Project NEDIA

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O5 REPORT

COOPERATION BETWEEN NETWORKS, ACTION PLAN

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1. Introduction

In his fundamental work on the competitive advantage of nations, Porter identifies competitiveness of nations as based on the productivity with which it produces goods and services. Competitiveness is of paramount importance for implementing Competitive Sustainable Manufacturing. This would enable and sustain global Competitive Sustainable Development. In our project we are planning to develop a network for developing the competences, which are basic force for high value-added manufacturing.
Sustainable development is a complex concept, concerning three domains: economy, society, and environment.

The World Commission on Environment and Development has a declaration „Sustainable development" is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with the future as well present needs".
Workers are the main value inside the company. Workers:

- are valued and their work is organized to conserve and enhance their efficiency and creativity;
- well-being is a priority;
- are encouraged and helped to continiously develop their talents and capacities
- input and participation in the decision making process is openly accepted.

2. Main objective of the output

In this project phase there was analysed how to realize effectively, consistently and sustainably previously developed activities (new teaching methods and these implementation in a teaching process) in cooperation network and how would be possible to expand the network to other institutions and states.

Cooperation network would have a ability to develop continiusly a value-added cooperation between

- countries (regions);
- educational institutions in different countries (at the moment between project partners);

- industry supporting institutions (competence centres, associations, etc)

General objectives of the cooperation network are as follows:

1. Share activities – cooperation for better achievements
2. Change knowledge and information – cooperation for increasing competitiveness
3. Share objectives, tasks, activities – achieving larger proffessionality with fewer costs and shorter time.

Creation of structure of cooperation network, determination of parties belonging to cooperation network and tasks of the parties for successful cooperation.

Till this every educational institution more or less worked only on their own inside dimension, by getting experience in different seminars on their own country level or by making small cooperation projects with other schools or companies. To increase and make wider options for cooperation with other countries and new partners it's necessarily to establish cooperation network.

Thanks to our project NEDIA there are already established cooperation core (figure1), which must attract each countries other schools what offers mechatronic specialization for their students.

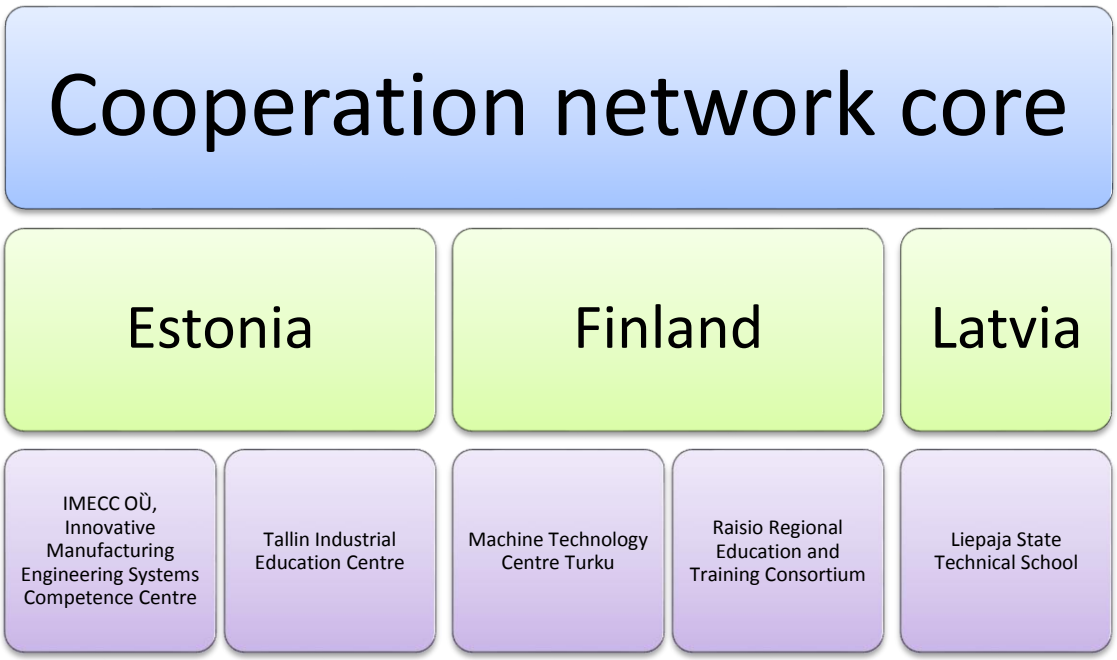


Figure 1. Cooperation network core

3. Networking and cooperation

To understand process of creating cooperation network first of all we should understand what each of words means by themselves. If we look in business explanation dictionary there are few explanations what is cooperation.

Cooperation - Voluntarily arrangement in which two or more entities engage in a mutually beneficial exchange instead of competing. Cooperation can happen where resources adequate for both parties exist or are created by their interaction.

In everyday language - **Cooperation** (sometimes written as **cooperation** or **co-operation**) is the process of groups of organisms working or acting together for common or mutual benefit, as opposed to working in competition for selfish benefit. Many animal and plant species cooperate both with other members of their own species and with members of other species (symbiosis or mutualism).

Cooperation is a process by which the components of a system work together to achieve the global properties. In other words, individual components that appear to be "selfish" and independent work together to create a highly complex, greater-than-the-sum-of-its-parts system. For example:

- The components in a cell work together to keep it living.
- Neurons create thought and consciousness, other cells work together and communicate to produce multicellular organisms.
- Organisms form food chains and ecosystems.
- People form families, tribes, cities and nations.
- Atoms cooperate in a simple way, by combining to make up molecules.

Understanding the mechanisms that create cooperating agents in a system is one of the most important and least well understood phenomena in nature, though there has not been a lack of effort.

Individual action on behalf of a larger system may be coerced (forced), voluntary (freely chosen), or even unintentional, and consequently individuals and groups might act in concert even though they have almost nothing in common as regards interests or goals. Examples of that can be found in market trade, military wars, families, workplaces, schools and prisons, and more generally any institution or organization of which individuals are part (out of own choice, by law, or forced).

Every day there is cooperation between someone or something that we sometimes don't even imagine is happening.

Networking is a socioeconomic business activity by which businesspeople and entrepreneurs meet to form business relationships and to recognize, create, or act upon business opportunities,share information and seek potential partners for ventures. There are four elements that makes conditions for collaboration and networking. [Figure 2]

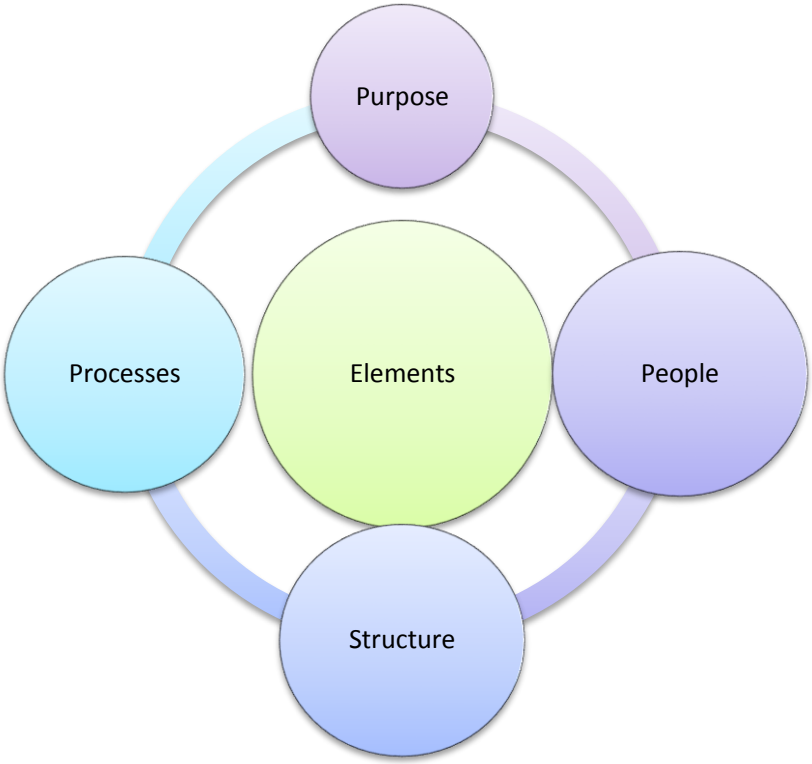


Figure 2. Four interactive elements of networking and collaboration

Purpose - agreed, common focus and shared values

People - agency

Processes - what people are engaged in when they are together

Structure - help bring people together in first place.

Each of us is part of already existing network. Simple explanation of such network is showed in figure 3.

Figure 3 Individual networking [http://creativesandbusiness.com/tag/social-media/]

4. Cooperation levels

Macro level – Cooperation between countries

A big potential is to organize a cooperation on the bases of industrial associations:

- Federation of Estonian Engineering Industries (EML) www.eml.ee
- Association of Mechanical Engineering and Metalworking Industries (MASOC) www.masoc.lv
- Engineering Industries Finland (Teknologia Teollisuus) www.teknologiateollisuus.fi

The main objective of cooperation in this level is:

- To have common understanding about the development trends in industry;
- To discuss about the education policy and current needs of industry;
- To discuss industry and education cooperation;
- To discuss the changes in professions in industry and the process of following this through professional standards;

- To visit different companies in different countries for having picture about the workforce employment and the needs of the company;
- To have a knowledge about the similarities and differences in educational processes and what are the key problems for preparing qualified personal to the companies

In the framework of Estonian Qualification Authority's (SA Kutsekoda) OSKA project, IMECC and EML in Estonia took part in mapping the needs of machine-building, metalworking and engineering industry as leading experts and members of workgroup. As a result of the project, a comprehensive survey about current competences and needs of labour-force of Estonian machine-building, metalworking and engineering industry was done.
The problems regarding labour-force and competences' development have been discussed and will be continually discussed in international events that have turned to be regular meeting places of interested parties:

- Tampere Alihankintamessut (Tampere, September, annually);
- Baltic Industry (Riga, December, annually);
- INSTRUTEC (Tallinn, November, annually).

During the project the contacts have been developed between the associations and project parties and general plans for further cooperation have been made. Further development between countries is also one of the project team's proposals in the current field. Today the following projects are currently running that to some extent are continuation of the work done in project NEDIA:

1. INSMER – Integrated Smart Education in Robotics – the basic idea is to develop smart education in robotics (also to develop a Case book for integrated studies in robotics using input from NEDIA) – leading partner IMECC;
2. 4Change – New methods for teaching in the field of CNC manufacturing.

Meso-level – Cooperation between industry and education

There is a certain contradiction between the materials learned at schools and the real necessity of skills needed at the labour market. From the trainers point of view, there is a certain passivity in the industrial world, but employers on the other hand are explaining, that the competences aquired at the trainings does not meet the necessary requirements of the industry. The effectiveness would increase, when „training themselves" would be brought forward into the learning process and the graduates would be with fixed level of competencies (professional standard) and immediately ready for work in the field they are trained.
Conceptual design means to bring forward the relationships between the industrial world and education on the basis of the following documents:

- list of positions
- vocational standards
- job descriptions
- curriculum
- vocational exams results
- key competences connected to the workplace and their estimation.

In this project phase, the elaboration of interactive process principles that would help to connect dynamically work-life and education took place. Following key points were analysed:

1. Determining the key competences for working on the certain workplace in mechatronics field (the pilot typical workplaces for mechatronics field (1-2) were determined) and the dynamics of these changes. Comparison of vocational standards with key competences
2. Transparency and comparability of competences (estimation and considering by the participating countries) (ECVET)
3. Recognition of the competences in the curriculum
4. The acquisition of competences in collaboration with the world of industry and education
5. Assessment of the competences and the adequacy of assessment
6. Highlighting the key competences by the companies
7. Continuous improvement of the learning process by the cooperation of education and industry

Elaboration of the report was planned in two stages:

1. Analysis of the best practices
2. Compilation of the roadmap, that would help to improve the training process by better cooperation between training institutions and labour market. The volume of the project does not allow to control and put into practice the whole process, but the real possibilities and most important tasks in order to develop more successful cooperation were fixed.

On the basis of our experiences and analysis we can declare that there is a big potential for further cooperation between industry and education. Concerning with our project we want to point out three main activity fields we suggest to develop further though this level of cooperation:

- **To use practical cases from the industry in the teaching process and explain these in a practical way;**
- **To use in some cases the specialists from industry to teach some specific topics;**
- **Try to integrate some self-interested companies more deeply in the teaching process.**

Micro-level cooperation - the cooperation between educational institutions

To make learning process more interesting and succinct, it would be efficient to unite resources and to make joint developments. Although educational institutions of the same level (vocational schools) are competitors to some extent, finally the quality is that matters. Therefore more attention has to be turned to:

- Inland cooperation between educational institutions;
- Transnational cooperation of educational institutions.

More effective cooperation points would be:

- Discussions about novel teaching methodologies and their implementation possibilities;
- Common development of teaching materials;
- Sharing resources and cooperation in teaching (development of technology is rapid and implementation of new equipment and systems is capacious, so inevitably all educational institutions can't keep the pace and this is not efficient, too). Therefore more need for cooperation.

Elaboration and compilation of seven textbooks in vocational education in mechatronics, leaded by IMECC and ordered by INNOVE was a good example of cooperation between educational and research institutions and industry.

A new project between Liepaja State Technical School (LVT) and Machine Technology Centre Turku (KTK) grown out from NEDIA project shows also successful cooperation between different organizations. Based on cooperation made by NEDIA between Liepaja State Technical School and Machine Technology Centre Turku, ERASMUS+ Key Activity 1 practice project was created. During this project 25 students from Liepaja State Technical School had 1 month (11.01.2016-10.02.2016) practical training in Turku. This kind of experience was something new and exciting for both sides. Students got the possibility to work with technologies that were not available in the school. All students were inspired by this experience and admit that this was very useful for achieving new knowledge, strengthen already existing knowledge, improving language skills, experience new culture and different environment.
There is also possibility to see students' weekly achievements in youtube:

- https://www.youtube.com/watch?v=WzeVvs22SCU
- https://www.youtube.com/watch?v=OA5lZbfVfe0
- https://www.youtube.com/watch?v=aR31vprTfl0

5. Why do we need cooperation network?

There is more than one reason, why international cooperation network is necessary. Mostly it is important to improve:

- Study programs;
- Education content;
- Study placement process;
- International cooperation between schools;
- Cooperation between different level education institutions;
- Study process quality;
- Different education method use in study process;
- Experience exchange.

Based on our cooperation network core, we are interested to attract and add to it other schools and educational institutions in different levels. Figure 4 shows, how it may look in near future when the network will expand.

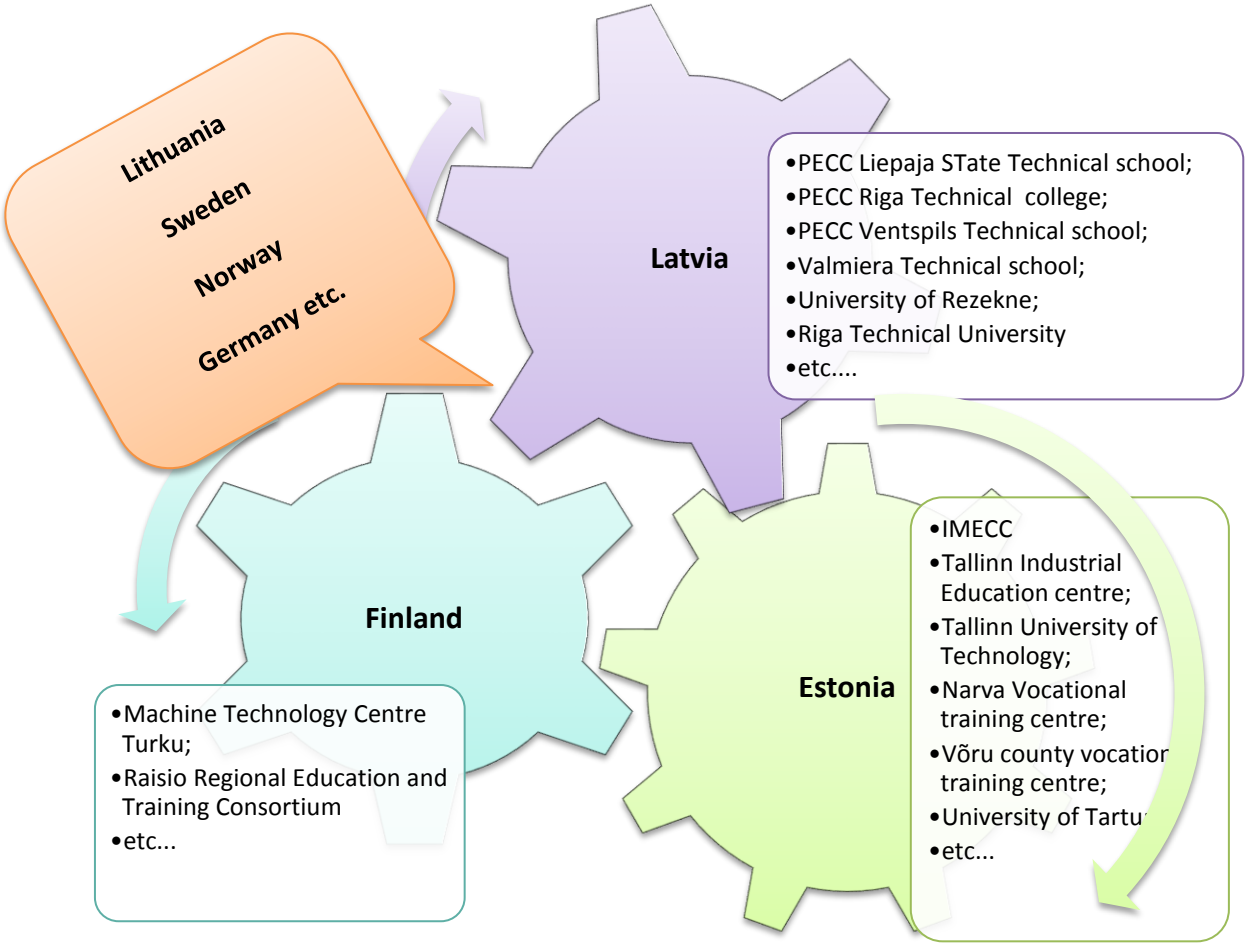


Figure 4. Future cooperation network between countries

6. Possibilities of cooperation (as examples)

6.1. Cooperation between countries

Cooperation among countries can help to solve joint problems and share knowledge and best practices. It often emerges around 3 common vectors:

- common challenges that extend beyond national borders;
- political, cultural, religious and economic commonalities that foster integration;
- inter-country engagement in regional and/or global processes.

The benefits of cooperation at the national level, cooperation among countries can support and reinforce national efforts for health development and also enrich perspectives on best practices and lessons learnt in other countries.

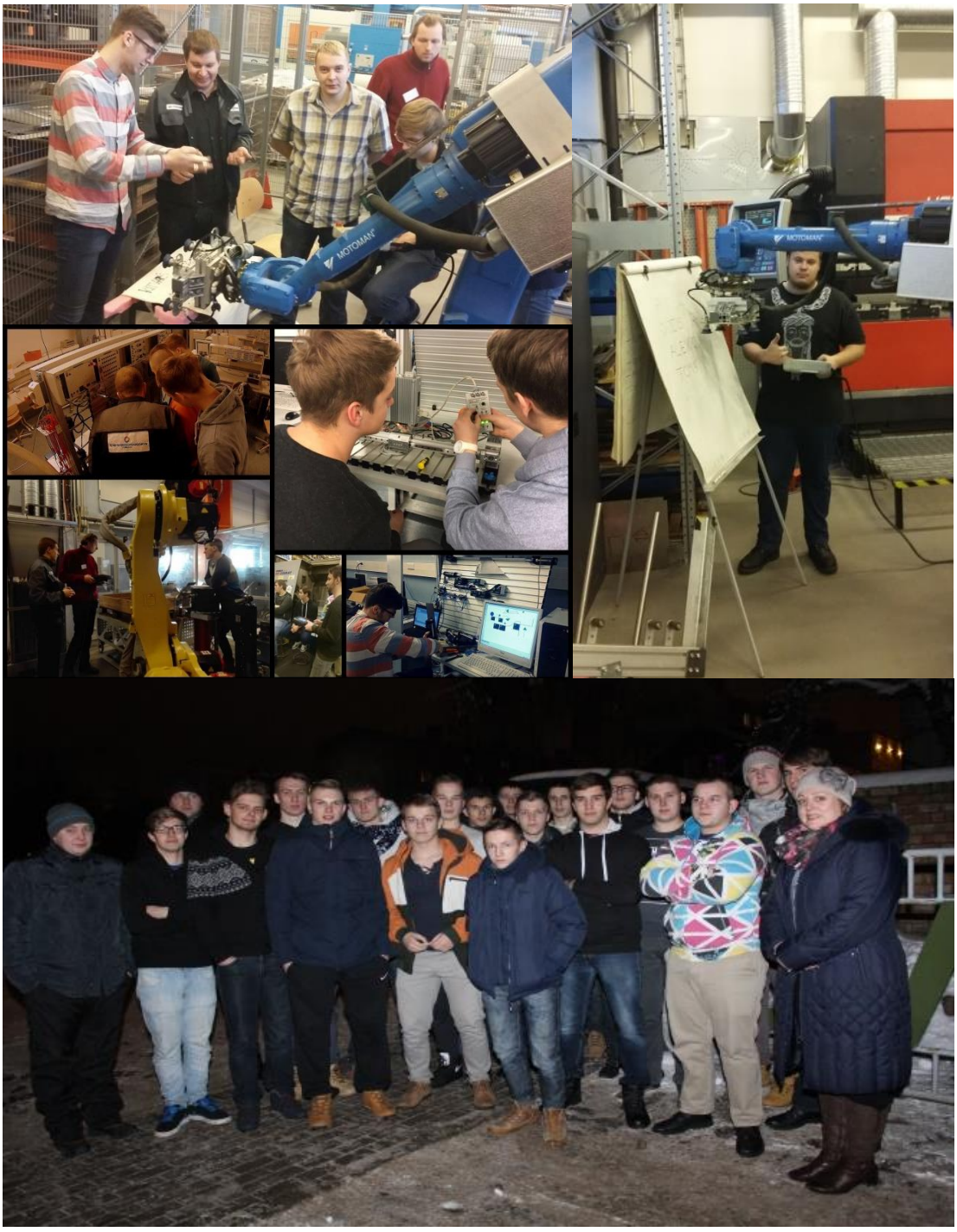
These exchanges have the potential to impact sub-regional and regional integration processes as well as global health policy debates.

As more or less successful big cooperations between countries are international organizations such as G7, NATO, ANO, EU.

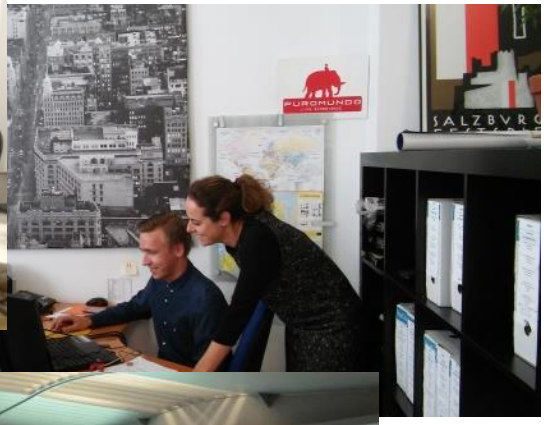
In education system especially in EU is exchange projects for students, teachers and educational staff. Before 2014 those were projects such as Comenius, Leonardo da Vinci and Erasmus. Now they are all under name of ERASMUS+.

Liepaja State Technical School is using this student exchange programs already more than 10 years. Students and teachers have been in study and placement exchanges in Germany, Norway, Poland, Spain, Portugal, Finland, Lithuania, and Czech Republic.

Last study-year 65 students were abroad during their placements. 25 mechatronic students went to Finland Turku machine technology center for 1 month, 20 students went to Spain Seville and 20 more to Braga Portugal also for 1 month period. All students returned satisfied with new and exciting experience.



Example 1. Finland, Turku Machine technology center



Example 2. Spain, Seville

Example 3. Portugal, Braga

6.2. Cooperation between education institution and company

Professional Education Competence Centre "Liepaja State Technical College" has a lot of different professions, so Liepaja and its immediate neighborhood, the majority of companies have different types of cooperation. Figure 5 shows a variety of examples of cooperation.

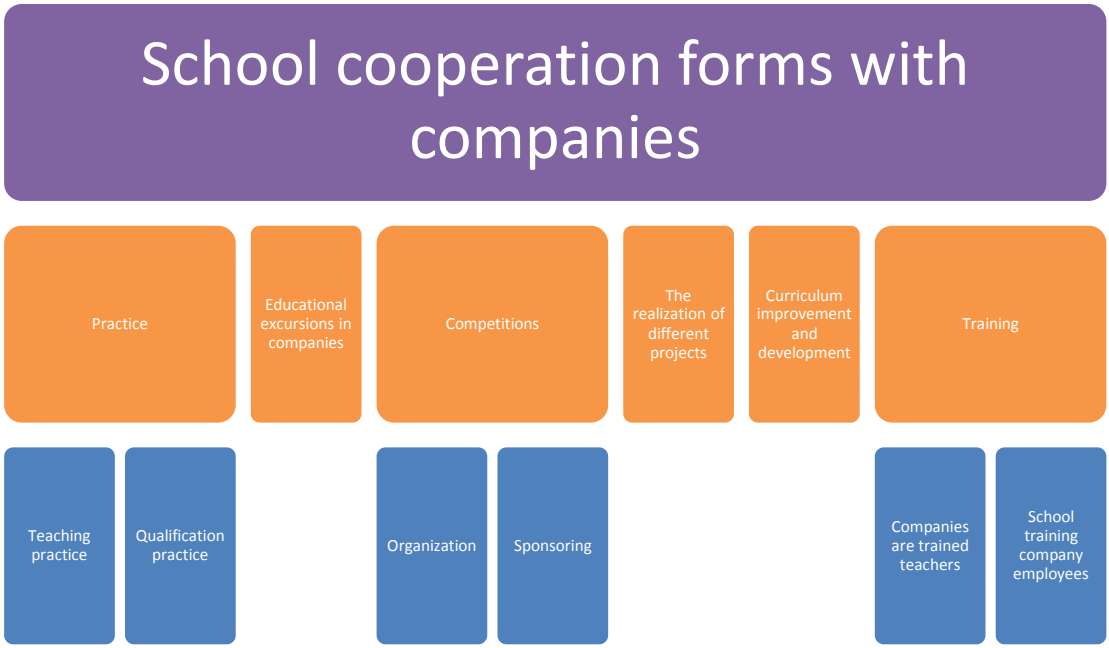


Figure 5. Cooperation frame

In Figure 5 you can see that the school cooperates with companies practices in the organization, because the best and most valuable work experience is what students can learn in real production. Students have a short training practice that lasts from two weeks to a month (second and third year), where they learn the skills, abilities and knowledge of the company's scope. The largest and major overhaul in work experience students acquire qualifying practice time that lasts six months. Approximately 80% of students at the end of qualifying practice are offered job opportunities for the company, where about 50% of the remaining work. The rest part of students go to university and about 20% of young people in their future life wants to be linked to other areas.

From the first year learners leads various field trips to companies in order to raise awareness of employment opportunities and business sectors (electronics, metalworking, printing, automated systems, etc.), When they leave school they will be able to prove themselves and to testify as a prospective employee. Educational excursions are valuable as it contributes to learners' understanding of the work environment, culture and the specific business development nuances.

Companies organize school competitions where their abilities and skills to be examined by both the school and members of the company's employees, which stimulates learners' the desire to learn, as far as possible, their profession because they want to show and prove themselves on the right side. In these

competitions their gaining a lot of new knowledge and the question derives from its competitors - company employees, new occupational specific small details, what school they are not taken advantage of. The school also organizes competitions for students only, which is also a good incentive, because everyone wants to show that he is the best school, region or country, depending on the competition level. In these competitions companies are invited as ideas and financial supporters, where they help to figure out the purpose of the competition and provide prizes contestants.

There are times that the company's representatives are turning to schools, so that it helps to identify ideas for solving the problem. For example the company wants to develop its own system, but they can not its own forces to deal with this task. After defining the problem students are involved in its own and with the help of the teacher are trying to realize and solve idea. Such as the school develops "Liepaja Museum" card, in which was illuminated navigation path on the route "Liepaja - Helifaksa - New York." Maritime Way emerged gradually from point to point. Light Indications were conducted with the help of microcontroller.

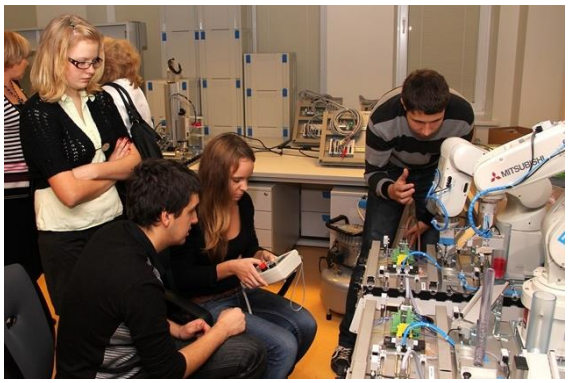
Elaboration of curriculum and improvement of takes into account the companys' recommendations and proposals that promote the competitiveness of the labor market. Company executives during practice and fix the students' strengths and weaknesses, which are important for professional work. Organizes business days on which way the discussion is being discussed how to improve the learning process and program. As well as being developed and accredited a new training program, after which the businesses are in demand, it is a lack of labor force. Such as the school in collaboration with the company "Jensen Metal" was created by welding program, which then will implement cooperation of public employment services.

At the initiative of business school is organized by company employees courses that they need, such as computer training (MS Office) and automated design (Autocad) to employees of the company to be able to perform their work faster and with better quality. In these courses can benefit both in teachers and employees of the company, as to each other in the learning process they tell different work nuances. As well as the companies will offer an opportunity for teachers to learn and develop practical skills in manufacturing, where teachers training at company for one week. During this week teachers understand the working environment, and then students are able to put more meaningful practical experience, knowledge and skills.

6.3. Cooperation between education institutions in different levels

Cooperation between different levels of education authorities to raise awareness of the differences in education levels, as well as the development of educational programs at different levels. Cooperation could improve their skills teachers. Co-operation would be useful not only nationally, but also internationally, as to find a common denominator for each level of education, which in turn could facilitate student interaction and exchange program for the realization of opportunities.

At the moment the local level in all countries is relatively small intermediary levels of educational institutions in collaboration. The most common co-operation takes place at the same levels, such as vocational schools cooperate with vocational schools and universities with institutions of higher education. Latvia has gradually established small vocational school cooperation with college programs, such as PECC "Liepaja State tehnical scool" and Riga Technical College. Cooperation within the framework of competitions designed robot programming, pneumatics and elektropneumatic.
Cooperation between different levels of education authorities could save schools also means the same material for the purchase of technical equipment, as if the educational institution is located close to each other, it is not effective for each educational institution to invest heavily financially in equipment. They may benefit from cooperation, each education institution go to study to partner existing equipment, and just the other way around, as if each school purchase specific equipment, the cooperation of investment will generate greater returns and efficiency.
This kind of cooperation is implemented in Ventspils, where institutions of higher education indoors learn PECC "Ventspils Technical School". They use mechatronics laboratory, which can be acquired pneumatics, electro pneumatics basics of PLC programming and production training station assembly, adjustment and programming skills. Similar collaboration is planned in Rezekne, in by far the largest financial contributions have previously acquired a university, so that they have already purchased new and modern technologies.



This year was established cooperation between PECC "Liepaja State Technical scool" and Riga Technical scool, which led to Pecci "Liepaja State Technical scool" Technical premises was opened in Riga Technical scool Liepaja branch. Where you can acquire post-secondary technical colleges occupations (2.5 years),

as Electrician, Mechatronics, car mechanic. Such cooperation is beneficial as Liepaja region, students and entrepreneurs, as employees of their professional qualifications can be developed right here on the spot.

Cooperation within the framework of teachers to acquire experience in dealing with different age group wishing to study. Another one of the most important forms of cooperation between different education institutions have continuing education, or mutual communication and sharing of good practice and experience. Where educational institutions can share their developed teaching aids, books, presentations, etc.

7. Problems in basic training

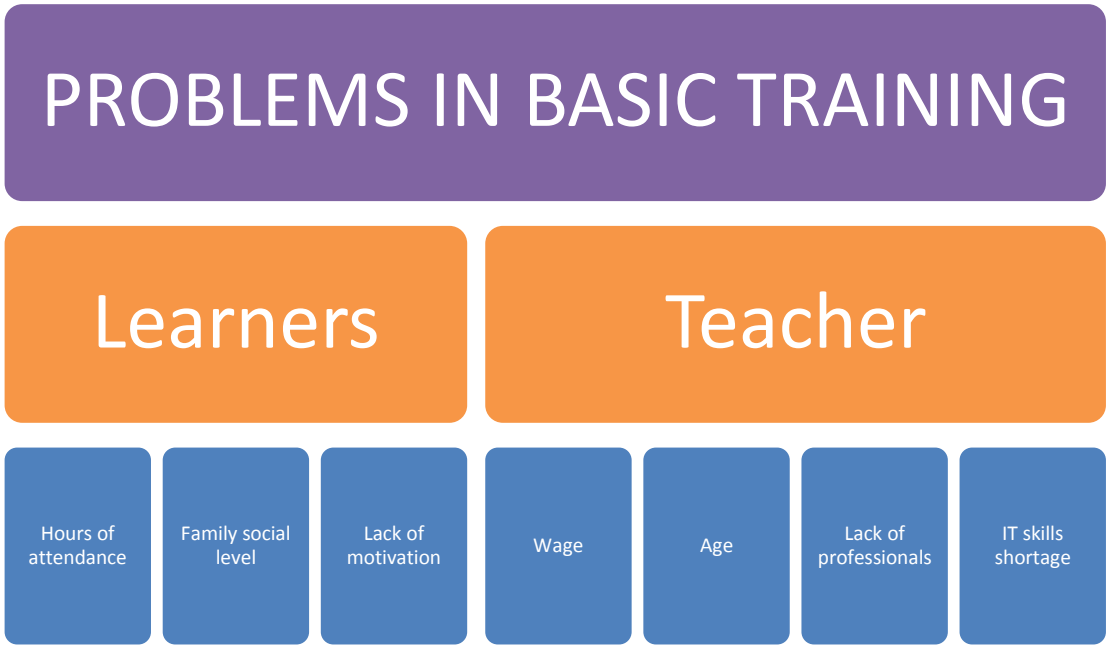


Figure 6. Problems in basic training

Basic training problems related to the fact that the knowledge of students from primary schools is relatively poor, in particular it is noticeable in mathematics. Mathematical basis of the ignorance or unwillingness to learn interferes with of various educational subjects as mathematics use is very wide.

The majority can acquire the education programs which are acquiring an occupation and high school (duration of studies in year 4). A frequent problem that students have problems with very large high school the teaching of subjects, but with a vocational oriented subjects they have no problems. It is related that the profession they like, and there they are increasing their efforts to produce results, but high school subjects they learn at a low level, as they are they are not as binding. Secondary school subjects learn at a level to be able to obtain successful assessments and diploma exam.

Often students have chosen acquire the a profession, which is not suitable for them, which interferes with the learning process. As well as young people who initially still really do not understand what they are learning, but over time has formed an understanding of their profession, and shows a greater return on the learning process, which in turn contributes to their growth in both practical and theoretical level.

The learning process can be observed very pronounced peculiarities of their age, as students in the first and second year absence of understanding about what they want to achieve, not a very big motivation. Third year students already have interest and motivation, as they have developed a sense that this is what they learn need them rather than teachers or parents. There is now a sense of responsibility, as well as higher requirements for the learning process.

Still in the learning process there are a variety of social problems that are related to the learner's education level and skills, and financial resources. There are situations where telling students dropping out only due to the fact that they have to go to work to help support their brothers, sisters, and so on. In such situations, the school tries to help the maximum, but it does not always succeed. In recent years, the

situation is improving because of the EU financed project to promote vocational education, in which students according to the average marks and an hour visit was paid to European scholarship. After the end of the project EU country increased its grants budget, and at the moment the maximum scholarship that a student can receive, 120EUR- if lmarks are 9 and 10 , which is a great support. But at the same time are students who are not motivated by scholarship, their knowledges and skills what they acquire are at sufficient level.

Problems associated with companies in the practical field of mechatronics profession

The main problem is that each company has its own profile to which it is oriented, so the areas are very different. Students should be able to quickly grasp the specific areas of specific knowledge and skills.

There are only few companies where you can use all the knowledge that the school has acquired a profession "mechatronic systems technician". In use the PLC programming knowledge is not possible because of the company's automation line programs are supplied from abroad.

School student, can manage to teach basic knowledge - technical thinking, which he then has to be able to apply in practice to quickly understand operation of the equipment principle, control technology setup.

Many companies are using old technology, very old equipment, which is a very complex mechanical structures.

8. Action plan, recommendations for the future steps

Following steps could be done to benefit from the cooperation:

- Present project NEDIA results and prepared material examples, get feedback and recommendations;
- Create online platform (forum or interactive environment) for mechatronics study process improvement between network participants, where they can exchange ideas, study materials, latest industry news and other schools where are mechatronic specialization and invite industry professionals to evaluate it;
- Create plan, how present NEDIA results and future plans for study process improvements to all interests after project is finished;
- Create international competition between mechatronics students, engage main industry specialists and companies;
- Create regular international placement opportunities by using ERASMUS+ or other projects;
- Create open lectures where interests, their teachers and industry specialists take participation;
- Create experience exchange seminars, videoconferences (online and offline), to exchange good experience examples.

In recent years, networking and collaboration have become increasingly popular in education. However, there is at present a lack of attention to the theoretical basis of networking, which could illuminate when and when not to network and under what conditions networks are likely to be successful.[School effectiveness and school improvement, vol 21] In educational practice, network goals as they are currently defined is about :

- School improvement;
- Broadening opportunities;
- Resource sharing.

By this networking can be aligned along two dimensions, in terms of goals and activities, as presented in Table 1. According to research conducted by West and Ainscow (2006), goals and activities of networks with examples in each cell.

Table 1 Goals and activities of networking [School Effectiveness & School Improvement research]

Goals	Activities		
	Short term	**Medium term**	**Long term**
School Improvement	Partner school Shares system to target low study level (borderline) students	School leaders support each other by sharing data and openly discussing approaches to school development. Leaders are available for support when necessary	Schools develop joint accountability systems, collegial leadership approaches, and sustained support networks that draw in any new leaders in the network.
Broadening opportunities	Partner schools put on a joint exam preparation day.	Partner schools develop some shared courses, offering specific vocational courses in each partner school to all pupils in the partnership.	Partner schools develop joint curriculum planning systems, with development done collaboratively.
Sharing resources	Teacher brought in from other school for Office for Standards in Education (Ofsted) inspection.	Teachers regularly help out in other network schools, with swapping and peer teaching common.	Joint appointments made to the network, schools collaboratively plan recruitment and succession.

Recommendations for study process improvement in Mechatronics:

- Interactivity - use different interactive study methods, materials, etc.;
- Use of modern technologies in study process;
- Technical equipment for qualitative practical training;
- More practical examples from work environment;
- Visualization of theoretical base;
- Industry news, current events and inventions (students are informed about news in industry) information is given by teacher and students get possibility to visit international expositions of industry;
- Theoretical lessons are available in video format (moodle), for extra education there are given literature resources of links, scientist articles or youtube or other video files;
- By time students are having their study placement, they manage to create little scientific research about industry topic there are interested, similar as comprehensive secondary school students has, to enlarge horizon of their knowledge.