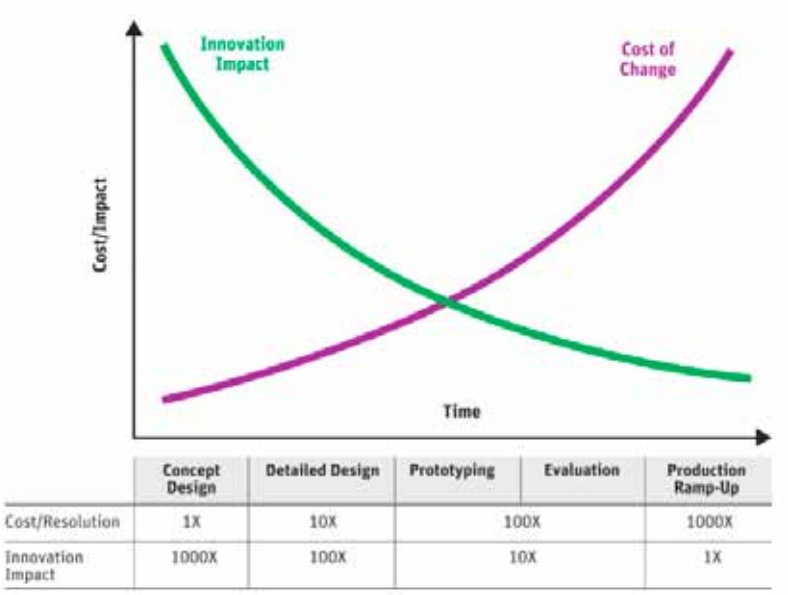
INDUSTRY:	**Metal production and processing**	**TECHNOLOGY GROUP:**	**Heat treatment**	**SPECIFIC TECHNOLOGY**	2.2. Heating and cooling
INTRODUCTION:	As long ago as Greek and Roman times it was known that the sharpness of a sword could b improved by rapidly cooling it after heating it up to forging temperature. 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 grade 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 KEY WORDS, ABBREVIATIONS:	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 for the purpose of altering 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 he 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. Mo than 90% of heat treatment is performed on steel and ferrous metals. Other heat treated al- loys are Al-, Cu-, Ti- or brass alloys. Heat treatment is not always for increasing strength or hardness. Sometimes is necessary to make the materials purposely softer – reveal internal stresses, make 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 importan of the engineering materials. It is thermally treatable because iron can exist in different crys tal structures: in room temperature it exist as ferrite but in higher temperatures as austenite In steels, ferrite can contain only a fraction of carbon, which forces the creation of two-phas mixture. The rest of carbon is in another phase called cementite. Heating to austenite form- ing temperature is called austenizing. Austenite can accommodate around 10 times more carbon and two-phase structure transforms to one phase structure. If such structure was slowly cooled, it would change again to room two-phase structure. By fast cooling (quench- ing) carbon has no time to transform to two phases yet cannot stay in high temperature on 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 an tensile strength but low toughness or vice versa. Low tempering temperature is for former and high tempering temperature for 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 lower end. A chisel is working in impact conc tions. By making low temperature tempering only, its cutting edge would be sharp for 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 hard ness 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 tempera- ture) the cutting edge would crack.		
EQUIPMENT:	**Simple batch type furnace**	**Vac- uum fur- nace**	**Continous heat treat- ment line**
EQUIPMENT PRICE RANGE	800 – 1500 €	~ 800000 €	> 800000 €
ECONOMIC FACTS AND DATA	Heat treatment costs only a fraction of product final price but extends many times its life		

REFERENCE PICTURES	

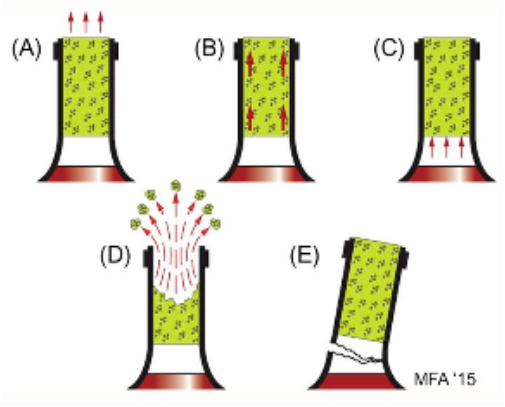
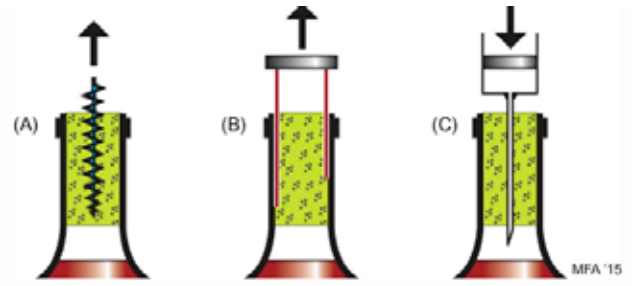
INDUSTRY:	Machinery	**TECHNOLOGY GROUP:**	Engineering Design	**SPECIFIC TECHNOLOGY**	2.3. Engineering Design
INTRODUCTION:	The general objective of Engineering Design (as compared to Design) is to "make" mechanical systems perform as we expect. Good engineering design gives you objects, that are functional, 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 KEY WORDS, ABBREVIATIONS:	Machine design, GrabCad, CAD, how things work, amazing robots, engineering design				

PROCESS DESCRIPTION:	The engineering design process is a series of steps that guides engineering teams as they solve problems. **All** possible aspects, that the product quality depends on, must be considered in detail. 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 how things work and, more importantly, 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 explaine https://www.youtube.com/watch?v=N7IWM_yDxU0 Door lock design and operation principles explaine 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=HMR0EMSc-Kk Innovative technological solutions for car parking Engineering design is always a problemsolving. The first step of it is understanding the basi problem being addressed and its solution requirements. For example, shall the device be o erated by motor or manually, used indoors or outdoors, what performance is expected, etc. Any engineering problem can be solved in many ways. Next important step is data collectio and solution ideas brainstorming. "**If you have just one idea for the solution, it is probab 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 promessing 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 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 o engineering data increases or by learning from failures.

EQUIPMENT:	**Meccano systems, LEGO systems, robot building kits, materials, workshop tools**	**Simple basic 3D CAD software**	**3D printer + testing equipment**
EQUIPMENT PRICE RANGE	a 100.- € + …		6000.- + 6000.-
ECONOMIC FACTS AND DATA	https://www.ansys-blog.com/engineering-simulation-the-10x-multiplier-to-top-line-growth/ 		

	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 desig to realise the importance of the **procedure' first phases**, where the basic solution ideas a generated with minimum cost. It would be much more difficult and costly, if this wasn't do properly and we have to change things at the later stages of engineering design procedure

REFERENCE PICTURES	https://reader.paperc.com/books/Materials-Selection-in-Mechanical-Design/605626/Contents An example below of engineering design procedure from need to final solution in order to illustrat the variety of engineering design options in all stages of product development.  Market need = engineering problem: " The liquid in corked bottle mu be effectively accessed".  Five possible conceptual ideas, how it could be don each having certain advantages and disadvantages. (A): axial pull; (B): shear assisted pull; (C): pressure push from inside; (D): cork destruction; (bottle neck removal.  There are technologies and tools available the market in order to use the first three ideas. The last two ideas are considered obsolete d to prevailing disadvantages.

INDUSTRY:	**Machinery**	**TECHNOLOGY GROUP:**	**Additive Manufacturing and Rapid Prototyping**	**SPECIFIC TECHNOLOGY**	2.5. Rapid Prototyping
INTRODUCTION:	3D Printing is the form of a formalized term additive manufacturing and use in the rapid pr typing process. The 3D printing process is used to rapidly creating a system or part represe tion before final release or commercialization. It highlights the fact to producing someth quickly and the output is a prototype or basis model from which further models and ultima the final product will be derived. Initially, polymer (plastic) materials are utilized in 3D prin such as ABS, Starch (powder) and Resin. But recently the material domain has extended and different metals and composites are used to form a shape (part). The additive manufactu technology (3D printing) is relatively new in terms of material development, feature sizes faster throughput. Moreover, this technology leads to the cleaner production concept as it tributes to the reduction of production process wastes because of its layer by layer additio material to produce a product rather removal of material as in conventional machining proc				
RELATED KEY WORDS, 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 software solid model of part that fully describes the external geometry. 2. **Conversion to STL file** – Convert the CAD model into STL file format to use i 3D printer equipment. 3. **STL file transfer and Manipulation** – STL file must be transferred into 3D printer and do necessary adjustment in size, position and orientation for building. 4. **3D Printer (equipment) Setup** – Properly setting up of parameters for build process such as material constraints, energy source, layer thickness, timings, etc. 5. **Building (forming)** – It is an automated process, only monitoring is needed ensure no errors. 6. **Removal** – Once the printer has completed the building step, the part must removed. 7. **Post Processing** – It may include the cleaning up of part, etc. before it is read to use. 3D printing mainly applied for creating prototypes, physical proof of concept, mock-ups, ed cational 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 – Worl Warcraft) https://www.youtube.com/watch?v=5rrpQnnGC6E (Metal 3D Printing)

EQUIPMENT:	**3D Printer (FDM – plastic filament)**	**3D Printer (SLA)**	**3D Printer (SLS and S**
EQUIPMENT PRICE RANGE	Depends on size (600 – 7000 EUR)	1500 – 6000 EUR	15000 – 500000 EUR or m

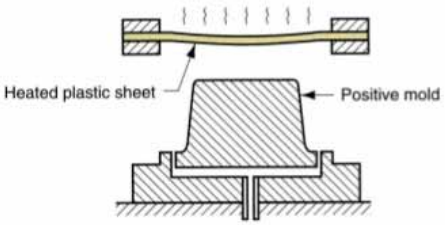
ECONOMIC FACTS AND DATA	3D printing is one of the advanced manufacturing technology and considered to be a fu manufacturing in the digital world. R&D in this technology progressing in incredible way al with 4th industrial revolution. The technology of 3D printing starts with the small scale pr types, size and speed limitation but today one can buy 3D-printed shoes, 3D printed jewel 3D printed pens, and even 3D printed vehicles spare parts. Automotive industry, airplane ma facturer use 3D printed parts in their industrial production. Even healthcare and life scienc dustries influenced by 3D printing applications. It also getting hype at school level and am secondary school students. In the global market the economic impact is projected up to the hundreds of billion euros by year 2025. Many start-ups companies open their businesses by providing 3D printing serv and they are also executed in Baltic States. Economic benefits of 3D Printing may include: It allows new complex shape to be created, E ness opportunity (shops) where anyone can get their design printed, prototypes can be fa cated easily without significant investment, Reduction of wastages in terms of materials (pla and metal) leftover [Madame Eureka 2012]. 3D Metal Printing at TTÜ (HTTP://BIT.LY/2OQER2A) 

REFERENCE PICTURES	 3D printers (Equipment)				
INDUSTRY:	**Machinery**	**TECHNOLOGY GROUP:**	**Manufacturing Processes (Shaping or Moulding Process)**	**SPECIFIC TECHNOLOGY**	2.6. Injection Moulding ar Vacuum Forming (Plastic)

INTRODUCTION:	The growing importance and applications of plastics during the last several years have increa at much faster rate than metals. It leads to the commercial and technological importanc the shaping processes such as injection moulding and vacuum forming. The reasons beh the importance of plastic-shaping processes are not only technological but commercial als everyone come across and uses plastics moulded products in the daily life. These shaping t niques increase the variety of part geometries, cut-down the energy and handling efforts. to their broad applications it is worth to know how those processes are carried out and ca further improved.
RELATED KEY WORDS, ABBREVIATIONS:	Heat, mechanical force, solidification, part geometry, metallic mould, thermoforming, ther plastics, deformation, VF – Vacuum Forming.
PROCESS DESCRIPTION:	The main process steps are: *product design*, *mould design* and *production process* Injection Moulding: 1. Feeding of plastic granular or powder into the injection moulding machine b rel via hopper. 2. Barrel consist of a screw and heaters that mix and melt the plastic into molte form. 3. The screw also acts as a ram rapidly moves forward to inject molten plastic in the mould. 4. Mould clamping forces are applied for a while to setting-up the shape of mou ed part. 5. Cooling and removing of the moulded part. Vacuum Forming: 1. Inserting of mould into the vacuum forming machine. 2. Placing and clamping of plastic sheet. 3. Heating of plastic sheet through heater. 4. Stretching of mould towards semi-melted (soften) plastic sheet via lever. 5. Creating of vacuum via vacuum pump to draw the sheet onto the mould and forming the part. 6. 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 mo
ECONOMIC FACTS AND DATA	All around the world, billions of goods are produced every year through those processes w huge turn-over to plastic industry. Applications of vacuum forming are wide spread in the c sumer goods packaging such as confectionary (chocolate and candy) packaging, and f packaging. It is also used in manufacturing of refrigerator interior, baths tub and shower t car interior, and children toys etc. Injection moulding process is more suitable for high volu production and use in manufacturing of bottles, packaging, automotive parts and compone some musical instrument, small chair and tables, etc.		

REFERENCE PICTURES



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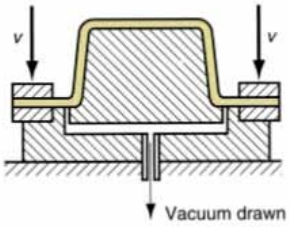
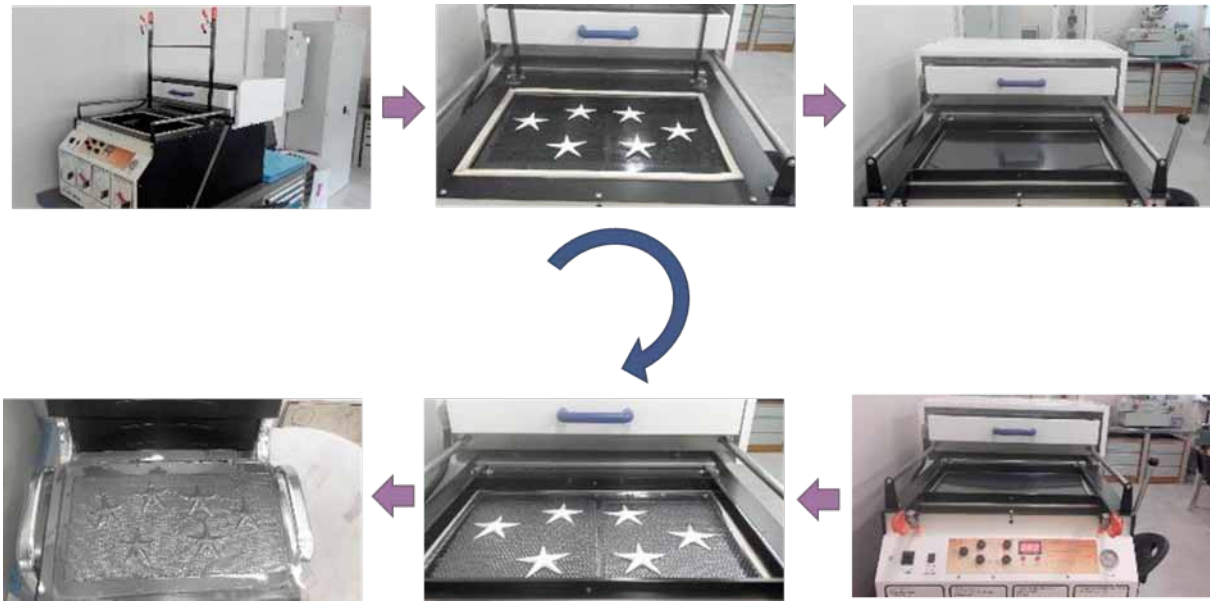


(2)



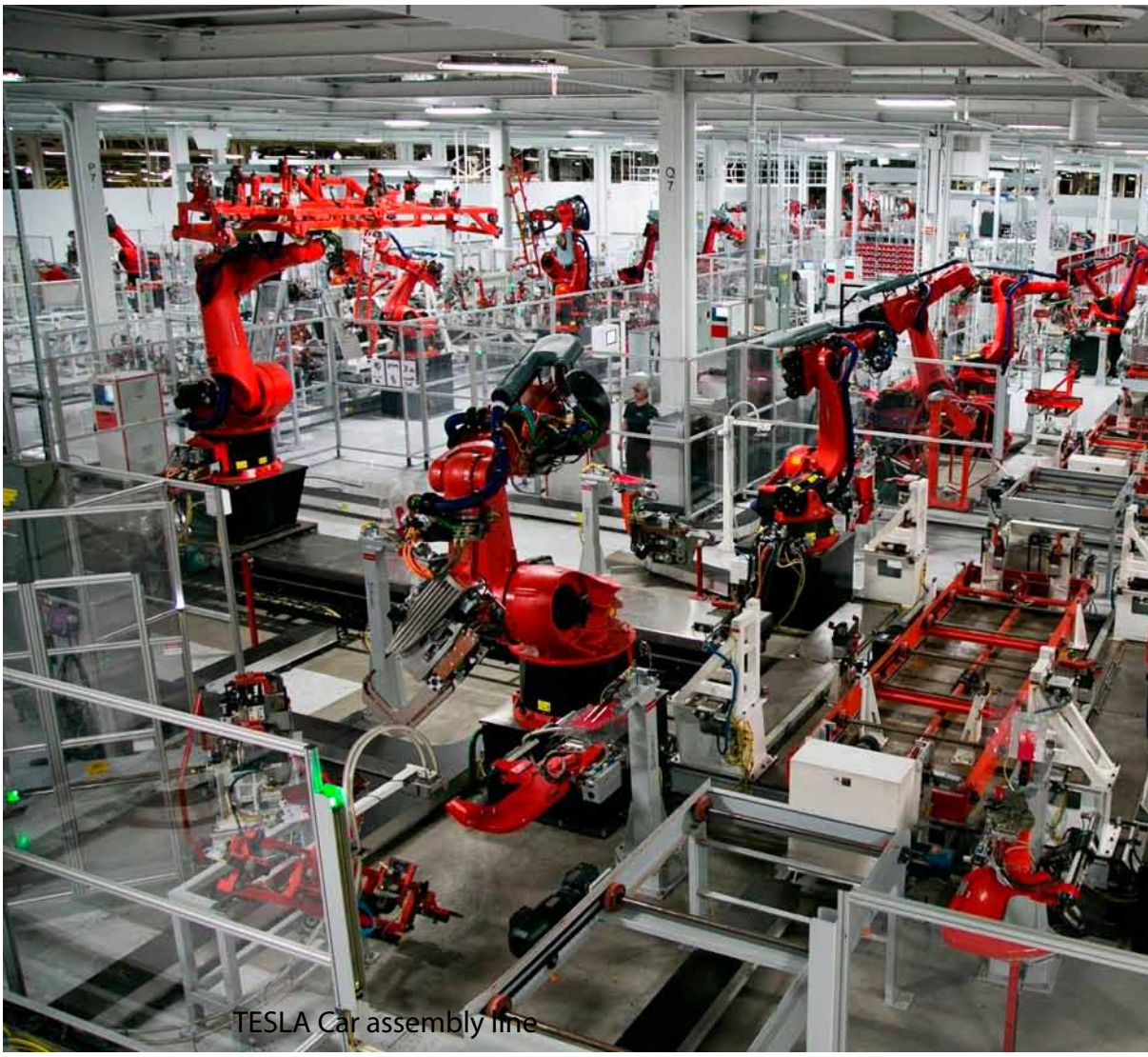
REFERENCE PICTURES	

INDUSTRY:	**Machinery**	**TECHNOLOGY GROUP:**	**Assembling**	**SPECIFIC TECHNOL-OGY**
INTRODUCTION:	**Automated assembly is a process where part feeding, detection, verification, orientati testing is done fully automatically. Sometimes human testing or packaging is run pa cesse quality.**			
RELATED KEY WORDS, ABBRE-VIATIONS:	DFMA - Design for Manufactory and Assembly, DFAA: Design for Automated Assembly , SM Technology, VPM: Virtual Product Model , MV - Machine Vision, Robot Welding			
PROCESS DE-SCRIPTION:	The Automated Assembly process mainly consist of following steps: 1. **Feed the parts** – depending on part size and shape different feed methods a 2. **Detect the parts presence in the pickup position** – confirm, that part is in 3. **Check the part** – Confirm, that part is genuine and suitable for assembly. 4. **Orientate the part** – If needed, part is turned around or pick-up system is in around after pick-up. 5. **Pick the part** – Grab the part and remove it from the feeder. 6. **Mate the part in its position** – Put part on its position in the assembly. 7. **Fasten the part** – one by one or all details together are fixed to the assembly 8. **Check the assembly** – Insure that assembly is well-assembled and all parts a positions. 9. **Packaging** – if product or sub-assembly is transported to the other location. Automated assembly is mainly applied for mass production but flexible production lines al 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_IfxPI5ObM (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 biger parts**	**Full**
E Q U I P M E N T PRICE RANGE	Depends on size: 10 000 – 1 000 000 EUR	Depends on size: 100 000 – 10 000 000 EUR	Depend

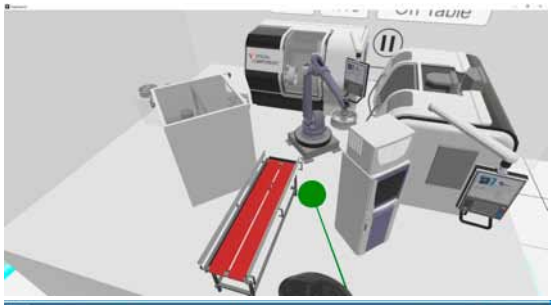
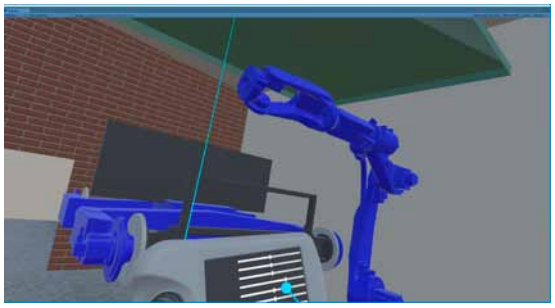
ECONOMIC FACTS AND DATA	Automated assembly gives us perfect, exact and fast set of repeated actions to complete pa ing and inspection for production final process - assembly. By using automated assembly th quality is increasing remarkably and cost of assembly process is usually lower and predictib is the weakest link because of health and mood variations. In case of automated assembly l continous working is quaranteed by wellorganized service plan. Pick and Place device for Printed Circuit Board assembly (fine electronics), details are putted fastening (welding) took place in the different device. 

Surface Mounting Device (SMD) with pick and place system.

REFERENCE PICTURES	 TESLA Car assembly line

	Machinery	**TECHNOLOGY GROUP:**	**Digitalisation. VR/AR, Simulations**	**SPECIFIC TECHNOLOGY**	2.8. Digital twin
INTRODUCTION:	The concept of Digital Twin (DT) is creating and maintaining a digital representa-tion of the real world of the factory and supporting its management and reconfigura-tion by the means of optimization 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 poten-tial of the DT in the manufacturing field.				

RELATED KEY WORDS, ABBREVIATIONS:	VR – Virtual Reality DT – Digital Twin AR – Augmented reality		
PROCESS DESCRIPTION:	Digitalisation of existing manufacturing equipment and products in 3D CAD software. Transfer of digital models to the game engine platvorm Unity3D and enabling interactions in Virtual Reality. 1. System arcihtecture creation (draft) 2. 3D models preparation 3. Interaction enabling - scripting 4. 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/f8PRUE0ER08		
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. Main cost is hardware.		

REFERENCE PICTURES	http://ivar.ttu.ee/    

Wood working and Forestry

NOZARE:	Forestry		Arbori-culture		3.1. Re-forestora-tion
IEVADS:	Forest regeneration decisions are made by the forest planner prior to 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 transperated (absorbing a lot of water). The forest typology is assessed and a decision is taken to restore the forest (natural / mechanical).				
ATSLĒGAS VĀRDI:	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. Tumbled mung agglomeration of wood.				

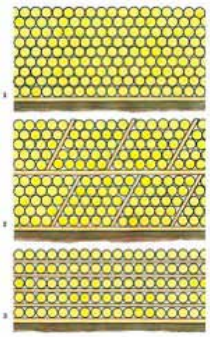
PROCESA APRAKSTS:	Forest soil preparation is carried out mechanically by removing the ground vegetation so as to ensure that the tree plants grow better in the ground. Mechanical processing takes place in two ways - with the help of a heavy cutter, also known as a disk plow. The cutter is powered by a special forestry tractor - a skider. 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 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.		
IEKĀRTAS:	**Skidder**	**Disk Plow**	**Tree planting bar**
IEKĀRTU CENU DIAPAZONS:			

EKONOMISKIE FAKTI UN DATI:	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 a hard, 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).
PASKAIDROJOŠI ATTĒLI:	    

NOZARE:	Forestry		Logging		3.2. Trees cutting
IEVADS:	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.				
ATSLĒGAS VĀRDI:	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.				
PROCESA APRAKSTS:	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 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. 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 quality requirements and to manually stop the process if a non-standard situation is followed - wood twist, truppe or dry matter and other cases.				
IEKĀRTAS:	**Harvester**		**Felling head**		
IEKĀRTU CENU DIAPAZONS:	300.000,-		100.000,-		
EKONOMISKIE FAKTI UN DATI:	The price of harvester averages 300,000, - eur, cutting head costs 100,000, - eur, service price is calculated from felling area, 6-8 eur / m3. The machine is operated 24 hours a day, with three operators working on it. During the day, cut and gobble from 150-250 m3 of different assortment of wood. Operators earn from 1 to 1.5 euros per m3, 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.				

PASKAIDROJOŠI ATTĒLI:	 

NOZARE:	Forestry		Logging		3.4. Assortment stacking
IEVADS:	The selection of the assortment begins with the felling planning, the logging master determines the stacking area (4m3 = 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 chipping, or to make them easier to collect.				
ATSLĒGAS VĀRDI:	Forwarder - a forestry vehicle that transports logs and moves on the road; Manipulator; 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.				
PROCESA APRAKSTS:	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 in accordance with the work order in assortment (7-9 main assortment types). The forwarder's operator marks the group of assortments (assortment, customer) with leaflets. Both Harvester and Forwarder'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 favorable, 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.				

IEKĀRTAS:	**Forwarder**		
IEKĀRTU CENU DIAPAZONS:	150.000,-		
EKONOMISKIE FAKTI UN DATI:	Forwarder's price is an average of 150,000, -eur. Service price 4-6 EUR / m3, operator's profit from development is from 0.7 to 1 EUR per m3. For one forwarder there are 2-3 people. During the day, 100 to 150 m3 are exported.		
PASKAIDROJOŠI ATTĒLI:	  		

NOZARE:	Forestry		Logging	**PRODUKTS:**	3.4. Timber logistics
IEVADS:	The main technological processes are assortment loading, assortment transportation and assortment unloading at the customer.				
ATSLĒGAS VĀRDI:	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.				
PROCESA APRAKSTS:	**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 in accordance with the instructions. **Timber assesment.** 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, height of branches, frequency, 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.				
IEKĀRTAS:	**Log carrier vehicle**		**Timber assesment authomatic line.**		
IEKĀRTU CENU DIAPAZONS:	200.000,-		1.500.000,-		
EKONOMISKIE FAKTI UN DATI:	The price of the car is approximately 200,000, - the service price is 5 eur / m3, the operator receives approximately 1200, - eur per hand, the net salary per month				

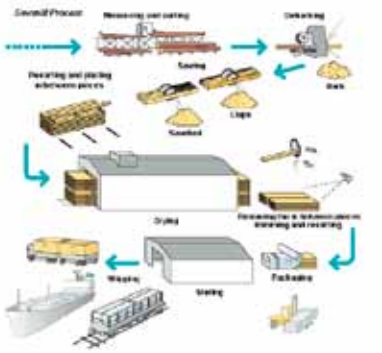
PASKAIDROJOŠI ATTĒLI:

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

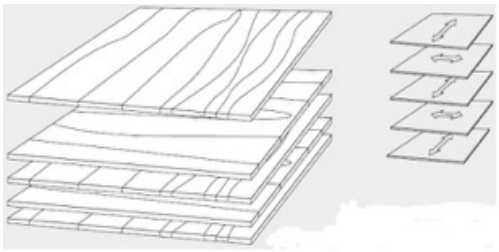
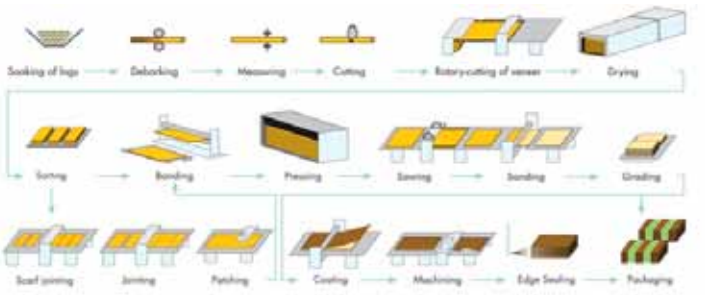
NOZARE:	Woodworking		Lumber production		3.5. Lumber
IEVADS:	Sawn timber is produced from the relevant timber assortment (wood species, log length, diamter and quality requirements, for example, the number of branches per meter, etc.), which are prepared by felling the forests and evaluated accordingly 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.				
ATSLĒGAS VĀRDI:	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.				
PROCESA APRAKSTS:	Sawing is carried out in a saw mill with circular saws (large saws) or Band saws (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. Basically, the deformation takes place on wooden fibers that are circular, trying to straighten. This lumbering property limits the use of wood as a material for the manufacture of precise 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).				
IEKĀRTAS:	**Multisaw**	**Band saw**	**Drying equipment**	**Moisture meter**	
IEKĀRTU CENU DIAPAZONS:	6.000 - 100.000 EUR	4.000 - 80.000 EUR	50 m3 aprox. 100.000 EUR		

EKONOMISKIE FAKTI UN DATI:	Service price to staff team: 10-20 EUR/m3 Lumber costs: 50-150-1000 EUR/m3 From 1m3 of logs is produced 0.4-0.55m3 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 € / m3 Drying of sawn timber from 15 € / m3 Lumber planing services starting from 10 € / m3
PASKAIDROJOŠI ATTĒLI:	  Lumber production   Daudzzāģis

NOZARE:	Woodworking		Lumber Processing	**PRODUKTS:**	3.6. Pr
IEVADS:	In order to further use the obtained lumber for the production of the finished product, for ture, building elements - stairs, shelves or decked floors, they must be processed. First of size.				
ATSLĒGAS VĀRDI:	Grooves-joints, grooves; Slats - timber used to enclose the gap between floor and wall; Cha ing timber into various incisions;				
PROCESA APRAKSTS:	Production of profiled materials. Dry boards are treated from all sides by milling the joints materials are floorboards, terraced boards, cladding boards, flooring trims. The profiled mat four-sided planer, whereby a rotating knife produces a smooth, pleasant surface in the requ that the material requires rounded edges or specific shapes, the so-called profile, it is obtain ate shape of the milling machine - the rotary knives of the required shape (the hammers milling cutter) such as baroque skirting, window laths or door shaping elements . Also, joini or cladding boards, are molded. In turn, the turning parts are produced on the turning ed piece of wood is used to produce a cutter or forge to obtain the required shape and size, for a simple broom shaft. In order to give the product a pleasant look, at the end, the material is made, sandpaper, which is applied to rotogravure or rotary instruments.				
IEKĀRTAS:	**Planer**	**Milling machi-ine**	**Lathe**	**Jigsaw**	
IEKĀRTU CENU DIAPAZONS:					
EKONOMISKIE FAKTI UN DATI:					
PASKAIDROJOŠI ATTĒLI:	 Milling  4 side planer 				

NOZARE:	Woodworking		Slab materials produc-tion		3.7. Slab materials
IEVADS:	There is a distinction between different types of board materials that are manu-factured 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.				

ATSLĒGAS VĀRDI:	Faction – KSP - particle board, OSB-oriented particle board; Finierkluči (LV) - birch logs; Plywood board - A thin veneer sheet made of plywood			
PROCESA APRAKSTS:	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, 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 a by-product chips are formed. From the beginning, the log is soaked, then the plywood is peeled off (the plywood is treated with hydrothermic 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 a glue and pressed in a hot press. The resulting plywood top coats are laminated with different materials , colors and textures as needed.			
IEKĀRTAS:	**Chipping production machine**	**Drying machine**	**Gluing machine**	**Pressing machine**
IEKĀRTU CENU DIAPAZONS:				
EKONOMISKIE FAKTI UN DATI:	ervice price not available Product price varies of qualaity and thickness and other dimensisons of materials 2-6 EUR/m2; 300-500 EUR/m3			

PASKAIDROJOŠI ATTĒLI:	  Plywood    

NOZARE:	Woodworking		Slab materials production / CNC procesment		3.8. Furniture production
IEVADS:	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 use of Precious woods				

ATSLĒGAS VĀRDI:	Spindle - Rotary heads; Natural or Precious woods - dried lumber; Reclaimed wood – old wooden parts refinished for durniture, 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;
PROCESA APRAKSTS:	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 identical required copies. Automated equipment necessary to operate a computer and special programaa, 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 computer-controlled process which is widely used in metal processing, wood processing and other automated production processes. Its main elements are the co-ordinating 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 files to develop special programs for vector graphics, where each point, line or shape has its own koordinātnes (3D) three-dimensional. Such programs are called CAD programs (AutoCAD, CorelDRAW, Illustrator, etc.), they are relatively expensive 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 follow-
IEKĀRTAS:	**CNC milling table** | **CAD Pro-** | **Hand tools**

IEKĀRTU CENU DIAPAZONS:	5000,-	Free – 10 000,-	100 – 5000,-
EKONOMISKIE FAKTI UN DATI:			
PASKAIDROJOŠI ATTĒLI:	 **Grīdas** pārsedze  CNC miling table Frēze ar rotējošu galvu		

NOZARE:	Woodworking		Construc-tion		3.9. Con-struction
IEVADS:	Wood is traditional and ecological materials are widely used in 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.				
ATSLĒGAS VĀRDI:	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 .;				
PROCESA APRAKSTS:	**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 graphe with a curved ax 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 are calibrated, grooved in length and glued together, combining heat insulation, various vapor compensating films and board materials. **Multi-storey modular homes**. In the world, wood is becoming increasingly recognized 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.				
IEKĀRTAS:					
IEKĀRTU CENU DIAPAZONS:					

EKONOMISKIE FAKTI UN DATI:	
PASKAIDROJOŠI ATTĒLI: