Project NEDIA

Project number: 2014-1-EE01-KA202-000490

O1 REPORT

NEW NEEDS IN THE INDUSTRY AND NECESSARY COMPETENCES IN THE FIELD OF MECHATRONICS

Turku, Tallinn, Liepaja 2015

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Introduction

Mechatronics is an area which is updated on a daily basis for the companies in the world and helping to grow and thrive. On the one hand, the company can benefit through the efficient functioning because of the human factor is of less importance in certain areas routine. The Industrial Revolution Industry 4.0, that emerged in Germany, supports the industry through the globalization of IT and automation equipment. It is only a question of time when it comes to the countries participating in the project Nedia.

For companies, the opportunities for the use of mechatronics are primarily related to investments in equipment and the existence of necessary competencies. If the labour market has favoured so far the job of people, then the demographic situation in the three countries changes significantly the of share of human labour in industry in former business models and mentality. The growth of companies depends on how they are able to remain efficient and competitive in an increasingly globalizing world.

Despite the necessity for competent people in the field of mechatronics, it is not very popular among the youth. The main reason is how to finish one`s studies, which require extensive theoretical knowledge, skills how to work with your own hands and work experience.

In this research, we want to track down what is the current status of the field of mechatronics and the necessity of competencies in labour market. What is today's reality, can we predict what is the future of Finland, Estonia and Latvia, and how would it be possible to develop the competence of employees? The research involved representatives of enterprises, professional schools, alumni and teachers, who got a chance to a say what and how to change. Research information is connected just mechatronics area and studies.

The object of project Nedia is to provide innovative ideas and relevant materials for studies that could help reduce the increasing shortage of mechatronics.

Purpose: The purpose of NEDIA research is to chart the current level of mechatronics job training in Estonia, Finland and Latvia from the point of view of vocational teachers, alumni and enterprisers and to find opportunities how to update job training in order to meet the needs of the job market.

Partners of NEDIA project:

- IMECC OÜ (Innovative Manufacturing Engineering Systems Competence Centre), EST;
- Tallinna Tööstushariduskeskus (Tallinn Industrial Education Centre), EST;
- PIKC Liepajas Valsts Tehnikums (Liepaja State Technical School), LAT;
- Koneteknologiakeskus Turku Oy (Machine Technology Centre Turku), FIN;
- Raision seudun koulutuskuntayhtymä (Raisio Regional Education and Training Consortium), FIN.

Execution

- The research was prepared from October 2014 till February 2015 and it included the following:

- The analysis of research conducted earlier in Latvia, Finland and Estonia.
- The compilation of the questionnaire of the present research made up on the basis of the analysis of the earlier research.

- The interviews were conducted from February till March 2015;
- The translations, analyses and conclusions were made from April till May 2015.
- All the partners conducted interviews in their countries and the final report was made up by principal partner IMECC OÜ.
- The final report was written by professor Jüri Riives, Triin Ploompuu, Eduard Brindfeldt, Virgo Rotenberg, Kaia Lõun.

The area of the project: Estonia, Finland (Varsinais Suomi), Latvia.

Structure of the questionnaire

All the project partners participated in the preparation of the questionnaire and its purpose was to chart the present situation, to evaluate different competences and expectations what might the future of the mechatronics job training be. The final list of competences was made up at the meeting of NEDIA partners in Finland (February 12 – 13, 2015 in Turku). Those competences that were as a result of the analysis of professional standards and/or curricula the most connected to the specialty and work of mechatronics were added to the list. Personal characteristics were divided into 8 different categories that were connected with entrepreneurship.

The NEDIA questionnaire consisted of different stages:

1) Background information of the respondent
2) Part I: Questions that are connected with the description of the present situation: (Does the level of job training satisfy the needs of companies in the field of mechatronics / engineering; the main strong points and weaknesses of vocational training; the main problems in competences of employees; How do enterprises usually train their personnel if they need new knowledge or a solution for a certain problem?)
3) Part II: Assessment of competences a) the actual situation today; b) what level is, in fact, needed.

The distribution of the list of competences:

1) Job-related competences (12)
2) Job-related additional skills (4; e.g. technical English)
3) Personal characteristics (8; e.g. creative and problem solving etc.)
4) Part III: Themes connected with the future: how to renovate vocational training, how do you visualize the future of mechatronics.

Basic studies

Basic studies were chosen with the help of all the partners. They were analysed and developed into the present questionnaire being as follow:

In Estonia:

- Analysis of human resources key competences and their development possibilities in mechatronics field, 2012. Tallinn Enterprise Board. (http://www.meca.ee/wp-content/uploads/2012/09/2012.06.29-Analysis-of-human-resources-key-competences-in-the-mechatronics-field.pdf)
- Estonian engineering industry current status and trends, 2011. University of Tartu.
- Estonian labour market of today and tomorrow, 2014. Republic of Estonia Government Office.

In Latvia:

- Science in Latvia. 2010.
- The Latvian Economy. 2014.

In Finland:

- The capability and competitiveness of the mechatronics field in the North-Estonia and South-Finland region. 2012. Tallinn Enterprise Board. (http://www.meca.ee/wp-content/uploads/2012/01/Mehhatroonika-valdkonna-ettevotete-suutlikkuse-ja-konkurentsivoime-analyys_ENGLISH.pdf)
- Human adaptive mechatronics methods for mobile working machines. 2010. Helsinki University of Technology. (http://lib.tkk.fi/Diss/2010/isbn9789526035307/isbn9789526035307.pdf)

Interviews

Within the framework of NEDIA project there were interviewed the teachers and alumni of trade schools and businessmen in Estonia, Latvia and Finland, altogether 52 interviews (see chart 1).

Chart 1: The number of persons interviewed within NEDIA project.

Together:	Estonia	Latvia	Finland
Teachers	7	7	5
Alumni	8	6	7
Entrepreneurs	5	5	5
	20	**18**	**17**
Interviews	**55**		

The purpose of the research was to involve 5 persons related to the teaching or methodology of mechatronics out of at least three different vocational schools; a minimum of 5 alumni graduated from the specialty of mechatronics or similar in order to analyse their opinion and feedback. Also to conduct interviews with spokesmen of 5 companies whose products or services were connected with the use or necessity of mechatronics. (See Appendix 1: List of surveyed teachers, alumni and

companies` representatives). The principle for choosing companies was to include different companies as of profile, size and production process.

Results

Part I: GENERAL THEMES

1.1 Does the level of vocational training satisfy the needs of companies in the field of mechatronics / engineering?

Although the expectations to the labour force and specifics of work of a company are different it will be difficult to give a clear answer to this question. All the businessmen, alumni and teachers see the situation from their point of view. For example, it is difficult to find good automation specialists in industry; the best alumni cannot find a job complying with their abilities – I doubt the question lies in the lack of skilled workforce; the session period of mechatronics is too short, the school has given the students the keys to unlock further knowledge. One gets the impression that who has more contacts and co-operation that can evaluate higher each other`s contribution. The enterprises whose contacts with trade schools are closer (constant training bases for our students) usually are satisfied with the teaching level at school.

In Estonia it is considered that the level of education will satisfy if it is being acquired on the basis of applied higher education (professional standard VI). If to assess the professional standards IV and V then they do not satisfy the need of enterprises. An enterprise expects to have a prepared specialist from the vocational school. They anticipate more while without experience it is impossible to be a specialist in this field. For enterprises a mechatronic is an important link in their process and for them the quality of studies is, no doubt, insufficient. In principle, the employees out of vocational schools are like people from the street who have a special training. The results will be better in case the enterprise co-operates closely with the vocational school and they have had an opportunity to explain their expectations. In the opinion of the alumni it is important that, although there have been shortcomings, still the vocational school has provided basic knowledge and the further development is up to any person himself. At the same time it is also pointed out that the proportion of mechanics should be greater and at programming the proportion of SIEMENS is too big.

In Latvia it is considered that, principally, one might be satisfied with the level of vocational education as the students gain “technical thinking” after graduating from a trade school that will help to settle in easily at their new job. It is being complained that students might have a better knowledge of metal work, exact sciences and 50% more knowledge about CNC management. The students have an ample range of theoretical knowledge but practical skills are inadequate. That is why enterprises have to train the youngsters a lot themselves. The alumni are in the opinion that basic knowledge is good and it is easy to continue studying at a certain enterprise. It also depends on the person himself if he is able to acquaint himself with the needs of a specific enterprise or else he has to leave.

The Finns are in the opinion that the vocational school gives general knowledge of technical skills and enterprises give special skills that are necessary in their jobs. If to proceed from this then yes, vocational education satisfies their needs. It has been pointed out that enterprises themselves have to be more active in order to communicate the trade schools their needs. The alumni say that although they have acquired basic education from the vocational school they have had the opportunity at their posts to improve their knowledge and thereby the mentors have been of great help.

1.2 What are the strong points of vocational education?

In the opinion of the Estonians the strong points in vocational study are connected mainly with the development of practical skills and learning by doing that the university graduates lack. It is important that it is possible to focus on a certain specialty and to learn how to use certain equipment. In case of trade school graduates it is positive that it is possible to become a very strong specialist depending on the person`s own will. In addition, they also adapt more easily and faster with the real needs of the enterprise, they have a realistic view on life and very often they are ready to do simple work that has also to be done. Also, the modern equipment and materials of the trade schools are being appraised as they are relatively new and not outdated. In the sense of efficiency, the educational establishments might economize by sharing the equipment (the co-operation of university and vocational school).

The Latvians also agree that it is good if the students acquire practical skills, experience and a specialty that gives competitiveness in the job market, there will be no problems finding a job and in comparison with the high school graduates the salaries are better. It is praised that the trade schools themselves deal with finding training positions or otherwise there would be a chaos. It has been pointed out as strength that the trade school graduates understand mechanics and technical documents, they have good technical English. Automatics, basics of programming and technical programs like AutoCAD and Solidwork are known.

In Finland it is being stressed that next to practical knowledge and skills vocational education gives also good manners and a right attitude like the respect for elderly people, no hats are worn indoors, greeting and all kind of good manners at work. Vocational training has good learning conditions and dedicated employees who have time to deal with students unlike the enterprises. The training is carried out in workshops and there are few theoretical classes. So, it is a good opportunity for students who are unable to learn by books. As the level of basic knowledge is good (cutting speed, fastening of details etc.) it is easy for companies to develop their skills according to their needs. The youngsters can start their working life and career at an early age. It is also positive to have an opportunity to study at a vocational school and at the same time attend high school courses.

1.3 The main weaknesses of vocational education

In Estonia the main weakness of vocational education is the public mentality and attitude that vocational training is poor and second-rate. This is not right as it is also important. The birth rate is low and everybody fights for the number of students. Officially, the figures of graduates are important, not their quality. For instance, if it is not managed to complete a group there will be no financing either. At the same time, if the group is smaller and its members are aware what specialty they have chosen and they are willing to develop themselves in the field, the learning outcome will

be of considerably better quality for the job market. At present parents select the specialty for their children and the primary school graduates might not realize the difference between automotive specialty and automatics.

The following observations are connected with training quality: the overemphasis to the theory (the classes are theoretical and dull – they do not motivate to learn); there are too many so-called horizon subjects, their time might be spent on professional lessons; the study groups are too big – the optimal number of students at a practice should be 8; outdated learning material; wrong methodology – there is no point to rewrite a complex technical text in an easy way; rushing with several themes gives superficial knowledge; if the comprehension of a topic is complicated or one must be absent due to illness it is very hard to proceed; teaching of a subject depends to a great extent on the personality of the instructor as well as co-operation with enterprises; the trainees do not know what their practice is about; there might be more tasks with equipment and machinery in the studying process. Moreover, school administrations that do not go along with the innovations have been presented as a minus; financing problems, as the equipment has constantly to be renovated; the teaching personnel is getting older and it is very hard to find young highly qualified specialists; proceeding to the university is rather complicated. It was suggested that several (international) projects, group work and other methods might make the studying process more interesting. The use of internet and various technologies might be prohibited during lesson as the students deal with secondary matters and are not able to focus on the topic.

Latvians` attitude towards vocational study is also problematic. The profession of a teacher is not prestigious. At the same time teachers do not sense responsibility for what happens with their students after graduating. The financing of vocational schools is also problematic.

The Latvian teaching quality is reproached for being orientated to technological renovations while several enterprises need still the ability to use older equipment. There also exists the opinion that vocational establishments should need more practice in their studies (the ability to solve practical tasks), exact sciences and a more profound understanding of theory. There are too few lessons of physics, chemistry, mathematics and computer sciences, but also the knowledge of electronics and the main physical properties of metal is insufficient. It is also pointed out that there should be more simulation systems and working displays in their studies where it is possible to learn independently. It might be the best thing to work on your own and obtain new knowledge.

The main problems for the Finns lie in the fact that the general reputation of industry is low and so, vocational study does not seem especially attractive. Although the number of theory classes is small, it is still considered that the best skills are still acquired through practice and its proportion has to be increased. The vocational schools do not have sufficient monetary resources in order to renovate constantly their technical outfit.

The students coming from Finnish basic schools are having trouble selecting the proper specialty to proceed with. It is hard to motivate students who have not been successful at general schools and whose only opportunity is to continue their studies in the machinery department of a vocational school. It is said that the social skills and capability for teamwork of the graduates are not good enough. Young people cannot assess the time that has to be spent on a specific operation and the

work itself. Focus should be on better quality. (If work has not been completed or it has not been done properly, it should not be postponed to the next stage or to the assembly process.)

Co-operation with enterprises and job-based study is complicated and varying. The schools should arrange more visits to enterprises because young people are not acquainted with working life and after the first session it is difficult to change the specialty. The practicing time at an enterprise should be longer. 4 weeks during the second academic year is insufficient.

1.4 What are the main problems in the competence of workers?

Estonian experience

Mechatronics is a domain that is costly to teach and often the means for learning are missing. There is a job competition for the teachers. The educational system reflects what is going on in the labour market. Time is deficit and problems have to be solved quickly. This anticipates a very strong basis of practical skills that is often missing. Companies do not agree to invest in upgrading as there are no resources. The principle “If you do, you do it to yourself!” is not often met any more. It seems that in industry there is a generation missing, the so-called lost generation. Some persons are 25 and the rest are 45 plus. If to assume that a generation instructs the following one then this generation of instructors is missing. If career potentiality has been proposed when starting work, of course, one would like to proceed not to stay in the same position. Management skills might be better.

Competence related problems: one can work on a machine tool only when there has been practice on a similar tool, the trust in a new employee forms in about a year; as mechatronics is a broad domain the specifics of the work needs to be explained separately at each work position. Elementary matters might flow faster. The capability of machinery and equipment should be used more. It seems to the self-learners that there is still something missing in comparison with those who acquired a special education.

Additional skills: questions concerning employment contracts; occupational health; language skills (Estonian and Russian) are a great problem.

Themes connected with personal characteristics: personal development and constant updating; co-operation and openness (between people in industry speaking Estonian and other languages); team work is very important; communication skill and relating in the team; showing initiative; coping with changes and difficult situations in work, time planning.

Latvian experience

The field is being influenced by the aging of teachers that has a direct connection with the quality of teaching. Low motivation is mainly related to financial reasons. Students believe that they know everything and are afraid of asking for advice or help with some kind of work. In case they learned certain operations and the use of equipment at school it would be easier to help them in their job. The competence of workers can be enhanced by participating in international exhibitions and seminars, it is important to have inter-cultural exchange of experience.

Competences: material technology; computer sciences; knowledge of IT technologies and not using them; a more thorough comprehension of theoretical knowledge is necessary; few practical knowledge of the basics; few knowledge of new technologies.

Additional skills: The language skills of teachers are problematic. That is why they are not able to read articles on new technologies in order to update learning material; few working skills and practice.

Themes connected with personal characteristics: motivation and readiness for changes of long-term teachers; stress tolerance of long-term teachers; coping with heavy work load of long-term teachers.

Finnish experience

In Finland it is being emphasized that they want to employ only good workers and each worker will have such kind a job that suits him and what he is capable of doing. Employees are personalities with their weaknesses and strengths. That is why it is hard to outline the general problems in competence. The learning of new skills is compulsory in this field. It is the responsibility of each worker and the employer has to support them in developing their skills. Long-term employees do not have problems in competence, but new employees have mentors who help them. It has been mentioned as a minus that some workers do not honour their job and they do not follow their working time, but this cannot be generalized to all workers. Employees are not motivated to work hard. Moreover, several workers use mobile phones too often for making personal calls.

Competences: the maintaining of one`s professional knowledge and skills; the main problem of vocational school graduates is limited practical skills; the basic knowledge of graduates is good but the skills for managing in their job are weak; about 30% of the employees do not want to rotate, i.e. to be persons who know all the operations in a company.

Additional skills: limited working skills.

Themes connected with personal characteristics: personal development; problem solving skills; some workers lack self-confidence and that is why they are not able to make decisions, they ask for unnecessary confirmation and advice; ability to show initiative.

1.5 How do enterprises usually instruct their employees when they need new knowledge or a solution for a certain problem?

In Estonia the training of employees is a constant process (occupational safety, questions of loyalty, code of conduct, e-training, controller programming, automation, pneumatics and hydraulics, 5S, quality, time planning, working methods etc.). Large companies have their own training centres (e.g. Enics in Elva), smaller companies participate in different in-service trainings. The vendors of new equipment usually provide also corresponding training (FESTO, hydraulics etc.). If one wants to study theory he attends a university. If one approaches a vocational school the tutors are usually overloaded and lack time. Companies are ready to train their employees either at evening courses or in distance education. It is extremely positive if a company meets halfway and supports the studies of the young workers.

If the specifics of a company are narrow they train themselves. Internal trainings take place rarely. It is being watched who is an expert within the team and who helps to settle the situation. Also, acclimation programs are being used; in case of new employees there are separately rewarded mentors; there are training programs for raising one`s level of qualification that terminates with an exam assessed by a commission; everyone can add training requests in an internal web; separate system for indication of competence; in case one needs training, a certain person will be found in-house; if not an expert will be involved outside the office; special designers and project managers who deal with problem solving in the company.

But at some companies it is acted as follows: the employee is handed the user manual and told to deal with it. One has to look up everything on the internet. E-training, self-education – there are quite a lot of opportunities. At us it has been like that: trainings have been strictly gear-bound. At enterprises there is no time for training, there work must already be done correctly (e.g. program automation). It should be like that: first you try on your own and only then get someone to help you.

In Latvia trainings and seminars are being arranged by big companies like FESTO. Some teachers can work only in case they have practical experience. New knowledge is being obtained at internal trainings, seminars, mentoring, acclimation programs, upgrading courses, separate projects and even exhibitions in Germany. Companies are interested in hiring students for practice as after graduation it is possible to have good workers. Each new employee has to undergo a certain standard how to use tools, how to read technical drawings etc. That is why they usually are satisfied with the employees out of vocational schools.

In Finland mentoring is the most wide-spread method. They also apply internal and external training courses in Finland and Sweden, apprentice study. The equipment vendors arrange training courses for a certain device (several times a year). It is quite common that companies have some development projects like quality improvement or other. Consultants are being used at the start of the projects. Internal trainings take place fairly seldom.

The teachers stress that personal development often depends on them but the price of good training courses limits the participation. Vocational schools arrange mainly trainings on pedagogy, didactics or other trainings concerning the development of education, not training for raising professional competence. Teachers have the opportunity to develop their skills at enterprises. It is generally sensed that there are a sufficient number of trainings.

Part II: The current situation of the competences in the field of mechatronics and the actual need

The competencies that have been set out are divided into professional, additional abilities and personal characteristics. Respondents assessed the competencies considering the real situation of today and the level of demand (see Chart 2).

Professional competencies consisted of the most important skills that are related to the competencies in mechatronics.

Chart 2: The assessment of professional competences

Competencies list	Real situation and level at the moment	What is the level of needs?	Difference
2.1 Machine assembly	3,19	4,06	-0,87
2.2 Maintenance and service	**3,25**	**4,48**	**-1,23**
2.3 Knowledge of hydraulics and pneumatics	3,31	4,08	-0,77
2.4 Reading and using technical documents (drawings, schemes etc.)	3,52	4,46	-0,94
2.5 Programming (PLC)	2,81	3,57	-0,76
2.6 Knowledge of electrical engineering	2,94	3,79	-0,85
2.7 Automation assembly	3,06	3,77	-0,71
2.8 Diagnostics and testing	**2,94**	**4,04**	**-1,1**
2.9 Industrial networks	2,27	2,73	-0,46
2.10 Knowledge of mechanics	**3,19**	**4,21**	**-1,02**
2.11 Knowledge of electronics	2,83	3,79	-0,96
2.12 Locksmith works	2,68	3,33	-0,65

Additional abilities are connected with competencies, which must be taken into account at work and which are connected indirectly (see Chart 3).

Chart 3: The assessment of additional abilities.

2.13 Technical English	**3,15**	**4,21**	**-1,06**
2.14 Russian/Swedish	2,27	2,98	-0,71
2.15 Work experience	3,1	3,81	-0,71
2.17 Work safety	3,75	4,56	-0,81

Personal characteristics are connected with entrepreneurial characteristics (see Chart 4).

Chart 4: The assessment of personal characteristics.

2.17 Creative and looking for solutions	3,31	4,35	-1,04
2.18 Self-conscious and eager to learn (personal development)	3,4	4,44	-1,04
2.19 Result (goal) oriented (also customer oriented), ambitious	3,21	4,29	-1,08
2.20 Independent, motivated and with positive attitude	3,35	4,42	-1,07
2.21 Dedicated and effective	**3,25**	**4,48**	**-1,23**
2.22 Self-guided and analytically thinking	**3,06**	**4,33**	**-1,27**
2.23 Responsible, disciplined and accurate (work moral)	**3,48**	**4,6**	**-1,12**
2.24 Co-operative, adaptable and flexible (including teamwork)	3,56	4,43	-0,87

The greatest difference is between „self-guided and analytically thinking“; „maintenance and service“; „dedicated and effective“; „responsible, disciplined and accurate (work moral)“; „diagnostic and testing“ (see Chart 5).

Chart 5: Competences where there is the greatest difference between necessity and reality.

Self-guided and analytically thinking	-1,27
Maintenance and service	-1,23
Dedicated and effective	-1,23
Responsible, disciplined and accurate (work moral)	-1,12
Diagnostic and testing	-1,1

Comparison of Estonian, Latvian and Finnish results

The differences in the comparison of competences of the three countries (see Figure 1, 2, 3) give an overview what are the specific differences in Estonia, Latvia and Finland.

The biggest difference in the assessment of the competencies in Estonia is „maintenance and service"; „self-management and analytical thinking" and „dedication and efficiency" (see Figure 1).

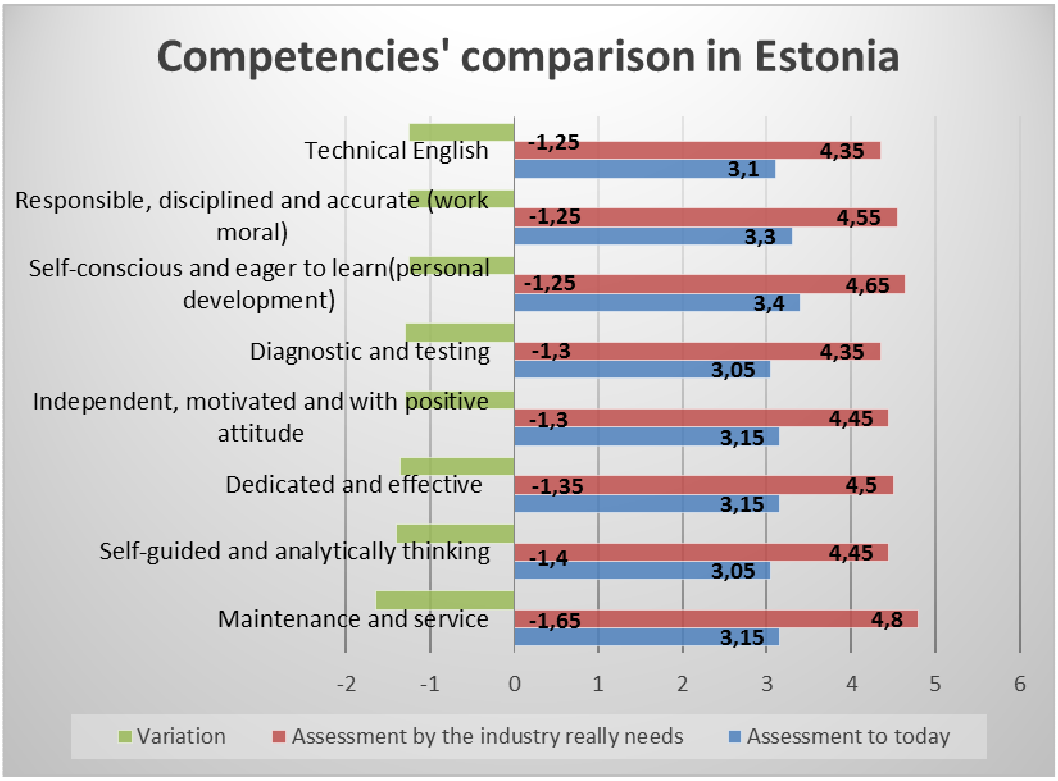

Figure 1: Competencies` comparison in Estonia.

In Latvia (Figure 2) there are the biggest gaps in „knowledge in mechanics"; „self-guided and analytical thinking" and „knowledge in electronics".

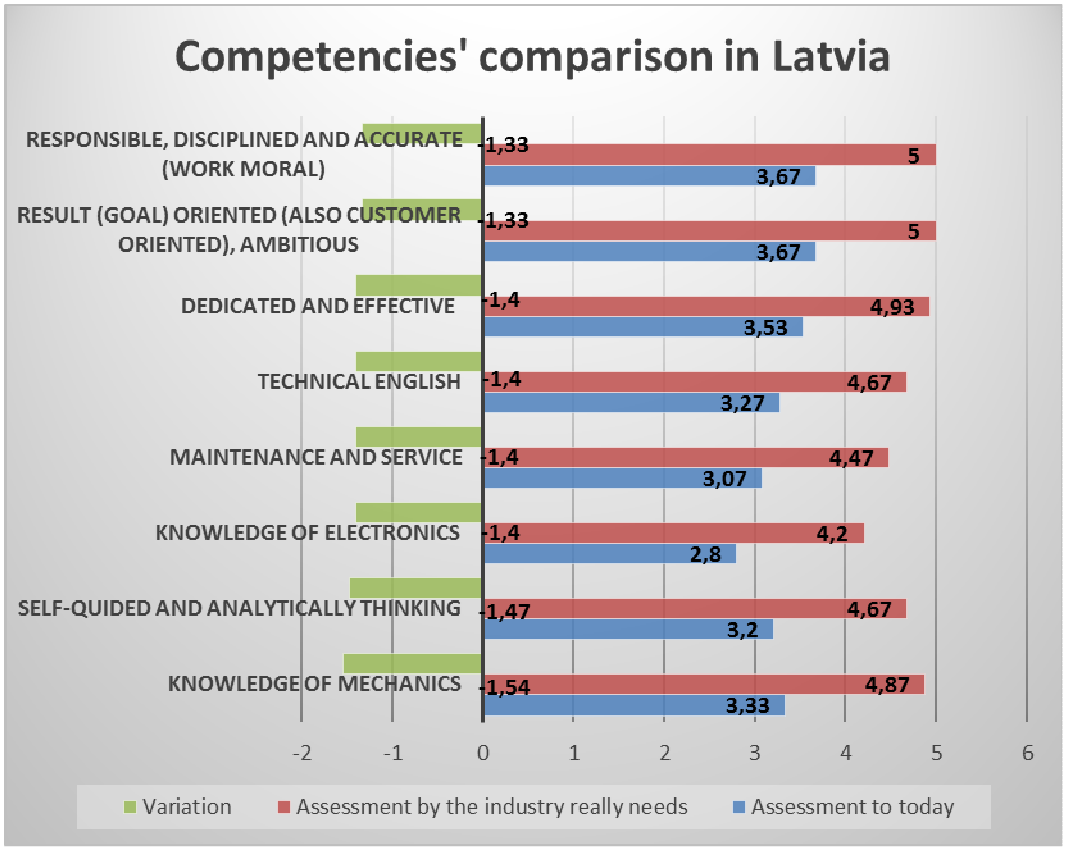

Figure 2: Competencies` comparison in Latvia.

Figure 3 shows Finland`s biggest deficiencies related to „result (goal) oriented (also customer oriented), ambitious"; „self-management and analytical thinking" and „dedication and efficiency".

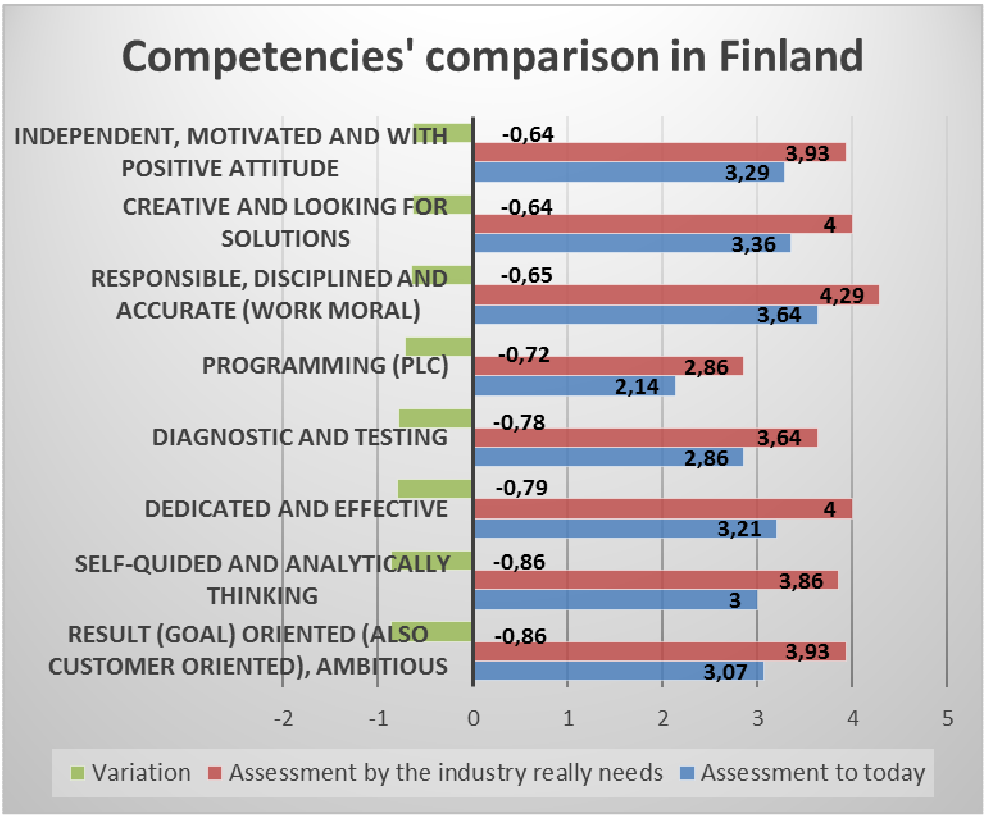

Figure 3: Competencies` comparison in Finland.

Part III: QUESTIONS DIRECTED TO THE FUTURE

3.1 The possibilities to develop competences

Estonian experience

The most important is the fact that any person would find the right sphere of activities. Anything will do, learning, listening etc. if a person only wants to… Also, the individual approach that takes into consideration the abilities of the learner is important in this field. Learning itself seems to be rather difficult and complicated, it is not easy to come out of one`s comfort zone. In Estonia one usually behaves the same in one`s working life and private life. These two different levels are not being distinguished, what is your professional or working life and what your private life and how to act correspondingly. One may proceed to the raising of narrower competences when there has been formed some kind of worldview. The perception of the world is important: how things work? How enterprises operate? How money emerges?

The best way to develop competences is through practical experience or through certain team work. According to the actual “hands-on” example the learners put the hands on the device and do the job, someone should be at his side and explain and instruct. There might be more tasks for detecting one`s mistakes, the solving of actual problems. In order to raise the competences it is important to participate, in the first place, in active and international co-operation. Language (English) and experience are the most important matters; knowledge can be acquired by reading and self-perfection.

In education it is important to pay more attention to practical tasks that resemble real-life situations. Trainings are usually competence-based. Without theory you do not understand how things work and without practice you cannot manage things, so the best way for learning is still theory and practice hand in hand. In the field of mechatronics one way is self-education where different videos and materials are being searched for to acquaint you with matters.

Although mentoring has spread sparsely in Estonia the method seems to be useful and necessary. It would be more effective than someone just helps you to solve some problem.

Latvian experience

The educational system might be module-based. In the first year the students have to be motivated because they are not interested in learning and they have not set goals. Students need practical experience with older equipment, technologies and mechanics, as well as practical training with metal work (milling, turning). Students have to develop communication skills, conflict management, knowledge on electronics and PLC. Teachers should communicate more with industry. They should acquaint themselves with latest technologies, be passionate and take an interest in new processes. In order to follow the reforms and the development of science the technical basis is necessary.

A person`s motivation to use one`s knowledge in practice and follow the newest trends is important. Educational programs should follow the needs of an enterprise and give more practical tasks. As wise and educated people are needed, young people must be allowed to use their innovative ideas.

It was suggested that companies should arrange Open Days in order to show potential workers the facilities and explain how work has been organized to give a wider understanding.

Finnish experience

Students may study through training and practice through making. Thus, the studying time and motivation of students should not be reduced. The main skills will be gained from vocational schools and knowledge at ascertaining the specific needs of the company from mentoring. At vocational schools co-operation with enterprises plays a major role. The schools and the employer have to create suitable conditions for studying.

It would be advisable if vocational schools could involve new know-how and skills from suppliers in the studying process. It would enable the teachers to upgrade their information on new technologies.

It is possible to learn through rotation that should be practiced more comprehensively.

3.2 How to innovate vocational studies?

Suggestions of the Estonian party:

First of all the mentality has to be changed. The preparation of the society and mankind has to start in elementary school already. Important is that every person can be good, it does not matter which is the education level. There is no difference whether to go to a vocational school or anywhere else.

1) The raising of the proportion of practice in studies and discussion at classes;
2) For visualizing it is important to use video material in studies;
3) In studies there might be compared different producers and their equipment; the opportunities the equipment provide should separately be observed in order to take ultimate use of them.
4) It is necessary to have additional funding for the better arrangement of studies – the current financing and budget need to be amended; software licenses are expensive, the equipment ages.
5) Teachers have to be sent to companies for practice in order to give them an overview what is going on at job sites.
6) The involvement of enterprises in studies has to be considerably higher (lecturing, the more efficient arrangement of practice, specialists have to be involved in demonstrating how they perform certain operations);
7) Young people have to be sent abroad on study tours to big companies (e.g. to Germany) in order to demonstrate the potential, capability and world standard of the mechatronics domain;
8) Vocational study should be more attractive and more of a fun (more attractive specialties, new technical equipment, exciting activities, for instance drones);
9) The mechatronics discipline assumes a more individual approach to students;
10) Schools should unite in order to procure new equipment;
11) The innovation might start with fixing the skills of a graduate of vocational training (For example: job advertisements require a document of the skills of electrical work. Students have studied it at school but they have no certificates and no idea what is their level);
12) The general proportion should be fixed nationally how much workforce and how many "academicians" are needed. What is the necessity of job market? Someone is obliged to regulate the situation.
13) To think if the innovations are always necessary?

One opinion: "I like the system of vocational training in Germany where in the first year the students are at a vocational school, in the second year they are at an enterprise part-time, in the third year they go to work for 2-3 days a week and in the fourth year they attend classes occasionally. The state will compensate it to the companies. In case a student disappears, everybody - the parents, the school and the enterprise - will answer. They have to co-operate in order the student not to vanish without a reason."

Suggestions of the Latvian party:

1) The professional standard has to be made more specific;
2) New interactive methods should be used in the studying process, more projects, practical tasks, experiments, lab work to be conducted;
3) Teachers need experience and a good technical basis, new equipment and test labs for conducting the studies;
4) Teachers need constant refreshment of the knowledge on the innovations in industry;
5) The specialties should be more confined like miller and turner. Students have to be taught to insert models like Heidenheim, Mazatrol and Fanuc;
6) Students need to have company based studies at contemporary enterprises;

7) Companies and vocational schools should have a more clear-cut co-operation;
8) If EU support should be involved in the renovation of studies the vocational schools would be highly professional.

Suggestions of the Finnish party:

1) More visits to enterprises and examples of production technologies; practice period lasts for 10 weeks in the second and third year and it usually involves only one company;
2) Study groups have to be reduced in order to have individual attention;
3) There should exist a methodology that motivated “challenging students” to learn and attend classes;
4) More team work and workshops in study;
5) Actual projects and co-operation with universities;
6) There should be less of general subjects for those who want to go to work faster in order to prepare them in 2 years;
7) Vocational schools should guide youngsters to take initiative, to impose oneself and to be more precise regarding their working hours;
8) The proportion of workplace-based studies has to be increased;
9) The international students exchange is relevant. It broadens the horizon and improves language skills.
10) The enterprising abilities of students should be supported.

3.3 What has to be done in order to improve co-operation between vocational schools and enterprises?

At present a vocational school and an enterprise live both in their separate worlds. They seem to be open but agreements remain on a formal level, nothing happens. Students should know better how real work life would look like. How will the system function? Going to work for the first time is harsh.

Suggestions of the Estonian party:

1) The state might stimulate the co-operation with enterprises;
2) Companies might donate different studying materials to vocational schools. For example, it is like that in Scandinavia (including Sweden).
3) The companies should also dare to address the vocational schools at least for the purpose of information flow.
4) Co-operation might be arranged, for instance, by professional associations and companies should show more interest; at present there are no certain goals to achieve;
5) Lecturers should be made to learn and they should be assisted in it;
6) Companies should be visited more often and the problems suggested by them solved;
7) Vocational schools should develop co-operation with alumni (round tables etc.);
8) Contacts with enterprises should be tightened (co-operation agreements, involvement in the teaching process, visits to companies/introductions of companies, training of practice supervisors);
9) Contacts should be mediated in order to introduce the students to the companies in the mechatronics field.

10) Vocational schools might explain to the companies what the studies were about. If the vocational schools give an occupation then the feedback from the companies is important for the studying process.
11) Workers should demonstrate their work places in order to show the students the real life.
12) Practice should be professional not any work that has to be done.

Suggestions of the Latvian party:

1) Vocational schools have to pay more attention to communication;
2) The benefit should be mutual;
3) The companies should show more initiative to come over to vocational schools having lectures;
4) Companies might present their outdated inventory to vocational schools for studying;
5) For co-operation, seminars might be held on new technologies and demonstrated how companies worked;
6) Both parties should deliver more information and communicate;
7) Managements should establish good relations;
8) Regular excursions might be organized to enterprises;
9) Representatives of companies should visit vocational schools on a regular basis;
10) Visit exhibitions and show interest in these themes;
11) Arrange student exchange abroad;
12) The co-operation of enterprises and vocational schools should be fixed by law.

Suggestions of the Finnish party:

1) Job-based study is important both for the students and the teachers. The teacher can build up his network with business people but also convey new ideas, wishes and knowledge the businessmen need.
2) More common forums;
3) The co-operation of enterprises and vocational schools should be fixed by law;
4) Enterprises should offer a wider range of job-based study and show up interest towards them;
5) More of active co-operation and more regular encounters between schools and companies;
6) More periods of job-based study;
7) Teachers should visit companies more often and intervene if the company does not train job-based students.

3.4 What is the future of mechatronics?

In the opinion of the Estonians the future will bring a lot in addition. For instance, the drones that did not exist earlier will be used on a daily basis. People`s creativity and imagination has no boundaries. Vocational schools should announce what will be waiting the students in the future and what is this job like – it is worth studying. Persons with this kind of education will not get in trouble in their life. It is clear that the quality in industry will go up and in the future qualified specialists will be required in industry. The raise of labour productivity can only happen through automation.

Automation is a highly required discipline but how is the curriculum distributed for the labour market? At this point specialization and profound training on different levels should be essential. Colleagues might not be competent if there is no co-operation with enterprises. The teachers might work at an enterprise for a certain period in order to teach their students according to actual necessity.

Mechatronics will have a bright future. The studies should be arranged in the way that mechatronics would be taught only to high school graduates. The study presumes also a longer so-called “digestion time”. Vocational schools might have preliminary tests in order to find out if there is any chance of covering the course. It might consist of logic puzzles or something like that. The greatest problem of the vocational school is lazy students. If there could be found a solution to this problem the reputation of vocational schools would be different. In addition, good examples could be brought in order to show who have outgrown from this school. Certainly, career planning has to be explained to the students and all kind of video materials should be used to a greater extent. Employers should request for documents from their employees, this would change the importance of vocational studies.

At present, trade schools often take the easier way what concerns the curriculum. Specialists from abroad might be invited. The flagship of mechatronics is Germany. So, foreign lecturers might be asked over. For sure, material science will be one of the future trends. New materials will change the world more and more.

The Latvians are not exactly sure about their market situation. They are not aware how production and engineering will develop and grow in their country. Still, it is considered to be necessary to deal with these themes, but they should be paid attention to on a national level. In general, this field is positively perspective. This will bring along the use of mechatronics in the daily procedures of industrial companies. The precondition for this has to be the educated and professional trade school graduate. Mechatronics will be the science of the future and the specialty will become considerably more required.

The existing programs of vocational schools need changes, some schools teach millers and turners, but no one would hire a person with general engineering education. There is no point teaching universal workers but mechanics, electronics experts and programmers.

In Finland it is also the opinion that automation goes uphill, systems get more complicated and the necessity for qualified personnel at an enterprise grows. If there is more automation the role of manual work will decrease. It may be that vocational school graduates lack skills and motivation in order to cope but for university graduates this field is not of interest as it does not involve sufficient opportunities for building up a career.

The economic situation in Finland is quite obscure at present. Some of the not highly demanding mechatronics work will be directed outside. Some of them, demanding more skills, will stay in Finland. There is a high risk and pressure of shifting production from Finland to countries where the production costs are lower. The production of electronic components will stay in Finland but the

composition of electronic products might shift to Estonia, Hungary etc. The image of industry would improve the level of qualification. The titles of disciplines have to be renamed.

In health care there is also a great necessity for changes. So, the situation has to be regarded more extensively. IT technology is being used more and more and we should strive in this field as well.

THE TOPICS OF TEACHERS

4.1 Learning process and the mentality of young people

Estonian teachers consider that although the learning process follows the changes in the mentality of young people then there are still shortcomings and promotion should be on the agenda daily (including the adjustment of actions, renovate and add materials to the website etc.). Also, the attitude of the youngsters wishes to be improved. The Latvian teachers are convinced that it is being followed and mentioned separately that the students grow together with their studies. The Finns also agree that the mentality of young people is being followed and add that the learning process is natural and supports the students in their aspirations. It is being mentioned separately that the students of mechatronics are not keen on studying theory but would like to focus on practice.

4.2 Learning materials and the development of industry

The Estonian situation concerning the learning materials of mechatronics is being characterized dually. Co-operation with some partners is characterized positively as well as good examples from e-study. But in general there prevails feedback that there are too few of special materials and they are too complicated for the level of vocational study as they have been made up on university level. There can be found articles in English but they cannot be used as clear learning material. The field is vast and it is difficult to follow constantly the new information. In the opinion of the Latvian teachers the learning materials follow the development of industry but they also think that there are too few of them and teachers have to labour hard in order to update the material. The Finnish teachers consider that the learning materials give the students basic knowledge but their updating and keeping themselves on track is just the personal initiative of the teachers. Schools cannot always afford the newest technology but is it necessary whatsoever, as every enterprise has to offer training that meets their own needs. In addition, it was thought that businessmen should be more interested in telling the vocational schools and the teachers about their needs.

4.3 Changing methods of study

The Estonians stress that in the teaching methods of mechatronics the proportion of practice has to be raised in comparison with theory as the proportion of the latter is too big and mathematics sometimes on university level. In mechatronics the volume of teaching should be increased and dealt in the first place with the development of special skills not to enlarge the proportion of the so-called “horizon subjects” (e.g. public performance). The study itself should be more interactive and videos and other visual materials for helping students should be in use. In the opinion of the Latvians attention should also be paid to mechatronics itself, to practice and tasks and to be focussed on

individual work as it is difficult to learn the subject in group. What concerns the methods, there has to been pointed out that they should not be altered but the way how data and materials are being presented. The Finns as well would like to have more time to focus on practice and for that purpose to co-operate more with enterprises. The use of different IT solutions in the study would also be of help. The former educational basis of the students is a problem as well as the lack of new methods and tools.

4.4 Teachers motivation to teach in a more innovative way

In the three countries the motivation of tutors to teach in a more innovative way is considerably high. The most important indicators in Estonia are as follow: the interest towards new things/ methods, self-development. Being innovative is important from the point of view of students, the school and specialties. Motivation is being hindered by a huge work load, the study is too theoretical and the development of technics too fast. This makes the constant renovation of study materials difficult. The Latvians say that motivation depends on every teacher himself and if they are not motivated the students do not want to study. The Finnish answers show in general a very positive attitude of the teachers toward innovation.

THE TOPICS OF ALUMNI

5.1 Learning process and the mentality of young people, view of alumni

Some of the Estonian graduates agree that the process follows the changes in the mentality of young people. The others say that one should keep up with developments, i.e. to use more e-study and IT opportunities (video material, additional materials etc.). The main problem that has been pointed out is the mentality that students did not bother to learn, they had no motivation. The Latvian graduates believe that the learning process mostly follows the mentality of young people. Although it is not easy to obtain the most recent information from the teachers as they are not able to follow the newest editions in a foreign language. Mechatronics is a future subject that offers a career opportunity and a job, so constant innovation has to be considered of. The Finnish alumni are of the opinion that the learning process follows the mentality of young people and if anybody has a problem or question the instructors helped to catch up and supported in the acquisition of information. It is also thought that vocational schools should focus on the maturing of students and explain them that they are dealing with the establishment of their career at school already.

5.2 Learning materials and the development of industry, view of alumni

Most of the respondents are of the opinion about the learning materials of the Estonian mechatronics field that they do not follow the development of industry. It was stressed that the material is outdated and most of the things have to be written down. As the level in industry is different, video materials, practical examples and tasks should be used today. Latvians also take two sides in this question. It has been pointed out that thanks to the EU support it is possible to change vocational education gradually and to obtain new machinery. The feedback of the Finns seems to be the most content – the material is considered to be pertinent and the students acquired the basics

from a vocational school and they will not age. Also, an adequate picture of the industry and expectations was formed although there might have been more practical work.

5.3 Alumni satisfaction with their career after vocational education

The alumni of the three countries are in general satisfied with their career after passing vocational education. In comparison with other countries it may be stressed that Estonian alumni are substantially more ambitious. Most of the respondents stress that they wish to apply more of the knowledge they acquired in their jobs. They want to proceed to university and plan to make a career. The Latvians and Finns are indeed satisfied but just 20% of them pay attention to further studies and the development in their career.

5.4 Alumni satisfaction with their choice by studying at vocational school

Most of the alumni have been satisfied with their choice of studying in vocational schools (right choice, I am satisfied, I have not regretted it etc.). Just a few answers from Estonia indicate that they might still have chosen university education. In Latvia it has been mentioned that learning motivation was lifted by the opportunity of having scholarship for good results. In Finland it is being stressed that the choice has justified itself as “one is not just a book-reader” and if there was a possibility to choose the person would not have spent time on high school and had gone directly to vocational school.

Conclusions

This study gives rise to the following conclusions:

1) In Finland, the problem of society is general attitude towards industry; in Estonia and Latvia, the biggest problem is the poor reputation of vocational schools.

2) In vocational education, there is no systematic and comprehensive vision of the co-operation with companies that contribute to the quality of learning and a better understanding of the expectations of employers.

3) Society does not know what is going on in industry, what are the conditions there, wage levels and possible promotions. For example, a number of key persons in industry have passed vocational studies and through constant development and work experience they have achieved leading positions.

4) An exciting future is awaiting the mechatronics field and you will never lose a job in this field.

5) In the mechatronics studies it is important that it is also focused on personal characteristics next to the development of practical skills. Learning must become much more personal, in order to raise the quality of education and reduce the number of failures.

6) Young people have a lot of choices when planning their future, many of them prefer areas that are much easier to learn. Mechatronics has to deal more seriously by the promotion and marketing of the field.

7) Entrepreneurs who are more familiar with vocational training have a sympathetic attitude towards co-operation and their expectations are realistic.

8) In the field of mechatronics educational materials have to be a lot more practical, more attractive and more visual (videos, animations). Teaching methods should include the tasks and cases, which could be analysed.

9) All countries have the same problem how to motivate young people to learn.

10) The demographic characteristics of the three states limit the field of renewal and growth.

11) All answers from all three countries indicate that vocational training and co-operation between businesses should be regulated nationally.

ESTONIA

12) In Estonia there is a cult of higher education that does not produce enough of important workers with necessary competencies to the labour market of the field of industry. Those who cannot cope anywhere else will arrive at vocational education.

13) Estonian vocational education is underfunded because the groups are large and the teachers do not have enough time to deal with each student individually. Equipment, programs, etc., essential for mechatronics, need also to be constantly renewed, but this cannot be afforded today.

14) Vocational alumni are more ambitious compared with Finland and Latvia.

LATVIA

15) Latvian vocational education is being affected by the heavy workload and teachers aging. Young talents go to enterprises, because they earn more money there than at vocational school.

16) The expectations of vocational schools and companies are controversial. Vocational schools want to teach the latest innovations in equipment, but companies are often using older devices and young people do not know how to make them work.

17) Professional Standards could be more specific and concrete.

FINLAND

18) The Finnish society has honoured vocational education for a long time already and they are more satisfied with it than in Estonia and Latvia.

19) The main problem is the cooperation with companies that do not always smooth (practise places etc.).

20) There is a well-established mentoring system that supports the development of young mechatronics.

SUMMARY

Nedia research has provided comprehensive and meaningful information on mechatronics and competences of the three states. So, it is possible to draw certain conclusions. Feedback from entrepreneurs, teachers and alumni gives a picture of the expectations and needs.

In order to learn mechatronics, a person must have the will, interest and often a bit of experience with technologies to reach professional studies. For the purpose of the development of the field, it is important to create early an interest in technics in young people (clubs of robotics and technology circles etc.) and to find in this way future students and professionals for the labour market.

The key point is the continuous development of vocational schools, the raising of the proportion of practice in the curriculum as an example, teachers` upgrading and motivation increase, time and resource planning in order to update the materials. Learning must become more personalized and more practical, in order to help the students to pass their studies, which are full of resource and at the same time extremely beneficial to the current labour market. According to Finnish example mentoring has given positive results in vocational studies. This is worth trying also in Latvia and Estonia.

Nationally, there could be a model for co-ordinating co-operation between vocational training institutions and enterprises. Today, it is of random nature and it is difficult to assess its quality. However, there are companies who are ready to contribute and vocational schools who wish to co-operate - but how, who and to what extent?

Studying should become more connected with learning places in order to make a student or a young worker aware of what are real work and the associated culture, as well as the skills necessary for work. Companies are afraid that if they train an employee he will certainly go to the next company where they do not need longer preparation. At this point we could think how the state could support businesses in this process.

Mechatronics should be marketed fully independently, to provide positive examples of practice and to involve bright-eyed graduates and professionals to talk about their career choice and job opportunities. At this point different schools should converge at promoting mechatronics and agree on how to do it collectively. Only promoting the area helps to stay competitive in comparison with other specialties.

Finland has a different mentality. People wish to acquire a solid profession and after it, if possible, to move on with their careers. Estonia and Latvia have a different mentality - a rapid career and quick money. It sometimes happens that people with a master's degree find themselves in vocational schools, because they cannot do anything with their knowledge in the labour market.

Altogether, it can be emphasized that according to the information there are lots of opportunities how to move forward and these opportunities should not be missed, because in today's difficult economic situation smart solutions and talented professionals are needed.

APPENDIX 1

Chart 1: List of surveyed teachers, alumni and companies` representatives

	Teacher	Organization
Estonia		
1	T1	EE1
2	T2	EE2
3	T3	EE3
4	T4	EE2
5	T5	EE4
6	T6	EE5
7	T7	EE2
Latvia		
8	T8	LAT1
9	T9	LAT1
10	T10	LAT2
11	T11	LAT3
12	T12	LAT4
13	T13	LAT2
14	T14	LAT1
Finland		
15	T15	FIN1
16	T16	FIN2
17	T17	FIN3
18	T18	FIN3
19	T19	FIN3
	Alumni	**Organization**
Estonia		
20	AL1	EV1
21	AL2	EV1
22	AL3	EV2
23	AL4	EV3
24	AL5	EV4
25	AL6	EV5
26	AL7	EV1
27	AL8	EV6
Latvia		
28	AL9	ALAT1
29	AL10	ALAT2
30	AL11	ALAT3
31	AL12	ALAT4

32	AL13	ALAT1
33	AL14	ALAT5
Finland		
34	AL15	AFIN1
35	AL16	AFIN1
36	AL17	AFIN2
37	AL18	AFIN3
38	AL19	AFIN3
39	AL20	AFIN4
40	AL21	AFIN4

Companies

Estonia	
41	COM1
42	COM2
43	COM3
44	COM4
45	COM5
Latvia	
46	COM6
47	COM7
48	COM8
49	COM9
50	COM10
Finland	
51	COM11
52	COM12
53	COM13
54	COM14
55	COM15

APPENDIX 2 Questionnaires

I Teachers questionnaire

NEDIA QUESTIONNAIRE

Project NEDIA purpose is to analyse the new needs in the industry and necessary competences in the field of mechatronics today and in the future, which give input how to develop vocational studies and which kind of new didactical solutions are needed.

Background information

Respondent name:

Respondent position:

Teacher questions:

T1 How long is Your experience in Your field?

T2 Does the studying process follow the changes of mentality of young people?

T3 Do the studying materials follow the development in industry?

T4 What would You like to change in Your teaching methods?

T5 What about Your motivation to teach in more innovative way?

I part

Open questions:

1.1 Does the level of vocational studies satisfy companies` needs in mechatronics/mechanical engineering? Please justify your opinion.

1.2 What do You think which are the main **strengths** of vocational studies?

1.3 What do You think which are the main **weaknesses** of vocational studies?

1.4 Which are the main problems with workers competencies?

1.5 How do companies usually teach their employees if they need some new knowledge or there is a need to solve some kind of problem? (Some examples: Inside trainings, mentoring, do they have co-operation with vocational schools?)

II part

Please rate mechatronics area competencies in Your point of view:

a) realistic situation and level at the moment?

b) what level is actually needed?

Score: 1 - not important at all; 2 – not so important; 3 – important; 4 - very important; 5 – crucial.

Competencies list	Realistic situation and level at the moment	What level is actually needed?
2.1 Machine assembly		
2.2 Maintenance and service		
2.3 Knowledge of hydraulics and pneumatics		
2.4 Reading and using technical documents (drawings, schemes etc.)		
2.5 Programming (PLC)		
2.6 Knowledge of electrical engineering		
2.7 Automation assembly		
2.8 Diagnostic and testing		
2.9 Industrial networks		
2.10 Knowledge of mechanics		
2.11 Knowledge of electronics		
2.12 Locksmith works		

Additional:

2.13 Technical English		
2.14 Russian/Swedish		
2.15 Work experience		
2.16 Work safety		

Personality traits

2.17 Creative and looking for solutions		
2.18 Self-conscious and eager to learn(personal development)		
2.19 Result (goal) oriented (also customer oriented), ambitious		
2.20 Independent, motivated and with positive attitude		
2.21 Dedicated and effective		
2.22 Self-guided and analytically thinking		
2.23 Responsible, disciplined and accurate (work moral)		
2.24 Co-operative, adaptable and flexible (including teamwork)		

III part FUTURE oriented topics

3.1 Which could be the best way to develop competencies?

3.2 How to innovate vocational studies?

3.3 What to do for better co-operation between vocational schools and companies?

3.4 How do You see the future in mechatronics? What kind of influences we can forecast?

II Alumni questionnaire

NEDIA QUESTIONNAIRE

Project NEDIA purpose is to analyse new needs in the industry and necessary competences in the field of mechatronics today and in the future, which give input how to develop vocational studies and which kind of new didactical solutions are needed.

Background information

Respondent name:

Respondent position:

Alumni questions:

A1 Graduate year and program:

A2 Does the studying process follow the changes of mentality of young people?

A3 Do the studying materials follow the development in industry?

A4 Are You satisfied with Your career after vocational education?

A5 What do You think, did You make a right decision choosing studies in a vocational school?

I part

Open questions:

1. Does the level of vocational studies satisfy companies` needs in mechatronics/mechanical engineering? Please justify your opinion.
2. What do You think which are the main **strengths** of vocational studies?
3. What do You think which are the main **weaknesses** of vocational studies?
4. Which are the main problems with workers competencies?
5. How do companies usually teach their employees if they need some new knowledge or there is a need to solve some kind of problem? (Some examples: Inside trainings, mentoring, do they have co-operation with vocational schools?)

II part

Please rate mechatronics area competencies in Your point of view:

a) realistic situation and level at the moment?

b) what level is actually needed?

Score: 1 - not important at all; 2 – not so important; 3 – important; 4 - very important; 5 – crucial.

Competencies list	Realistic situation and level at the moment	What level is actually needed?
2.17 Machine assembly		
2.18 Maintenance and service		
2.19 Knowledge of hydraulics and pneumatics		
2.20 Reading and using technical documents (drawings, schemes etc.)		
2.21 Programming (PLC)		
2.22 Knowledge of electrical engineering		
2.23 Automation assembly		
2.24 Diagnostic and testing		
2.25 Industrial networks		
2.26 Knowledge of mechanics		
2.27 Knowledge of electronics		
2.28 Locksmith works		

Additional:

2.29 Technical English		
2.30 Russian/Swedish		
2.31 Work experience		
2.32 Work safety		

Personality traits

2.17 Creative and looking for solutions		
2.18 Self-conscious and eager to learn(personal development)		
2.19 Result (goal) oriented (also customer oriented), ambitious		

2.20 Independent, motivated and with positive attitude		
2.21 Dedicated and effective		
2.22 Self-guided and analytically thinking		
2.23 Responsible, disciplined and accurate (work moral)		
2.24 Co-operative, adaptable and flexible (including teamwork)		

III part FUTURE oriented topics

3.5 Which could be the best way to develop competencies?

3.6 How to innovate vocational studies?

3.7 What to do for better co-operation between vocational schools and companies?

3.8 How do You see the future in mechatronics? What kind of influences we can forecast?

III Companies questionnaire

NEDIA QUESTIONNAIRE

Project NEDIA purpose is to analyse new needs in the industry and necessary competences in the field of mechatronics today and in the future, which give input how to develop vocational studies and which kind of new didactical solutions are needed.

Background information

Respondent name:

Respondent position:

Company questions

C1 Organisation name:

C2 Sector:

C3 Products:

C4 How many employees?

C5 What are the main processes?

C6 Last year turnover?

C7 Export - which countries, ratio:

I part

Open questions:

1. Does the level of vocational studies satisfy companies` needs in mechatronics/mechanical engineering? Please justify your opinion.
2. What do You think which are the main **strengths** of vocational studies?
3. What do You think which are the main **weaknesses** of vocational studies?
4. Which are the main problems with workers competencies?
5. How do companies usually teach their employees if they need some new knowledge or there is a need to solve some kind of problem? (Some examples: Inside trainings, mentoring, do they have co-operation with vocational schools?)

II part

Please rate mechatronics area competencies in Your point of view:

a) realistic situation and level at the moment?

b) what level is actually needed?

Score: 1 - not important at all; 2 – not so important; 3 – important; 4 - very important; 5 – crucial.

Competencies list	Realistic situation and level at the moment	What level is actually needed?
2.33 Machine assembly		
2.34 Maintenance and service		
2.35 Knowledge of hydraulics and pneumatics		
2.36 Reading and using technical documents (drawings, schemes etc.)		
2.37 Programming (PLC)		
2.38 Knowledge of electrical engineering		
2.39 Automation assembly		
2.40 Diagnostic and testing		
2.41 Industrial networks		
2.42 Knowledge of mechanics		
2.43 Knowledge of electronics		
2.44 Locksmith works		

Additional:

2.45 Technical English		
2.46 Russian/Swedish		
2.47 Work experience		
2.48 Work safety		

Personality traits

2.17 Creative and looking for solutions		
2.18 Self-conscious and eager to learn(personal development)		

2.19 Result (goal) oriented (also customer oriented), ambitious		
2.20 Independent, motivated and with positive attitude		
2.21 Dedicated and effective		
2.22 Self-guided and analytically thinking		
2.23 Responsible, disciplined and accurate (work moral)		
2.24 Co-operative, adaptable and flexible (including teamwork)		

III part FUTURE oriented topics

3.1 What could be the best way to develop competencies?

3.2 How to innovate vocational studies?

3.3 What to do for better co-operation between vocational schools and companies?

3.4 How do You see the future in mechatronics? What kind of influences we can forecast?