



Erasmus+

ARCHIMEDES

IMECC

Innovative Manufacturing Engineering  
Systems Competence Centre

New didactical approach in mechatronics  
vocational education – NEDIA

# O1 REPORT

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

24th AUGUST 2016

PROJECT NO 2014-1-EE01-KA202-000490



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# Research purpose

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**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.



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# Execution

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- **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.



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## The NEDIA questionnaire consisted of different stages:

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**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?

**Part II:** Assessment of competences a) the actual situation today; b) what level is, in fact, needed. The distribution of the list of competences: Job-related competences (12); Job-related additional skills (4; e.g. technical English); Personal characteristics (8; e.g. creative and problem solving etc.)

**Part III:** Themes connected with the future: how to renovate vocational training, how do you visualize the future of mechatronics.



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# The distribution of the list of competences:

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- Job-related competences (12)
- Job-related additional skills (4; e.g. technical English)
- Personal characteristics (8; e.g. creative and problem solving etc.)



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# The number of persons interviewed within Nedia project

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<u>Together:</u>	<u>Estonia</u>	<u>Latvia</u>	<u>Finland</u>
Teachers	7	7	5
Alumni	8	6	7
Entrepreneurs	5	5	5
	<b>20</b>	<b>18</b>	<b>17</b>
<u>Interviews</u>	<b>55</b>		



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# Part 1

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- 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?



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

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- There is not clear answer. All participants 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.**



## What are the strong points of vocational education?

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- **Estonia:** practical skills and learning by doing that the university graduates lack; to focus on a certain specialty and to learn how to use certain equipment; it is possible to become a very strong specialist depending on the person`s own will; 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.
- **Latvia:** 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; graduates understand mechanics and technical documents, they have good technical English. Automatics, basics of programming and technical programs like AutoCAD and Solidwork are known.
- **Finland:** after practical knowledge and skills vocational education gives also good manners and a right attitude; good learning conditions and dedicated employees who have time to deal with students; the training is carried out in workshops and there are few theoretical classes. As the level of basic knowledge is good; opportunity to study at a vocational school and at the same time attend high school courses.

# The main weaknesses of vocational education



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- **Estonia:** In Estonia the main weakness of vocational education is the public mentality and attitude that vocational training is poor and second-rate. The birth rate is low and everybody fights for the number of students; the figures of graduates are important, not their quality; if it is not managed to complete a group there will be no financing either, but if the group is smaller the learning outcome will be of considerably better quality for the job market.
  - **Latvia:** 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 problematic; teaching quality is reproached for being orientated to technological renovations while several enterprises need still the ability to use older equipment.
  - **Finland:** 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; it is hard to motivate students who have not been successful at general schools.



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## What are the main problems in the competence of workers

**Estonia:** Mechatronics is a domain that is costly to teach and often the means for learning are missing; no teachers; practical skills that are 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.

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.



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## What are the main problems in the competence of workers

**Latvia:** 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.



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# What are the main problems in the competence of workers

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**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. 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 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.

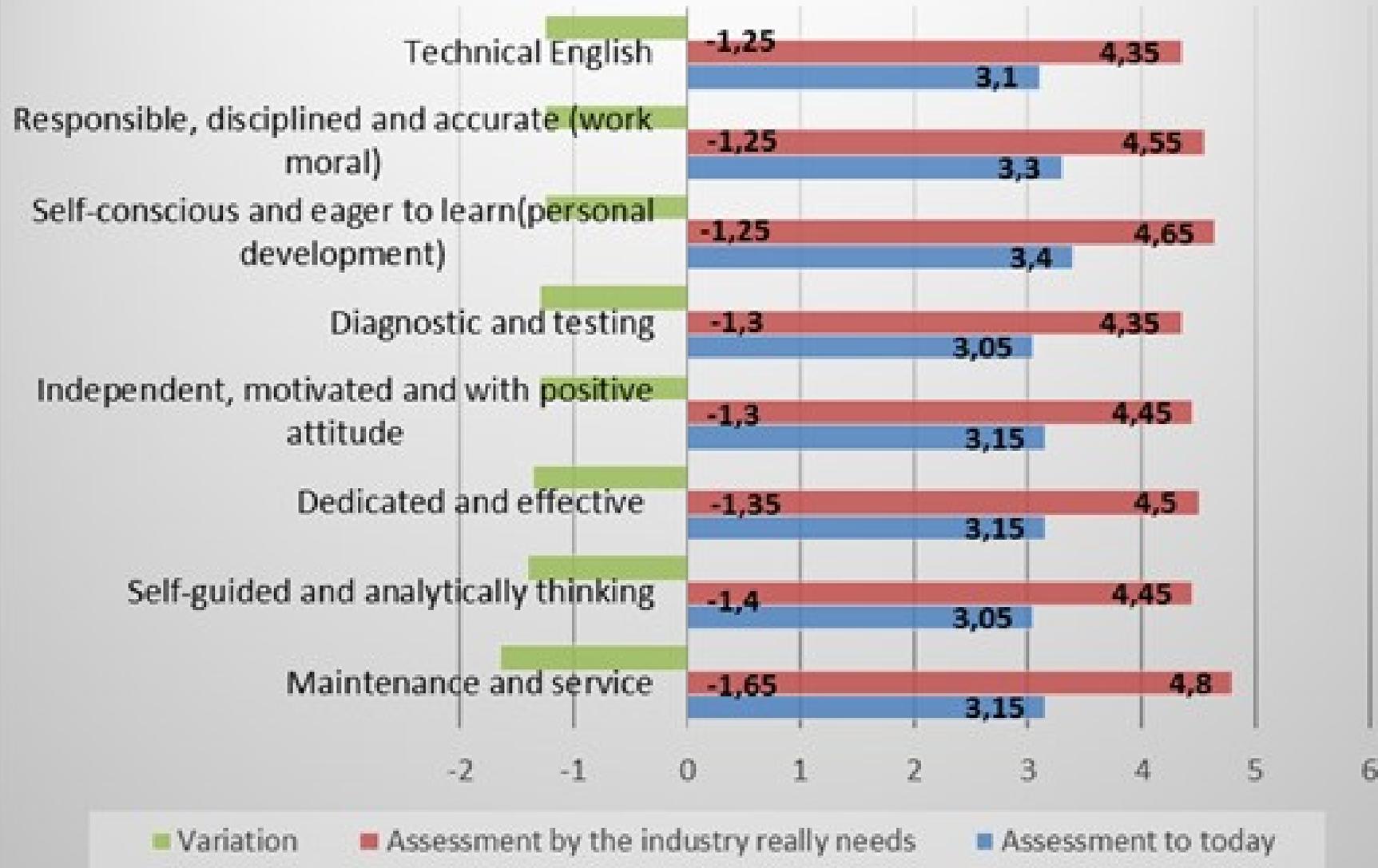
Additional skills: limited working skills.

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.

# Competencies' comparison in Estonia



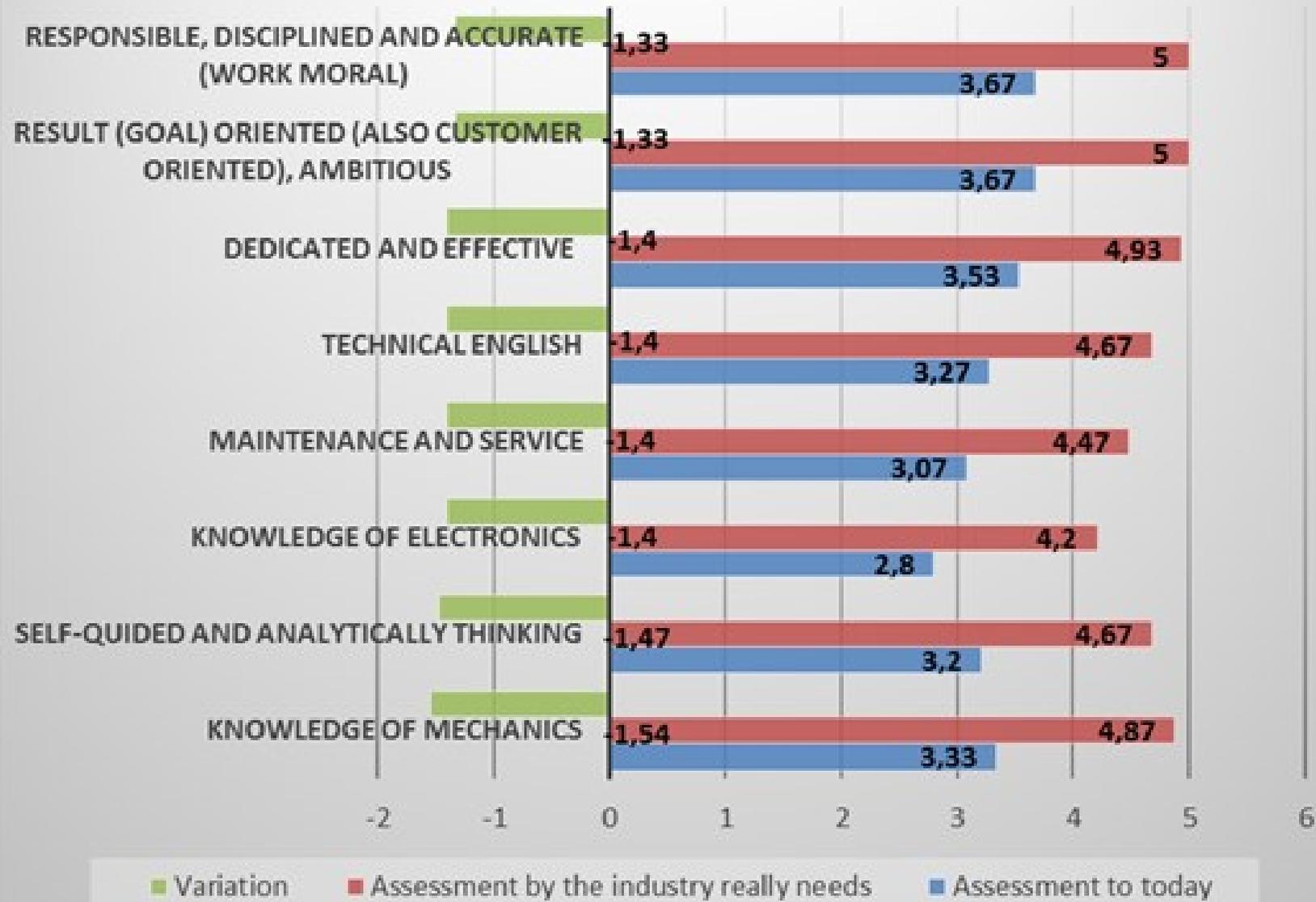
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# Competencies' comparison in Latvia



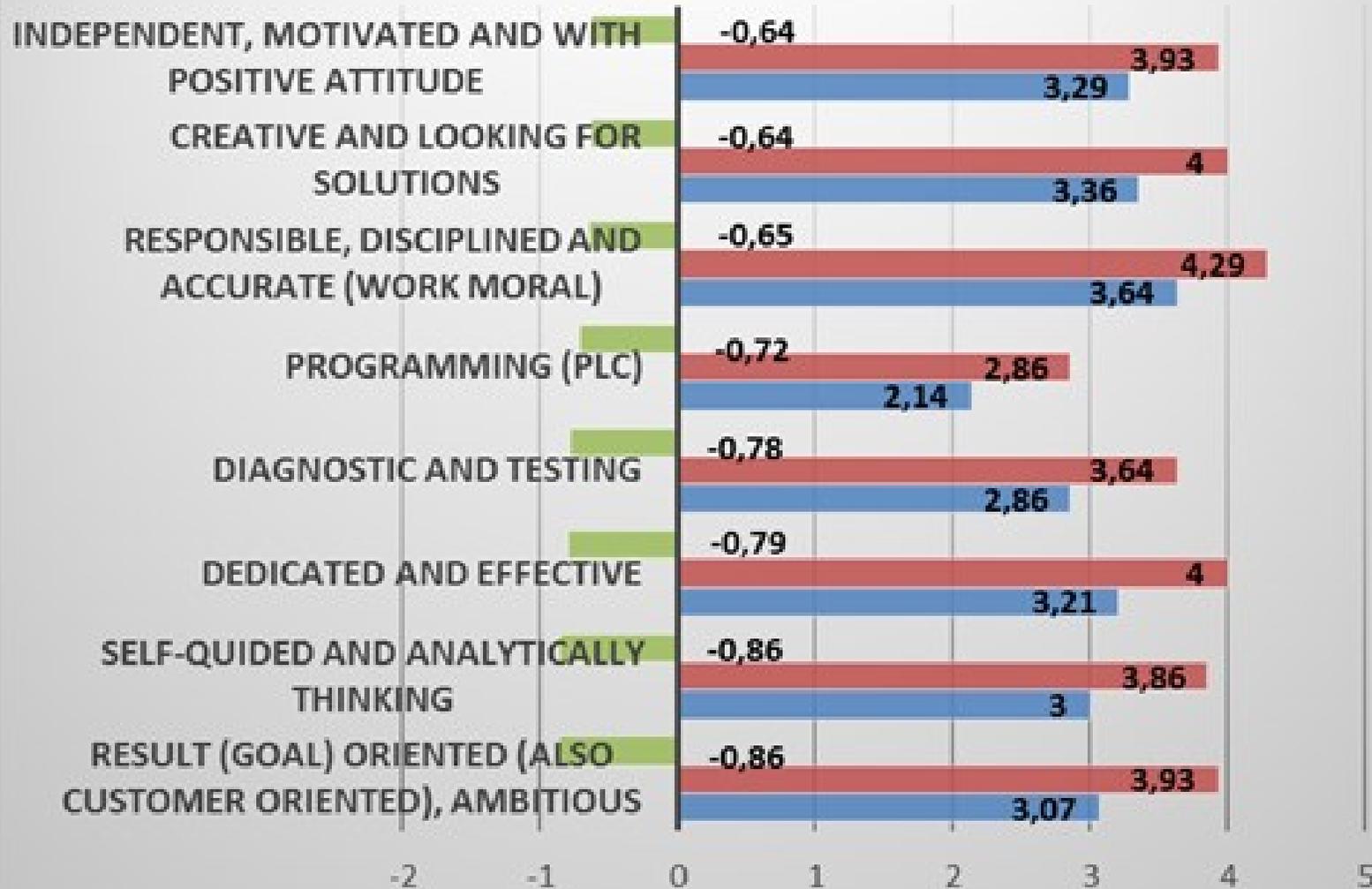
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# Competencies' comparison in Finland



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■ Variation ■ Assessment by the industry really needs ■ Assessment to today



# Competences where there is the greatest difference between necessity and reality

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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

# How to innovate vocational studies?



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**ESTONIA: 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; NEDIA

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?



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## LATVIA:

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- 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.



## FINLAND

- 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.



# What is the future of mechatronics?

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- 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.
- 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.



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# What is the future of mechatronics?

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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.



# What is the future of mechatronics?

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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.



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# Conclusions

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- 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.



# Conclusions

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- 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.



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# Conclusions

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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**.



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# ESTONIA FEEDBACK

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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.**



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# LATVIAN FEEDBACK

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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.



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# FINLAND FEEDBACK

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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



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**\* 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?



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# Summary

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\* 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.



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# Summary

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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.**



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# Final research

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You can find final reports from IMECC OÜ website: [www.imecc.ee](http://www.imecc.ee)

[In English: http://www.imecc.ee/wp-content/uploads/2015/10/Project-Nedia-final-report-O1.pdf](http://www.imecc.ee/wp-content/uploads/2015/10/Project-Nedia-final-report-O1.pdf)

[In Estonian: http://www.imecc.ee/wp-content/uploads/2015/10/Projekti-NEDIA-l%C3%B5pp-raport-O1.pdf](http://www.imecc.ee/wp-content/uploads/2015/10/Projekti-NEDIA-l%C3%B5pp-raport-O1.pdf)



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Thank You!