MECHMATE

Strategic Partnership in the field of Mechatronics for innovative and smart growth of European manufacturing SMEs

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SMEs' requirements and constraints with respect to introduction and training of innovation mechatronics technologies in their production process

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Contents

Abbreviations (if necessary/used in text)

ICT	Information and Communication Technology
IT	Information Technology
LCMS	Learning Content Management System
LMS	Learning Management System
LO	Learning Resources/Objects
HW	Hardware
MS	Management of SMEs
RTD, R&D	Research and Technological Development
SME	Small and Medium Enterprise
SW	Software
TC	Trainers and Consultants
TS	Technical Staff
GUS	**Central Statistical Office**

1 Introduction

Manufacturing is a central pillar of the European economy – the EU manufacturing sector accounts for 2 million companies and 33 million jobs. MechMate project addresses the problems of manufacturing SMEs' managers, people employed in SMEs (technicians, administrative staff) as well as students and trainers/ teachers in terms of mechatronics and lack of training means to facilitated innovation mechatronics - based technology introduction in manufacturing SMEs in Europe. The main objective is to provide an interactive training on mechatronics and to assist advanced mechatronics-based technologies introduction in manufacturing SMEs across Europe to support increase the level of innovativeness of SMEs and finally result for them in a significantly higher competitiveness on the European and global market.

During the first phase of the project partners conducted a research on requirements and constraints with respect to introduction and training of innovation mechatronic technologies in manufacturing SMEs production process. This document provides specific information on actual needs, requirements & preferences of the MechMate target groups that will be valuable during the MechMate products development. The Report gives detailed information on the status-quo and understandings from the point of view of real SMEs belonging to the manufacturing sector operating in partners' countries.

The report will be the basis for next project steps and will guarantee that MechMate products will correspond to real problems and needs of SMEs with regret to the innovation and mechatronic-based technologies implementation without overlapping currently existing programmes.

2 Context analysis in Partner Countries

2.1 Poland

2.1.1 Status of production SMEs in Poland

Number and structure of enterprises in Poland

According to the statistical data in Poland in 2015 there were 1.84 million non-financial corporations, referred to as active enterprises. Among these companies, the majority (99.8%) are micro, small and medium enterprises - there are respectively 1.76 million, 59.2 thousand and 15.5 thousand. Large businesses are group of 3,4 thousand enterprises.

The structure of working in enterprises in Poland was - according to GUS data for 2014 - dominated by the service sector, which is the workplace for 3.3 million people. Industry created jobs for 2.9 million people and trade for 2.2 million people.

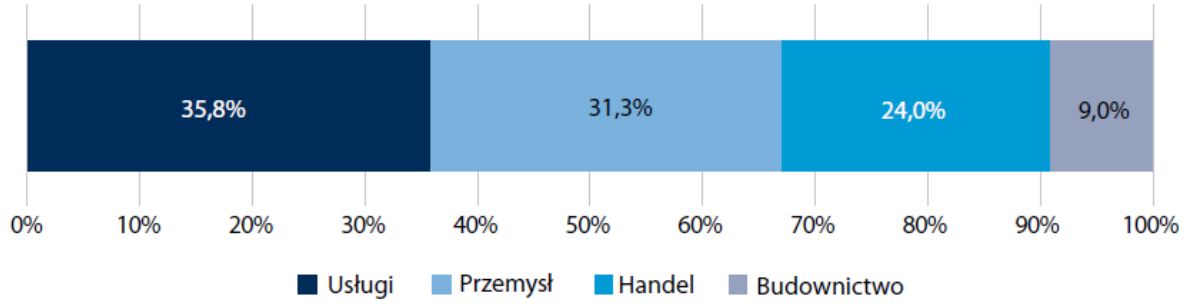

Fig.1 Employment structure of people working in companies in Poland in 2014

Barriers to economic activity for entrepreneurs.

The questionnaire surveys "*Development trends in micro, small and medium enterprises from the perspective of entrepreneurs"*, carried out by the Ministry of Economic Development shows information on barriers to economic activity faced by entrepreneurs. The most recent questionnaire survey was carried out at the turn of February and March 2016.

The primary problem, which entrepreneurs have been facing for many years is the level of taxes and fees provided by law. These issues are more important for the self-employed than for entrepreneurs employing workers. The second barrier to running a business, which has been pointed to most frequently, are low turnovers. Some respondents point to complexity of regulation. Other problems are competition from large enterprises and small companies and the problem of bureaucracy. Factors related to employees, i.e. costs, qualifications is also a barrier that would be important to entrepreneurs in similar degree to those coming directly from external environment.

2.1.2 Requirements and constrains for introduction of innovative technologies in Polish SMEs

The level of innovation of Polish manufacturing enterprises in the SME sector differs significantly from that of the old EU countries. It is also very different from most of the new member states of the European Union coming from central and southern Europe. This is due, among other things, to the fact that SMEs are more reliant on informal and therefore difficult-to-measure R & D and rarely use external sources of knowledge than their larger counterparts and have less ability to absorb external knowledge. Nevertheless, companies in this sector are innovating primarily through new competitive products or specialized production technologies. They use it as an element of gaining and maintaining their market position. Each company has its own specific innovative behavior. Manufacturing enterprises in the SME sector use both simple imitations and also in these companies radical innovations. Also, most Polish manufacturing companies of various industries declare their interest in implementing innovation.

At the time of innovation, there are different kinds of problems in the enterprise that effectively discourage the entity from introducing such activities. SMEs do not often carry out innovative activities because they do not have their own resources or cannot obtain foreign capital. The owner and often the managerial staff have no knowledge or competence in this regard; There are also no isolated R & D cells in companies. Uncertain demand is also a big barrier for this type of business, as failure with a product can end up in bankruptcy. Institutional barriers have no impact on the institutional barriers and there are many in the Polish economy. The reasons for the low innovation of the SME sector can be traced to the fact that there are no such significant competition in many domestic markets in Poland as in the leading countries of innovation, which may result in many companies not motivating to create more innovative solutions. All business entities must have the internal ability to create new products, technologies or organizational methods, as well as be able to absorb and apply knowledge produced outside the enterprise. However, the SME sector has more problems with its internal innovation capacity than large companies, although in niche areas they can gain technical and market advantage. Factors limiting the innovation of the SME sector can also include: financial constraints, lack of marketing skills, management irregularities, time constraints, difficult access to external consulting services. Often also the person managing the enterprise does not have sufficient knowledge of the economic processes, and therefore reluctance to innovate. Entrepreneurs, even though they do not have the ability to forecast economic phenomena and management skills very rarely, also decide to save on the use of third party consulting services.

All these barriers significantly affect the very low innovation of small and medium-sized manufacturing companies, leading to the fact that they are unable to compete with other players in the global market and achieve competitive advantage through innovation.

Implementing innovation is not an easy process and requires a lot of knowledge and above all the persistence and patience of entrepreneurs. The process of introducing them consists of:

• identification of innovations (including, but not limited to, the needs of the company and its customers and the technology that can be met);
• planning innovation implementation (including: selection and selection of technologies, technology purchase negotiations, innovation preparation, preparation of technology implementation plan);
• implementation (among others: model, organizational change and processes, implementation financing);
• monitoring and modification of innovations (inter alia: production monitoring, sales monitoring, customer feedback, organizational change, process or marketing changes, product modification).

Given these factors, the MechMate project will help manufacturing companies to prepare for innovation by providing knowledge to better identify potential sources of innovation and to prepare for the implementation of advanced mechatronics solutions..

2.1.3 Requirements and constrains for application of vocational training courses in in Polish SMEs

At present, no institution is no longer able to maintain a competitive advantage on the market in the longer term without increasing the qualifications of its employees.
Workforce improvement activities are more often undertaken by larger, more innovative and growing companies. Corporations see employee training as a long-term investment, of great importance for the development of resources for the organization. They therefore seek to apply and elaborate a variety of vocational training instruments, including the most advanced ones, such as the enchacement of individual plans for the development of employees, and in the unfavorable economic climate at least try not to limit training budgets. The situation is different in the small business sector, whose educational and training activity is exceptionally vulnerable to economic fluctuations.
Continuous improvement of the qualifications of the employees is conditional on maintaining market position. The size of the business also determines the choice of the form of training. Among the most popular forms of conducting classes among micro-businesses, open training is clearly predominant. Their merits include, in particular, a great variety of topics, a lower cost of sending a few or even one employee to them, and the possibility of networking and exchanging experiences with participants who work for companies. On the other hand, as the number of employees increases and the complexity of the organization structure increases, the frequency of using open training is reduced to closed training. This is due to the lower cost of this form of training the case of a larger number of employees. The term of the course is then determined according to the client's wishes, as well as the detailed thematic scope, adapted to the current needs of the contracting authority.
Small companies prefer open training, corporations are more likely to choose training that is tailored to their individual needs. Although there is still a significant part of the overall number of training courses required (eg Health and Safety at Work), this can be explained by

the financial rationality of the companies that first select the necessary training and then, after a certain minimum, decide on a specific direction for individual or team development. Significant differences in the structure of training vary from sector to sector.

More and more of the training is typically industry-specific and results from education or further training that is inseparable from the path of development of a particular profession or occupation.

On the occasion of the research on the topic of training, it turned out that there was a gap between the training needs of the examined subjects and the topics of training chosen by them. The market is dominated by training aimed at meeting current needs, while employees - employers - the most lacking professional competencies and so-called. "Soft" - individual, interpersonal, managerial or cultural (eg. teamwork, multicultural, communicative, time-efficient, flexible, open to change and empathy for understanding and understanding business needs of the company). Nevertheless, companies increasingly focus on tailoring training to the company's current needs, in line with business objectives or development strategy, and creating the same demand for such training, also exerting an influence on changing the offerings of training companies.

2.2 Greece

2.2.1 Status of production SMEs in Greece

Number and structure of enterprises in Greece

The following statistics/data come from the 2016 Small Business Act for Europe (SBA) Fact Sheet for Greece [European Commission, 2016]. SMEs are highly important to the Greek 'non-financial business economy'. According to the SBA Fact Sheet, SMEs in Greece generate three quarters of added value and almost 90 % of employment, compared to an average of 60 % and two thirds respectively throughout the rest of the EU. Micro firms are the backbone of the Greek economy, providing almost 60 % of employment and 36 % of added value. SMEs are largely concentrated in wholesale and retail trade, where almost 40 % of SME employment and added value is generated.

Class size	Number of enterprises			Number of persons employed			Value added		
	Greece		EU-28	Greece		EU-28	Greece		EU-28
	Number	Share	Share	Number	Share	Share	Billion €	Share	Share
Micro	682 132	96.8 %	*92.8 %*	1 264 804	59.1 %	*29.5 %*	17.0	35.9 %	*21.2 %*
Small	19 631	2.8 %	*6.0 %*	361 331	16.9 %	*20.2 %*	9.6	20.3 %	*18.0 %*
Medium-sized	2 576	0.4 %	*1.0 %*	241 105	11.3 %	*17.0 %*	9.0	18.9 %	*18.2 %*
SMEs	**704 339**	**99.9 %**	***99.8 %***	**1 867 240**	**87.3 %**	***66.8 %***	**35.6**	**75.1 %**	***57.4 %***
Large	397	0.1 %	*0.2 %*	271 720	12.7 %	*33.2 %*	11.8	24.9 %	*42.6 %*
Total	**704 736**	**100.0 %**	***100.0 %***	**2 138 960**	**100.0 %**	***100.0 %***	**47.4**	**100.0 %**	***100.0 %***

These are estimates for 2015 produced by DIW Econ, based on 2008-2013 figures from the Structural Business Statistics Database (Eurostat). The data cover the 'non-financial business economy', which includes industry, construction, trade, and services (NACE Rev. 2 sections B to J, L, M and N), but not enterprises in agriculture, forestry and fisheries and the largely non-market service sectors such as education and health. The advantage of using Eurostat data is that the statistics are harmonised and comparable across countries. The disadvantage is that for some countries the data may be different from those published by national authorities.

Fig.1 Constitution of "Non-financial business economy" in Greece (from 2016 SBA Fact Sheet for Greece)

SMEs in Greece were hit hard by the crisis and have still not recovered. Added value and employment in 2015 were 35 % and 22 % below their respective values in 2008. Most recently, the ongoing recession has turned to stagnation. Whereas for five years in a row, both added value and employment were contracting, added value remained roughly constant in 2014 and 2015. For SME employment, the negative trend ended in 2015.

In the manufacturing sector, SMEs were strongly affected by the economic crisis. Added value fell by 41 % between 2008 and 2015 and employment contracted by 32 %. SMEs in the pharmaceutical sector stand out, however, as they outperformed SMEs in most other manufacturing sectors.

Barriers to economic activity for entrepreneurs.

According to the findings of several surveys, it seems that the socioeconomic environment in Greece does not encourage advance of entrepreneurial activities, negatively influencing

competitiveness and the business environment and thus numerous economic and policy implications are derived [Bitzenis et al., 2011]. The lack of financing support has been a major constraint for entrepreneurs in Greece for many years. Other important barriers to entrepreneurship in the Greek market have been the "monster" of bureaucracy, followed by the taxation system, corruption, and the labor market. The strong competition from larger firms but also same-sized enterprises is another problem. Additionally, the educational system does not provide sufficient practical skills to graduates required to start-up a business. More recently, SMEs have faced high cost and difficult access to credit as risk premiums rose and banks weakened. According to the European Central Bank (ECB), access to finance is regarded as the most important problem of Greek SMEs [Bitzenis et al., 2011].

On the positive side, as a result of the recent adoption of several measures and policies in Greece, referred in the EC 2016 Small Business Act for Europe (SBA) Fact Sheet for Greece [European Commission, 2016], with regard to access to finance, some 2500 SMEs are expected to be established, or advance their operations, and improve their cash flow. As a result, approximately 15000 jobs are expected to be created. The new measures lack multi-level funding mechanisms and tools to assist and advise SMEs — individually or collectively — on how to use the new funds. Another notable measure, linked to entrepreneurship, is an initiative that aims to help some 1800 SMEs improve their operations by investing in technological and commercial modernization, the use of ICT, the standardization and certification of products, and in improving their products and the quality of their services. A third measure of particular importance which was implemented during the reference period relates to skills & innovation. A new programme aims to support the establishment of innovative start-ups. Overall, the measure will use total funding of EUR 120 million to create 2500 new businesses and 4500 new jobs. As mentioned by stakeholders, *the issue of innovation skills development is considered of primary importance for Greek enterprises in general and SMEs in particular and should be further supported at policy level.*

2.2.2 Requirements and constrains for introduction of innovative technologies in Greek SMEs

Innovation is considered as the major key for the survival, growth and development of the small and medium-sized enterprises [Acs and Audretsch, 1990]. Thus, SMEs in order to sustain their competitive advantage must continuously exploit new opportunities, as their capacity to develop new products and to innovate "are in the very core of value creation" [Hurmelinna-Laukkanen et al., 2008]. Manufacturing SMEs more specifically must continuously improve their manufacturing processes in order to achieve long-term sustainability [Lagace and Bourgault, 2003]. In addition, there is strong evidence to support the significance of innovation in the manufacturing sector. Manufacturing SMEs are capable to maintain their position in the market through product innovation [Wright et al., 2005]. Furthermore, through a process innovation scheme they can improve their competitiveness by reducing production costs and increasing the flexibility of their productive mechanism [Lefebvre et al., 1991].

Innovation management, especially after the economic crisis of 2008 – 2009, emerges as a powerful way to facilitate a firm's adaptation to new conditions [Dervitsiotis, 2010]. The

necessary adaptation to a changing business landscape can occur only through successful innovations for new products or processes, innovations for more effective business models and innovations for new leadership styles and organizational structures [Dervitsiotis, 2011].

However, there are several barriers to the process of innovation in Greek SMEs, as pointed out by the findings of Piperopoulos (2007), such as "old" management techniques, bureaucratic structures, lack of financial support by governmental sources and the lack of university-business cooperation. They also hinted toward the attitudes of some Greek business men who do not introduce new management thinking and knowledge in order to propel their SMEs towards the fierce competition of the internationalized economy, and do not engage in university-business-government co-operations, which according to evidence from international research studies and literature could assist innovative activities [Piperopoulos, 2007]. Sa and Abrunhosa (2007) use the term 'innovation' as embracing the creation or application of new knowledge to generate value through the introduction of new or substantially improved products, processes, markets or organizational forms. However, access to external knowledge that will create new innovation skills is limited in Greek SMEs, as described in the next chapter. Moreover, in a survey performed by the National Bank of Greece on SMEs on the basis of a questionnaire submitted to a sample of 1,200 companies, ⅔ of export-oriented and innovative SMEs state that there is a lack of skills (this is double the figure stated by traditional SMEs) – implying difficulties in finding staff that can meet the greater demands of a global competitive environment [National Bank of Greece, 2016].

A positive measure recently taken by the Greek government offers tax-breaks to companies promoting innovation and research[1]: "A joint ministerial decision was recently published in the government's gazzette offering another significant institutional tool for the support of innovative enterprises through tax breaks offered for spending on research equipment and scientific tools. This decision, combined with a tax code, envisages that spending related with amortization of equipment used for research projects will be deducted from gross revenues of enterprises, raised by 30 pct. Additionally, the criteria of characterizing these spending are expanded, while clear and more favorable measures are introduced for innovative enterprises, adding amortizations both for buildings and operating spending".

2.2.3 Requirements and constrains for application of vocational training courses in Greek SMEs

Productivity gains and innovation cannot be achieved on the basis of low-skilled work. As such, SMEs need to invest in human resources development in order to gain a sustainable competitive advantage [Panagiotakopoulos, 2011]. The capacity of SMEs to innovate requires a complex set of skills, networks and processes [Voss, 2009].

SMEs face particular problems due to their small size and limited resources [Farvaque et al., 2009]. Due to their limited resources, they often struggle to keep on top of new developments in information and communication technologies, and encounter difficulties finding qualified staff as well as providing them with adequate training and education.

[1] http://www.amna.gr/en/business/article/171518/Greece-offers-tax-breaks-to-enterprises-promoting-innovation

The size of the enterprise is highly related with the type of training/learning used to acquire new skills. Small enterprises are characterized by very low levels of formal training; the smaller the firm the less use they make of formal training courses [Ashton et al., 2008]. In SMEs training often takes place in the form of informal competence and skills development and on-the-job- training. One of the main reasons for this is that the cost of using formal training courses is much greater for small enterprises than for larger companies. Another reason is the cost of disruption involved in sending a person to a formal course, which is frequently regarded by many owners/managers of small enterprises as far more serious than the actual cost of the course.

On the contrary, in larger enterprises, managers and employees generally have specialized and well-defined work roles and their behavior is often governed by formal procedures [Ashton et al., 2008]. When it comes to training, managers and/or employees will identify training needs that are then examined by training specialists who search for appropriate courses. If none are available, courses are designed specifically to develop the appropriate skills. These courses are usually off-the-job and very often in specialist training departments.

However, this is not the case in small enterprises, where courses tend to be either too specialized or too general for their needs [Sung et al., 2000]. Although entrepreneurs in SMEs often argue that training courses need to be tailored to their needs, tailormade training in this case can be prohibitively expensive. The activity of analyzing training needs in small enterprises is usually performed by the owner/manager who decides who needs what training. However, with the growth in size, this process becomes more formalized.

The main barriers to employee training and learning in SMEs can be summarized as follows [Panagiotakopoulos, 2011]:

- Lack of time for training and learning activities.
- Limited financial resources for training provision.
- High cost of external training provision.
- Lack of external training programs tailored to the specific needs of SMEs.
- Small firm owners' negative attitudes towards employee training (lack of awareness by small business owners of the importance of training for firm success).
- Lack of awareness by small business owners of the training opportunities available.
- Fear of ''poaching''.
- A low-cost business strategy.
- Lack of employee desire for training and learning.
- Problematic training needs analysis.
- Poor quality of external training vendors.

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2.3 Bulgaria

2.3.1 Status of production SMEs in Bulgaria

Number and structure of SMEs in Bulgaria

Small and Medium-sized Enterprises (SMEs) are the backbone of the European economy. Numbering over 20 million, SMEs represent 99% of European businesses, and provide 85% of all new jobs. (Internationalisation of Small and Medium-sized Enterprises, Flash Eurobarometer 421, October 2016).

The statistical information below is presented in the 2016 Small Business Act for Europe (SBA) Fact Sheet for Bulgaria. SMEs play a particularly important role in the 'non-financial business economy' in Bulgaria. They account for 66.3 % of value added and more than three quarters of employment, compared with an EU average of 57.4 % and two thirds respectively. For micro companies, SME value added and employment shares are roughly comparable with those in the EU as a whole, but in the case of small and medium-sized companies they are above the EU average.

The manufacturing, wholesale and retail trade sectors generate half of SME value added. Their combined share is almost 10 percentage points higher than on average in the EU. These two sectors also account for 58 % of SME employment.

Class size	Number of enterprises			Number of persons employed			Value added		
	Bulgaria		*EU-28*	Bulgaria		*EU-28*	Bulgaria		*EU-28*
	Number	Share	*Share*	Number	Share	*Share*	Billion €	Share	*Share*
Micro	288 956	91.3 %	*92.8 %*	574 747	30.1 %	*29.5 %*	4.2	21.6 %	*21.2 %*
Small	22 615	7.1 %	*6.0 %*	458 065	24.0 %	*20.2 %*	4.3	21.8 %	*18.0 %*
Medium-sized	4 178	1.3 %	*1.0 %*	417 462	21.9 %	*17.0 %*	4.5	22.8 %	*18.2 %*
SMEs	**315 749**	**99.8 %**	***99.8 %***	**1 450 274**	**75.9 %**	***66.8 %***	**12.9**	**66.3 %**	***57.4 %***
Large	646	0.2 %	*0.2 %*	459 503	24.1 %	*33.2 %*	6.6	33.7 %	*42.6 %*
Total	**316 395**	**100.0 %**	***100.0 %***	**1 909 777**	**100.0 %**	***100.0 %***	**19.5**	**100.0 %**	***100.0 %***

These are estimates for 2015 produced by DIW Econ, based on 2008-2013 figures from the Structural Business Statistics Database (Eurostat). The data cover the 'non-financial business economy', which includes industry, construction, trade, and services (NACE Rev. 2 sections B to J, L, M and N), but not enterprises in agriculture, forestry and fisheries and the largely non-market service sectors such as education and health. The advantage of using Eurostat data is that the statistics are harmonised and comparable across countries. The disadvantage is that for some countries the data may be different from those published by national authorities.

Fig.3 SMEs — basic figures in Bulgaria (2016, SBA Fact Sheet for Bulgaria)

99.8% of all enterprises in Bulgaria
76% of the labour force in enterprises
69% of investments in fixed assets
67% of the turnover generated by businesses
62% of all fixed assets
59% of the value added created by businesses
42 per 1000 is the average density of SMEs in Bulgaria

Fig.2. Importance of SMEs in Bulgaria in numbers (National Strategy for Small and Medium-sized Enterprises, Ministry of Economy, 2014)

Main sources of funding for Bulgarian SMEs

The main source of funding to support production SMEs in Bulgaria during the last seven-year period /2007 – 2013/ was the Operational Programme "Competitiveness" at the Ministry of Economy and Energy.
In the current programming period /2014 – 2020/, the main source of funding to support SMEs is the Operational Programme "Innovation and Competitiveness" at the Ministry of Economy. Aside from the contracted funds program JEREMIE, the largest financing schemes for technological innovation - total 515 contracts worth over 370 million BGN and another 659 contracts for the introduction of internationally recognized standards worth 65 million BGN (by the editorial completion of this part of the Strategy) - insufficient for significant impact on any of the priorities of the this is not the case in small enterprises. Formal courses tend to be either too specialized or too general for their needs [Sung et al., 2000]. Although entrepreneurs in SMEs often argue that training courses need to be tailored to their needs, tailormade training in this case can be prohibitively expensive. The activity of analyzing training needs in small enterprises is usually performed by the owner/manager who decides who needs what training. However, with the growth in size, this process becomes more.

2.3.2 Requirements and constrains for introduction of innovative technologies in Bulgarian SMEs

Innovations have a crucial position in the policy of the EU for increasing the competitiveness of European economy. (Agency for Economic Analysis and Forecasting, 2010). The innovation potential acquires primary importance among the competitiveness factors. The Bulgarian enterprises gradually start realizing the role of innovations. The need for new technologies in production is recognized as a key factor in the survival and consolidation of companies in an environment of dynamic competition. The vast majority of manufacturing SMEs in Bulgaria ("Innovation enterprises – an essential requirement for the Bulgarian economy competitiveness", 2014) report that the lack of financial resources, the uncertainty for the future and the lack of skilled staff plays a negative role in introducing new technologies. Moreover, in order to survive on the market, SMEs need to introduce

innovations and development of new products. For the creation of innovations the availability of financial resources, technological base and qualified staff is a must.

The innovation index of Bulgarian enterprises during the year of 2015 shows that over 60 % of the Bulgarian enterprises have not introduced any innovations (Innovation.bg report, 2015, Applied Research and Communications Fund). The main part of the Bulgarian innovation enterprises (about 24 % of all enterprises) realize values of the index below 40. The innovation activities of Bulgarian companies are characterized mainly by purchasing machines and equipment and personnel training. R&D comes second and the share of expenditure for it remains comparatively low. However, R&D spending in Bulgaria rose by about 26% in 2015 as compared to the previous year – the highest growth of this indicator since 2000, mostly as a result of the participation of private sector companies in international value added networks. Since 2010, the main sources of R&D investment have been foreign investments and the European structural funds, whose importance for the national economy has grown. In 2015, this trend continued and their share in the total R&D spending reached 51%. Given its pull effect in terms of business expenditure for R&D, external financing becomes central to the existence and development of the national research and innovation system.

Most of the policy measures implemented over the last years have been adopted within the operational programmes. Most notably, examples of measures implemented include grant schemes, such as the development of new and strengthened technology centres, support for R&D, support for Technology Transfer Offices, support for innovations in start-ups and the Sofia Tech Park. Despite the ambitious strategic framework adopted for the new EC programming period 2014 – 2020, a number of problems persist. The innovation potential of the Bulgarian economy is driven primarily by the impact of external factors (European structural financing), and hampered by the existing obstacles at the national and local levels (lack of understanding among policy makers of the importance of innovation; low administrative capacity; lack of mechanisms for promoting entrepreneurial and innovation culture).

We can outline the following main constrains for introduction of innovative technologies in Bulgarian SMEs:

Administrative constraints

Many SMEs in Bulgaria face particular administrative constraints to their business activity due to the frequent changes in the legislation, difficulties in participating in public procurements and poor interaction with the local and state authorities.

A great part of the administrative constraints are due to the inability of SMEs to finance a separate legal department, which to protect their interests. Also an administrative constraint is considered the lack of capacity of SMEs to prepare and implement innovative projects which to be awarded national or European funding.

Financial constraints

The financial constraints of SMEs are related to the difficulties in obtaining loans from banks and the ability of firms to repay loans already taken in the situation of recovery from economic crisis. The existence of intercompany indebtedness further undermines trust between companies and their limited resources to produce and develop new products.

Technological constraints

At present – the existing difficulties in borrowing loans from banks deter SMEs from updating their technological base. This restriction leads to consequences associated with firms' competitiveness, opportunities to develop new products and opportunities to reduce production costs by introducing new technologies.

Constraints related to staff

Despite the relatively high unemployment in Bulgaria (over 10%), the majority of SMEs report difficulties in finding trained and qualified personnel. The majority of the unemployed do not possess the necessary technological and production skills that would help them find jobs. On the other hand, the lack of trained staff deters some of the small and medium enterprises to expand their operations. In many cases, companies hire people without the necessary skills and then invest in their training.

Some additional factors also can be outlined:

- not sufficiently clear state policy regarding innovation;
- insecure protection of intellectual property, problems with finding partners;
- lack of knowledge, know-how and financial instruments and resources for the technologies;
- lack of stimuli for the application of the intellectual property protection;
- severed “science – business” connection;
- lack of stimuli for commercialization of scientific activities in the country.

The implementation of scientific achievements, new technologies and development of innovation potential are of great importance for the consolidation of the Bulgarian manufacturing and economic growth. Taking into account this, the MechMate project will help manufacturing SMEs to prepare for innovation by providing knowledge to better identify potential sources of innovation and to prepare for the implementation of newest mechatronics & robotics solutions.

2.3.3 Requirements and constrains for application of vocational training courses in Bulgarian SMEs

For the realization and implementation of their plans and ideas, SMEs enterprises need highly qualified and well trained staff. Innovation and new ideas can be achieved only by well-trained and motivated people. The need for such personnel is not only due to technological

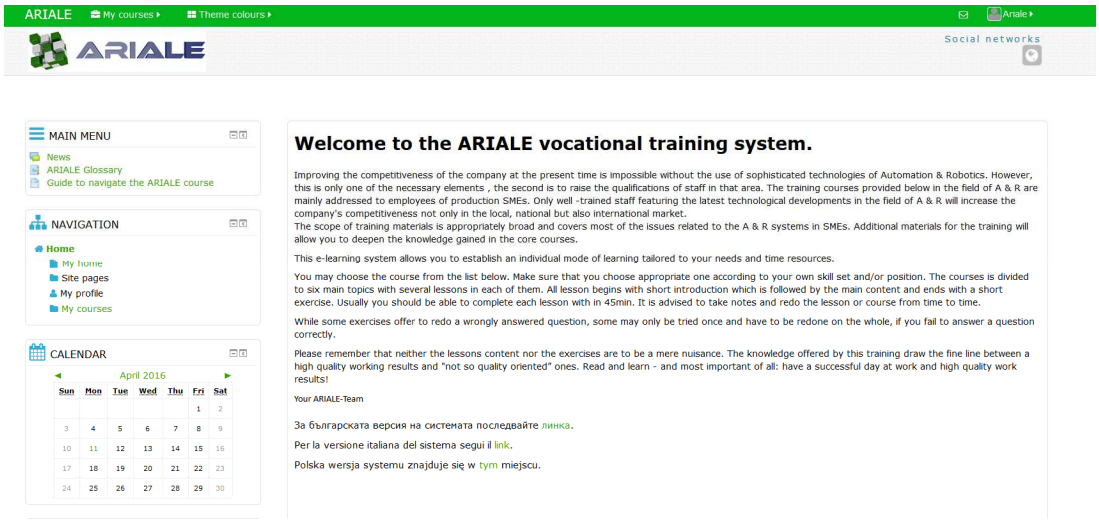
developments and their application in modern manufacturing, but is also a requirement for building a professional team, necessary for creating of competitive and high quality products. Here an important point is the need for the existence of quality technical education and retraining opportunities for employees during their work and easy access to new knowledge of changing technology. Retraining can be done by organizing specialized courses within and outside the work environment and self-training of employees using specially designed training materials for this purpose.

Below are presented examples of vocational educational programmes in the field of mechatronics and automation available in Bulgaria. Based on the desk research conducted, the following e-learning & blended learning courses can be outlined:

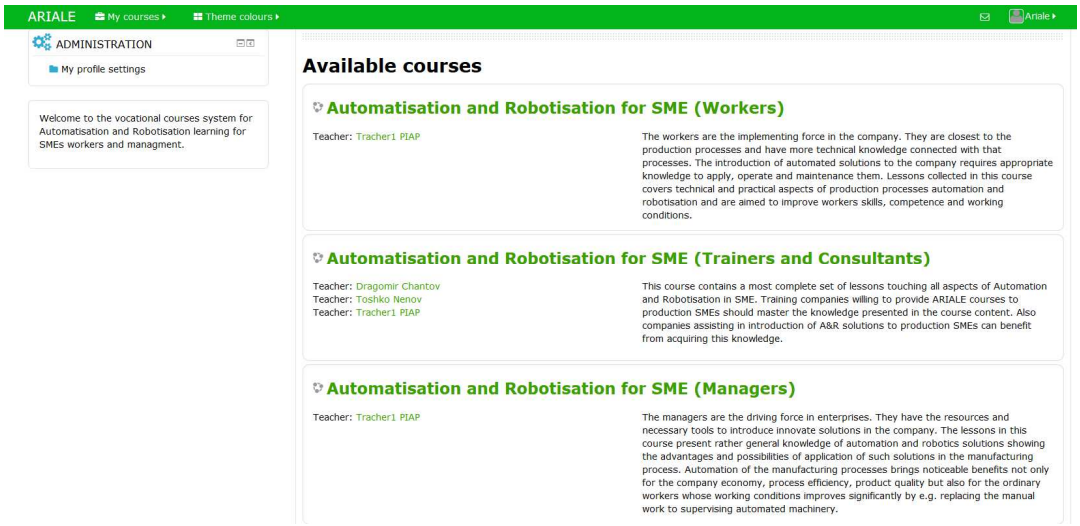
A) E-learning courses in the field of Mechatronics and Automation

Under the project Automatization & Robotization for a New Reindustrialized Europe – ARIALE (http://ariale.eu/) within the project framework were developed: ARIALE ICT system (e-learning system); comprehensive study content in the field of Automation and Robotics; methodology and Public Report on Manufacturing SMEs Requirements with respect to Training of Automation, Robotisation. The material developed are available in Bulgarian, Polish, English and Italian and can be accessed absolutely free of charge.

The ARIALE ICT training system is available at the following web address:
https://195.187.100.184/ariale-course/en/



The system has 1 course – Automation and Robotisation for SMEs which, differentiated according to the target groups they are meant to support. There is course for SME managers, for consultants and VET providers, for workers.



The course is divided into 6 main modules which address the following main topics:

- ✓ ICT based means for automation and innovation (this modules is available only for managers, consultants and trainers)
- ✓ Sensors in industrial automation
- ✓ Actuators in industrial automation
- ✓ Application of PLC in industrial automation
- ✓ Industrial networks and interfaces in industrial automation systems
- ✓ Industrial robots in automation systems

The modules are structured in a similar way and each one contains comprehensive learning materials divided into multiple sub-topics, which is actually the main study material. Each module has glossary explaining the terms used in the text; interactive exercises; self-test questions for learners to check their knowledge. The system also has options for live chats; video conferencing with tutor or fellow learners, etc. The system also has option for issuing certificate of successful completion of the ARIALE training course in A& R.


CERTIFICATE of ACHIEVEMENT

This is to certify that

Ariale Student

has completed the course

Automatisation and Robotisation for SME (Workers)

4 December 2014

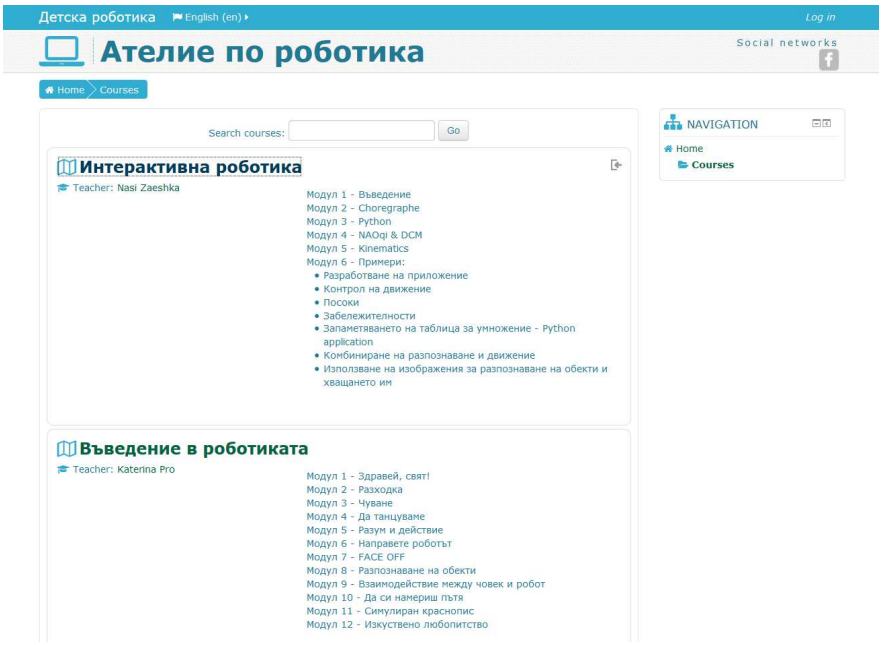
3prtennSWk

B) Blended-learning courses in the field of Robotics and Automation

Interactive course in the field of robotics for students (http://detskarobotika.com/course/index.php)

The courses are held in 6 cities in Bulgaria – Sofia, Plovdiv, Varna, Gabrovo, Ruse and Vidin. There is also a possibility for conduction of the courses in other towns in Bulgaria in case of interest. People can express their interest towards the topics' courses via online contact form which they need to fill.

The courses are blended learning - include both face-to-face sessions combined with e-learning. **There is also a course in robotics for teachers.**



Barriers to application of vocational training courses in Bulgarian SMEs

The main barriers to employee training and learning in SMEs can be summarized as follows:

- Lack of work-life balance
- Limited financial resources for training provision
- Lack of external training programs tailored to the specific needs of SMEs
- Lack of awareness by management team of the training opportunities available, as well as their importance
- Lack of employee desire for life-long learning
- Lack of necessary technical aptitude
- Barriers related to a learner's personality or nature, such as attitudes, motivation, learning style, self-efficacy, and confidence
- Barriers associated with course content, structure and design, such as organization of learning materials, perceived difficulty, relevance and the role of prerequisite knowledge
- Poor quality of external training seller

2.4 Estonia

2.4.1 Status of production SMEs in Estonia

In Estonia currently lives 1,32 million people. According source data in the statistical database: NAA0012 Estonian Gross domestic product (GDP) at current prices in 2016 was 21098,3 million euros. In 2015, industrial production at current prices amounted to approximately 11.4 billion euros. Number of enterprises in manufacturing sector was 7053. The biggest branches of manufacturing were the manufacture of wood and wood products (1.7 billion euros), the manufacture of electronic products (1.6 billion euros) and the manufacture of food products (1.3 billion euros). The greatest number of enterprises (1,100) and persons employed (about 17,200) were recorded in the manufacture of wood and wood products. Unemployment rate in Estonia is about 7 %.

The contribution of small and medium-sized enterprises to employment and turnover constitutes about a half of the total contribution of Estonian enterprises. Therefore, their innovations plays an important role in future economic development.

Regarding the SMEs, their link with mechatronics is highly related to the business activities in a sector. In the industry, the one with more usage of mechatronic systems is machine-building industry, followed by food industry and timber industry.

SMEs commonly facing quite big problems while introducing modern mechatronics in their processes. New challenges in Estonian economy are summarized with term industry 4.0. The introduction and use of new materials, complex machines and the tight integration of information and communication technology (ICT) in different production processes in SMEs will also have a role to bring competitiveness to the Estonian economy.

SMEs, in general, show several causes why they do not support the implementation of complex mechatronic systems as robots in their manufacturing processes. The implemented manufacturing processes are not enough profitable, the payback time is too long, not having qualified staff so too big risks connected with SME staff.

2.4.2 Requirements and constrains for introduction of innovative technologies in Estonian SMEs

There are two main types of innovation by definition (Oslo 2005: 45–52). Technologically innovative enterprises have, over the previous three years, launched new or significantly improved products (goods or services) or have introduced new or significantly improved processes (concerning the manufacture of goods, provision of services, delivery, or production support activities). Enterprises are also considered technologically innovative if they have not yet applied their innovation but have had innovative activities (reflected by expenditure on the development or implementation of a technological innovation) in the reference period. These activities may be in progress or even suspended, because not all attempts succeed. In the period 2008–2010, every eighteenth surveyed SME had suspended an

innovative project and every eighth SME was in the middle of completing a project. However, the enterprises who have had innovative activities but have not implemented any technological innovations hold a minor share (a few percent) in the total number of enterprises.

Non-technologically innovative enterprises are those who have implemented an organisational or marketing innovation within the previous three years. Innovativeness depends primarily on the size of the enterprise. The bigger the enterprise, the more resources (funds, knowledge and labour) it has to plan and implement innovations. A share of innovative enterprises among medium-sized enterprises is more than 20 percentage points higher than among small enterprises.

The Estonian economy and industry in particular faces a double challenge. On the one hand be able to gain competitive advantages thanks to new technology enablers, lean production, and on the other hand, organizations should adapt to a new way of designing products and services and then define and redesign existing production processes.

The use of new product materials and the integration of ICT in manufacturing processes will have a role in encouraging trends in industry location in new ecosystems that bring competitiveness to the Estonia production sector against the relocation trends that have recently destroyed much employment. Nowadays too many Estonian people work aboard, e.g. Finland.

However, the SME sector has more problems with its internal innovation capacity than large companies, although in niche areas they can gain technical and market advantage. Factors limiting the innovation of the SME sector can also include: financial constraints, lack of marketing skills, management irregularities, time constraints, difficult access to external consulting services. Often also the person managing the enterprise does not have sufficient knowledge of the economic processes, and therefore reluctance to innovate. Entrepreneurs, even though they do not have the ability to forecast economic phenomena and management skills very rarely, also decide to save on the use of third party consulting services.

All these barriers significantly affect the very low innovation of small and medium-sized manufacturing companies, leading to the fact that they are unable to compete with other players in the global market and achieve competitive advantage through innovation.

The Internet of Things (IoT) and Industry 4.0 technologies can also contribute to the Estonian industry with a new way to understand the worldwide collaboration and participation among actors that currently make up the industrial ecosystem.

2.4.3 Requirements and constrains for application of vocational training courses in Estonian SMEs

In order to explain the current situation of mechatronics within SMEs and Estonian educational system, we have divided the education in two terms: vocational and higher education. Vocational education refers to the path that students follow on their education, from high school to technical university. On the other hand, with higher education we mean the learning activities that a student can attend to satisfy needs and special interests connected with his speciality in a SME or other type of organization. SMEs directly employ people who

completed studies in a vocational or higher education schools. When there is bigger demand then special vocational training courses offered by vocational or higher education schools for people already working in SMEs.

The academic education includes mechatronics since the Compulsory Primary and Secondary Education, where students start the experimentation with automatic systems, designing and building machines and robots. In addition, in almost any bigger town, there are organized mechatronics and robotics hobby groups in schools. In Estonia there are some competitions organized during a year in the field of mechatronics.

In Estonia, there are 41 Vocational Education and Training schools. There are also training contents related to mechatronics and robotics in the Intermediate Vocational Training and Educational Cycles and in higher education.

Some schools are private and rest are managed by the Ministry of Education and Research. Some of the Vocational Education and Training schools have curricula connected with mechatronics, robotics and automation. Some other study modules include Mechanics; Special automation; Numerically controlled machines (CNC); Computer-aided design (CAD); Computer Aided Engineering (CAE). Almost in every region in Estonia is at least one public educational centre that provides such or similar education.

In order to improve next-generation skills in the field of mechatronics and increase the competitiveness of European SMEs, we believe that the learning methodology and the package of learning materials prepared during this project could be effective to improve professional knowledge and skills. To achieve this, more motivated human and financial resources should be provided to the vocational education centres.

In the higher education system, we need to carry out more effective measures such as: recruiting and skill conversion the teaching staff specialized in mechatronics, robotics, and economics. Mechatronics and robotics courses at the university master level educational should be a natural extension to the vocational education courses. Professional organizations can promote mechatronics events among public universities and SMEs and improve educational resources to promote also robotics as part of modern mechatronics.

For the business side in order to improve SMEs competitiveness there are some available measures that can be taken into use in order to promote the public initiatives focused on the use of mechatronics in the production processes. Such measures as providing financial support for young motivated people, who are willing to improve productivity and innovation in enterprises, where they are working.

The study programme at upper secondary school nowadays is arranged into mandatory (National Curricula) and voluntary courses. Graduation from upper secondary school requires the student to complete a curriculum consisting of at least 96 individual courses. Passing the upper secondary school exam as well as completing the courses a student presents research paper or practical work during the entire study period. The Ministry of Education and Research fixes mandatory training contents in Estonian Compulsory Secondary Education. However, there is also some freedom retained for schools. The mechatronic training is connected with the subjects generally entitled "Technology" **https://www.hm.ee/en/national-curricula-2014** (Last updated: February 2017). Students can

experiment with automatic control systems, sensors, actuators and other devices. They use of computers as programming and control elements for small (educational) robots. Technology studies contributes to the development of five constituent skills: technology in our daily lives, design and drawing, materials and their processing, home economics, and project work. The first three constituents comprise approximately 65% of the total duration; home economics 10%; and project work 25%.

In technology studies, the stress is on a modern technological mind-set and development of ideals and values required for employment. Taking into account required sustainable development; the students acquire the skills of coping with today's rapidly changing world of technology. They learn to understand and analyse the essence of technics and technology and their role in social development. The studies direct the students to make connections between mental (knowledge), emotional, and manual activities and understand how what they learn at school is connected with the living environment. Subject studies can be diversified by making use of local opportunities. The contents of learning are combined with the solving of practical problems (e.g. in local SMEs); the process of planning and manufacturing a product in a class covers the entire development cycle, from idea generation to product presentation.

Technology and innovation requires that various materials and processing methods be used in lessons. By solving problems and presenting results, students learn how to use computer software and identify possibilities for using the digital environment in the learning process. Familiarity with computer-controlled and fully automated equipment and, if possible, the operations of such equipment enhances perception of contemporary technological possibilities.

Familiarity with technological development and changes in the human role in the work process helps students realize the need for life-long learning. Selection of technological options to implement their own ideas, work planning and both individual and collective work help the students develop and analyse their working abilities, interests and cooperation skills.

Study activities facilitate direct contacts with the world of employment (e.g., study visits to enterprises). The common problem is that connections between schoolteachers and technicians, working in enterprises, are weak. Students should learn from experienced technicians and engineers and vice versa about occupations, professions, jobs and further education opportunities associated with the subject field. Study activities provide students with an understanding that different jobs can have different requirements, working conditions, and guide students to analyse whether their health status and physiological attributes are suitable for the jobs they are interested in.

In respect of adult-oriented learning activities, we can find in internet marketing information about special courses related to product manufacturing, and general technical information about mechatronics and robotics and cutting-edge technologies as Industry 4.0.

3 Analysis of results of focus groups survey

Focus groups research was organized to hear the voice of engineering SMEs and the people employed in those enterprises as well as other interested stakeholders. In every partner country project partners organized one focus group interview with at least of 10 stakeholders - SMEs managers and people employed in SMEs as well as teachers and learners in the field of Mechatronics. During these Focus Groups workshops partners presented the project to the target audience and discussed with them what kind of training they need and what king of competencies and skills they are looking for to implement successfully the innovative mechatronic-based technologies into the everyday working processes in their companies.

All participants were asked to share specific difficulties and complications that they have faced in the introduction of innovation mechatronics technologies in their companies and organizations. These examples were collected will be taken into account when developing the training materials.

At the end of the focus group interviews participants were invited to fill in feedback questionnaires. A common template for these questionnaires was provided by PIAP. The questionnaire and the Focus Groups organization guidelines are presented in the Appendix 1. Each partner prepared a short report summarizing the collected feedback and summary of this research is presented in the following sections.

3.1 Focus group in Poland

Focus Group in Poland took place on 16th February 2017 during Robotics Day at the PIAP Institute. The conference was attended by representatives of production companies, where there are various processes of palletization and depalletisation, welding and bevelling of steel sheets , conveying and inter-operative transport , totaling nearly 150 people. From those attendants 38 took part in the Focus Group research organized by MechMate PIAP team and filled in Focus Group feedback questionnaire.

3.2 Focus group in Greece

The Focus Group research in Greece took place in two phases with participants from two different target groups: The first meeting took place on 20th February 2017 at the Laboratory of Distributed Multimedia Information Systems and Applications (MUSIC), Electrical and Computer Engineering School, Technical University of Crete. The participants, eight teachers and five students in Electrical Engineering, were initially informed about the MechMate project, its aim and objectives. Five teachers focusing on the fields of Robotics, Automation Systems, and Multiagent/Intelligent Systems took part in the Focus Group research organized by MechMate TUC team and filled in the Focus Group feedback questionnaire. The second meeting took place on 22th February 2017 via video-conferencing with three SMEs

managers, one consultant and one employee in SMEs located at different places in Greece. At the end of the meeting all of them filled in the feedback questionnaire which was provided online on the limesurvey platform.

3.3 Focus group in Bulgaria

The Focus Group in Bulgaria was organized by the Technical University of Gabrovo with technical support from ECQ and was held on the 12th of April 2017. The focus group took place in the university's premises. The event was attended by a total of 40 people – predominantly representatives (skilled workers, middle managers) of production companies, operating in the electronics and machine building economic sectors as well as students of the university. Representatives of TUGAB's project team presented a short overview of the MechMate project to the participants as well as the aims of the focus group event and asked them to complete the focus group questionnaire. All 40 participants in the event filled the Focus Group feedback questionnaire.

3.4 Focus group in Estonia

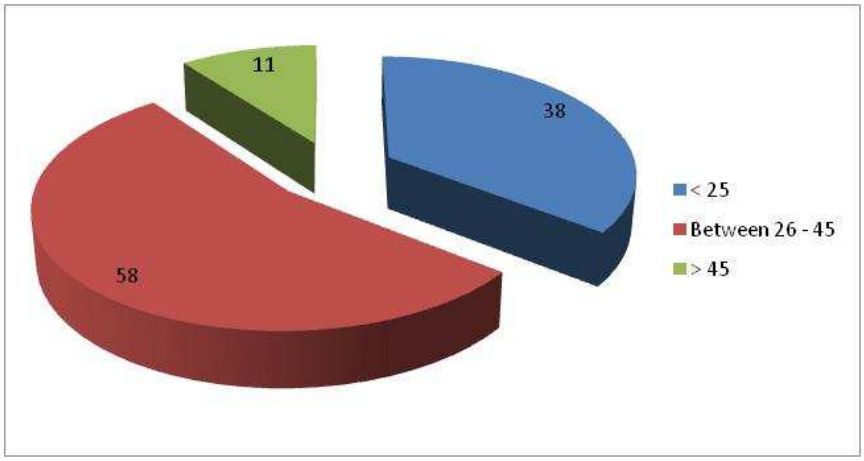
Focus Group in Estonia took place in Tallinn Industrial Education Centre, where continuing professional education course organized for mechatronic specialists working in different SMEs (28.02.2017), in Tallinn University of Technology and in Innovative Manufacturing Engineering Systems Competence Center (15.03.2017). MechMate TUT team introduced the MechMate project for participants and organized the Focus Group research. During the interviews, representatives from different SMEs and students of Tallinn Industrial Education Centre filled in Focus Group feedback questionnaire. Total number of filled questionnaires was 20.

3.5 Survey results

Overall 107 people representing different target groups responded to the questionnaire during 4 events organized in partner countries. In Poland 39 questionnaires were collected, 40 in Bulgaria, 18 in Estonia and 10 in Greece. Below consolidated results are presented, detailed country reports are available in the separate documents.

Question 1. What is your age?

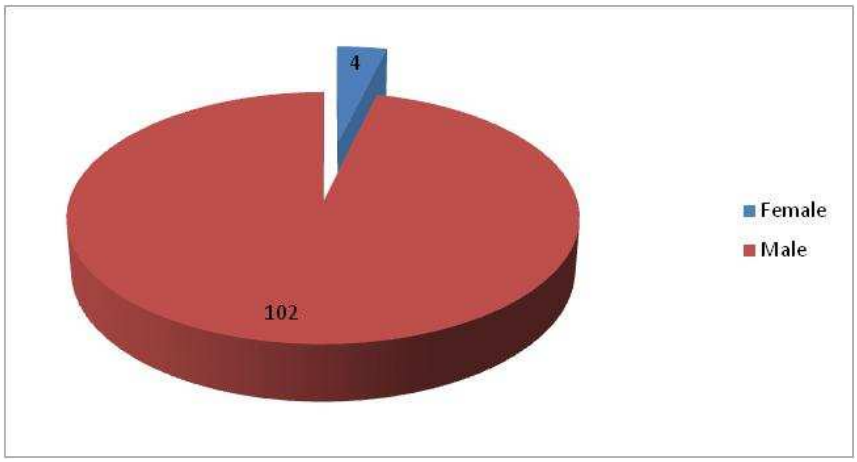
Global results: 38 under 25, 58 between 26 and 45 and 11 over 45.



The vast majority of respondents are under the age of 45. This may indicate some reluctance of older employees to engage in new innovative solutions in their companies. Considering the structure of employment, it would be useful to consider developing a special program to reach older workers in particular.

Question 2. What is your sex?

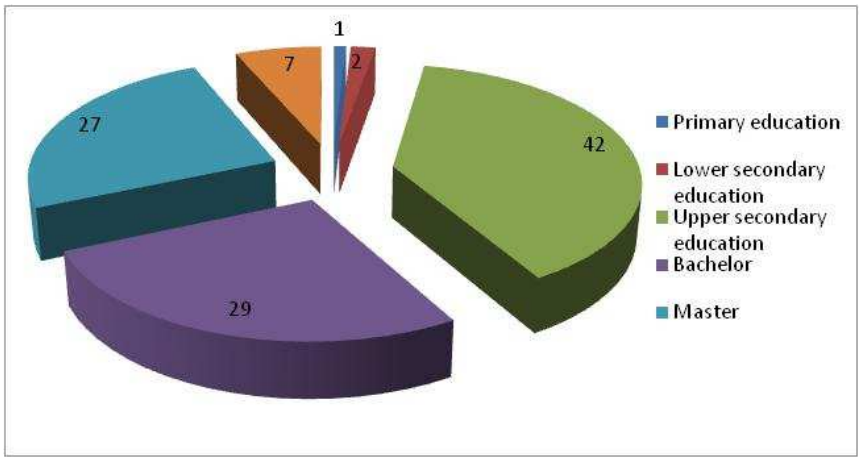
Global results: Male: 102, Female: 4.



Only 4 women participated in the survey, which is surprising even considering the fact that in manufacturing companies a higher percentage of employees are male.

Question 3. What is your education level?

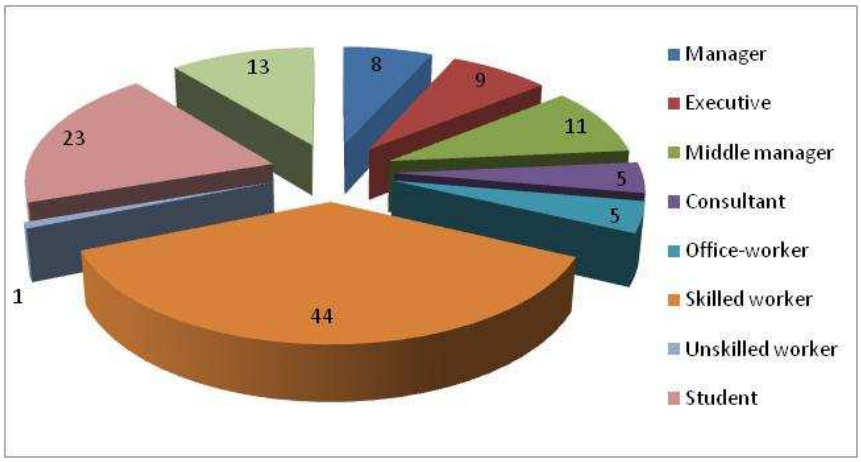
Global results: Primary education 1, Lower secondary education 2, upper secondary education 42, bachelor 29, master 27, and doctoral 7.



About half of respondents have higher education, which, given the target groups studied, is the expected result.

Question 4. What is your job position?

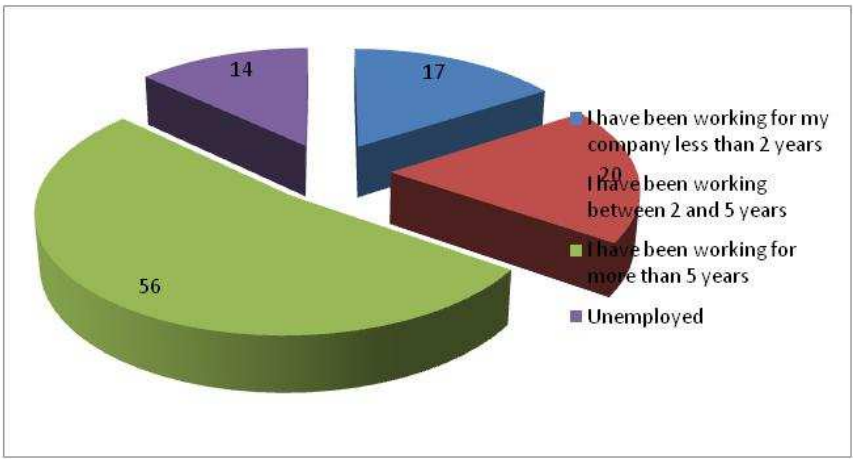
Global results: 8 Manager, 9 Executive, 11 Middle manager, 5 Consultant, 5 Office-worker, 44 Skilled worker, 1 Unskilled worker and 23 Student.



Respondents represent all project target groups. This makes it possible to presume that the results obtained are reliable and that the underlying assumptions underlying the system will reflect the real needs of enterprises and their employees.

Question 5. Are you working at the moment and if yes for how long?

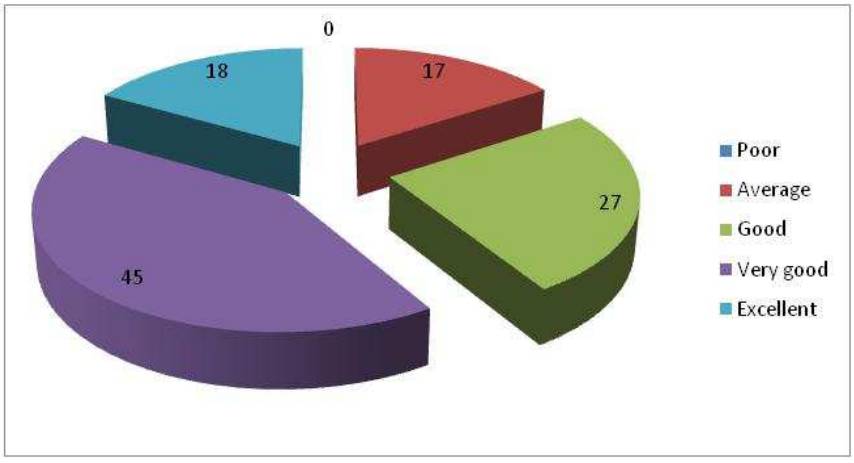
Global results: 17 people less than 2 years, 20 between 2 and 5, 56 more than 5 and 14 unemployed.



More than 50% of respondents have a seniority of more than 5 years. The option for non-employment was mainly marked by students, so we may consider that the questionnaire has been filled by people currently active in the labor market and those who are looking for or looking for the job in the near future.

Question 6. How would you rate your computer skills in general?

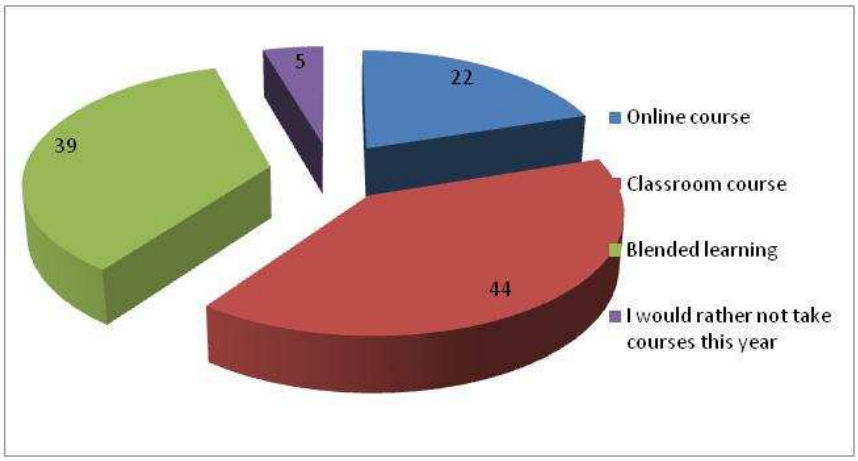
Global results: 18 excellent, 45 people very good, 17 average and 18 poor computer skills according to self assessment.



35 people at their own discretion may have some difficulty in using the computer and may therefore be interested in learning additional training materials for learning how to use the e-learning system.

Question 7. If you have the opportunity to attend a course this year, which kind of course would you pick up?

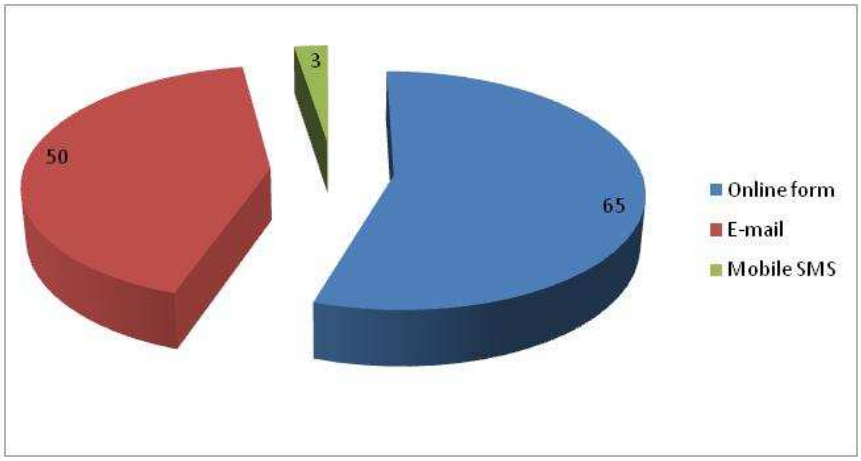
Global results: 22 people would chose online course, 44 classroom course, 39 blended learning solution and only 5 would rather not take any course.



44 people have declared that they would prefer to participate in traditional, traditional training and are not interested in e-learning. One should think about the right incentive for them to be convinced of the idea of distance learning.

Question 8. Which form of registration to a course would you prefer?

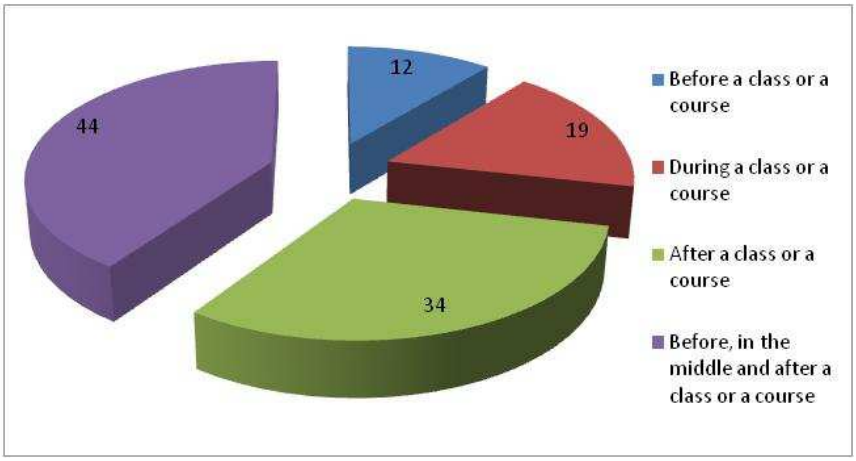
Global results: Most chosen option was online form with 65 answers, followed by e-mail with 30 answers. 3 responders chosen SMS registration.



Almost all respondents chose an electronic form of entry for the course.

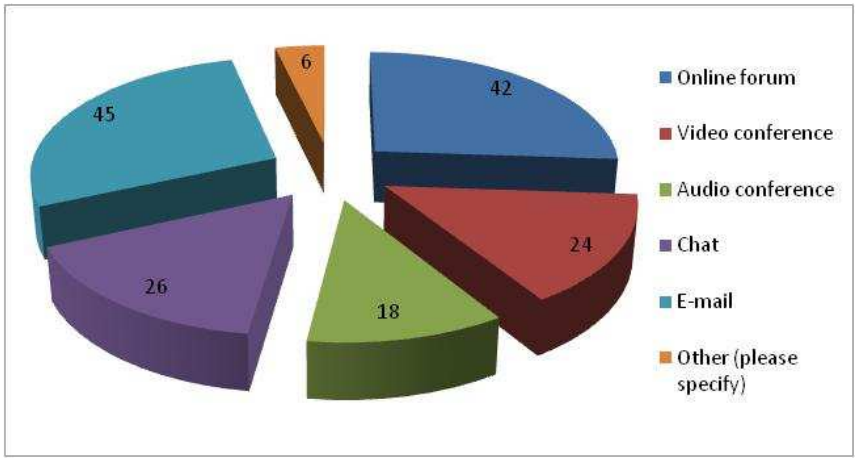
Question 9. When do you think is better to evaluate the competences?

Global results: 44 people chosen evaluation before, in the middle and after the class (no preferences), 34 people prefer evaluation after the class, 19 during the class and 12 before.



Question 10. What type of communication with others would you prefer?

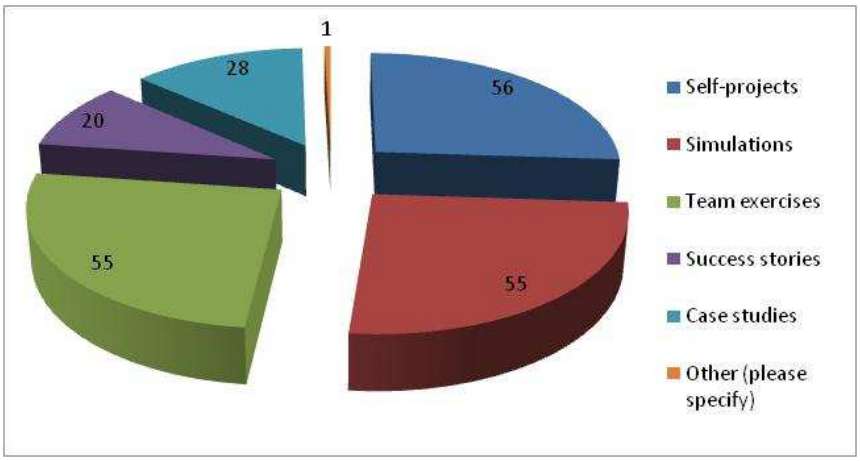
Global results: E-mail was the most selected option with 45 answers, followed by online forum with 42 answers and chat with 26 answers. Video conference was chosen 24 times and audio conference 18 times. 6 answers. Some people specified combination of several types of communication.



Most respondents chose asynchronous forms of communication and their use should be the most pressing in the solution.

Question 11. What kind of practical tasks should be included in training activities?

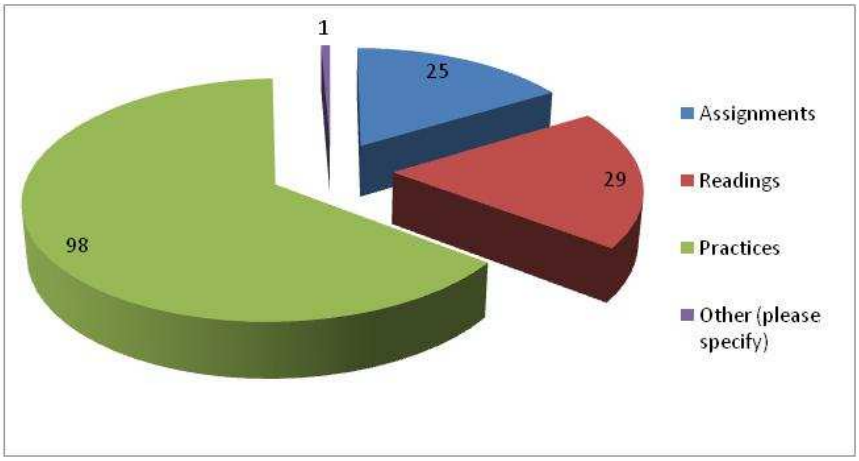
Global results: Three options were selected above all: Self projects with 56 answers, simulations and team exercises with 55 answers each. Case studies were picked 28 times and success stories 20 times. Several people picked more than one answer.



Self projects, simulations and team exercises were the most chosen answers so those should be included in training activities. Success stories and case studies can be considered as less important.

Question 12. How effectively can out-of-class work help your learning?

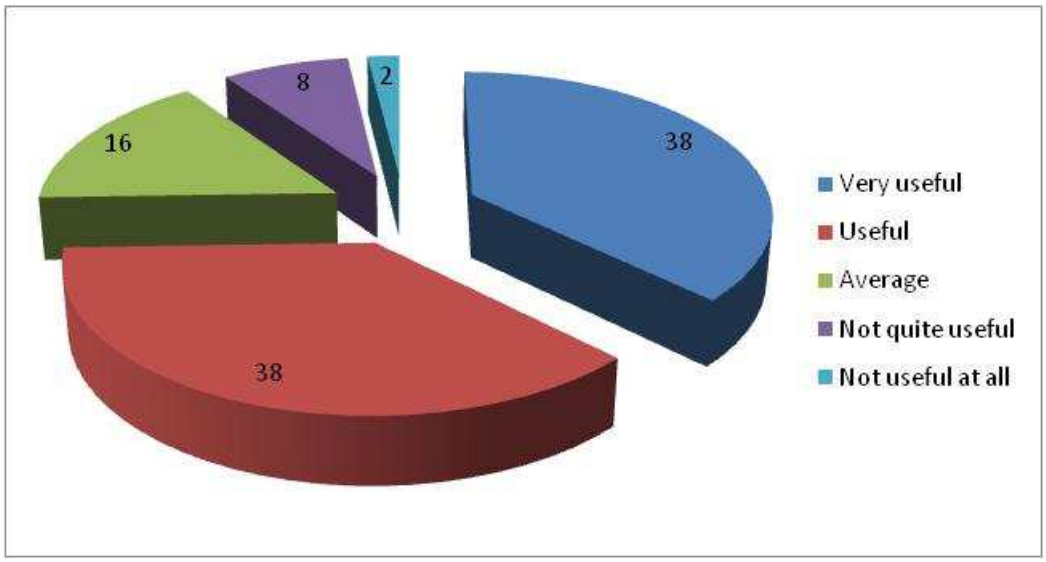
Global results: Practices were the most often selected answer with 98 picks followed by readings with 29 answers and assignments with 25 answers. Several people picked more than one answer.



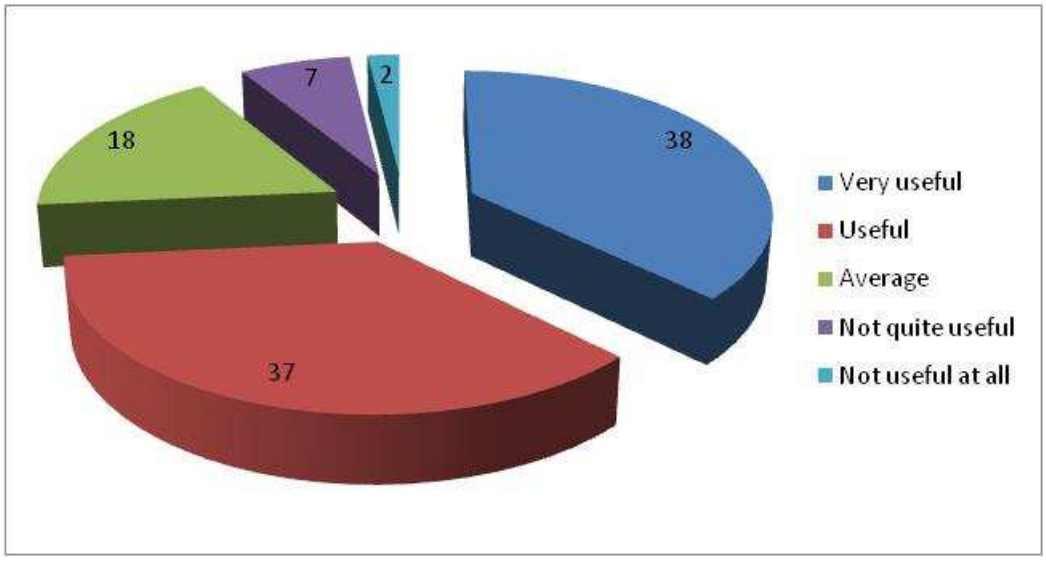
Practices were chosen as most effective way of out-of-class learning and they should be considered for implementing in the course.

Question 13. Please rank if the following subjects could be consistent and useful with your daily activities:

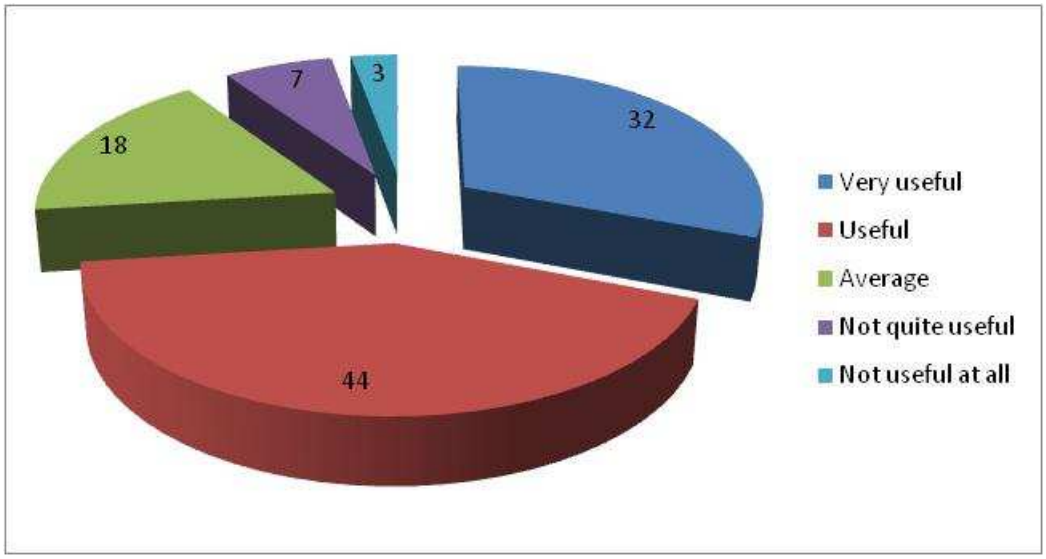
13.1 Mechanics and machine elements



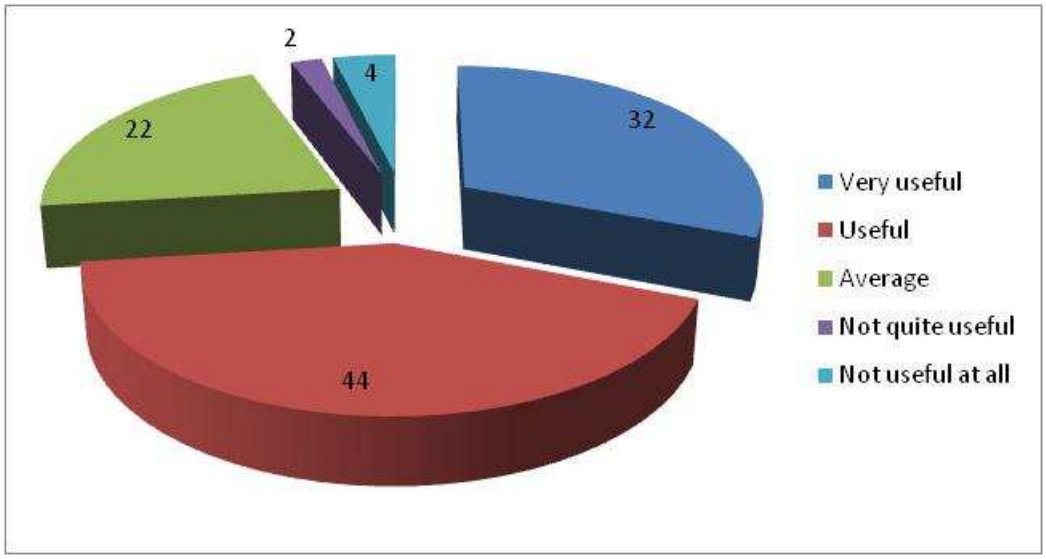
13.2 Fundamentals of electrical engineering and electronics



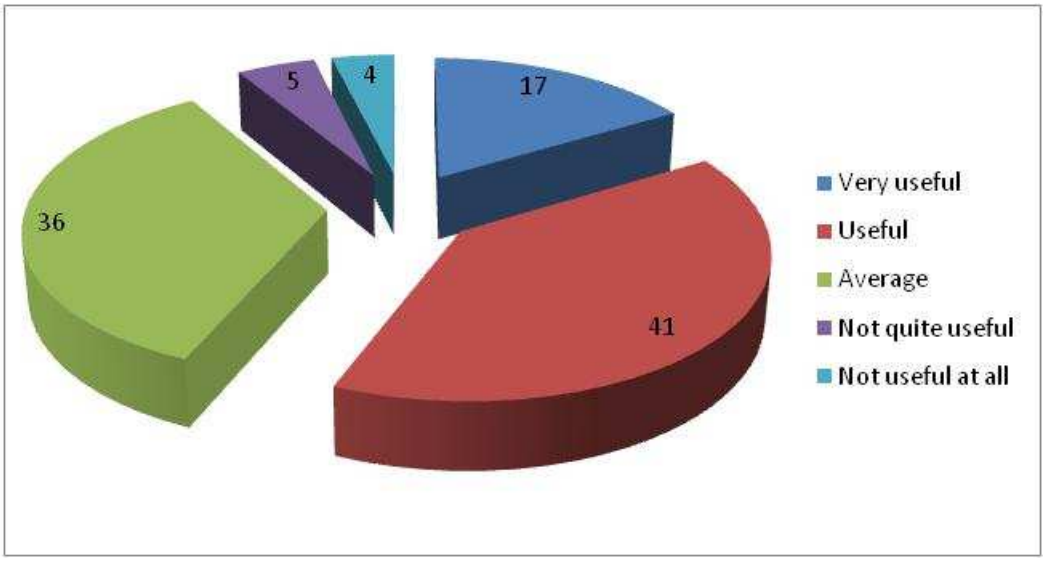
13.3 Signals, systems and control in mechatronics



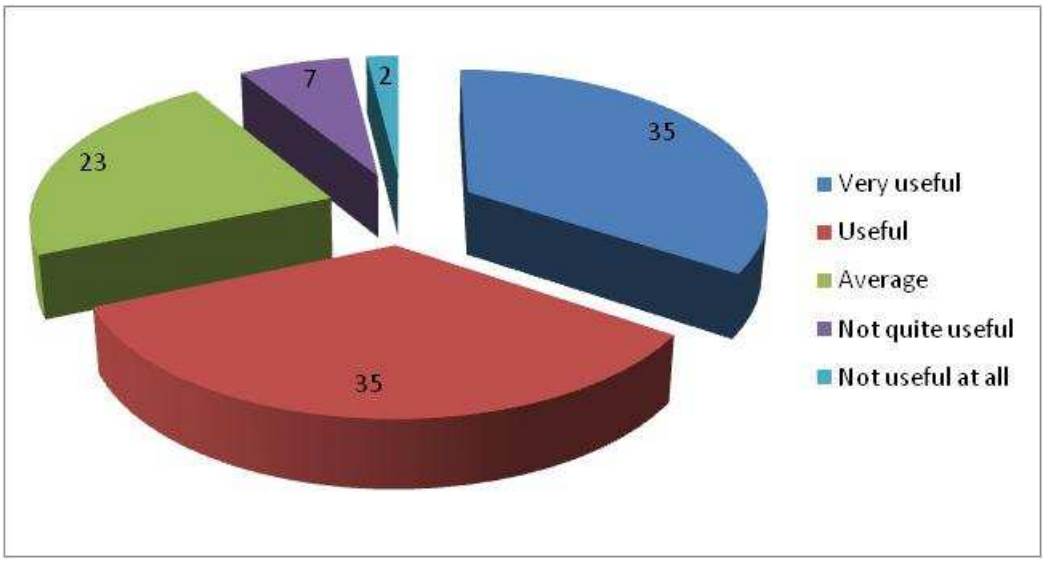
13.4 Digital Systems



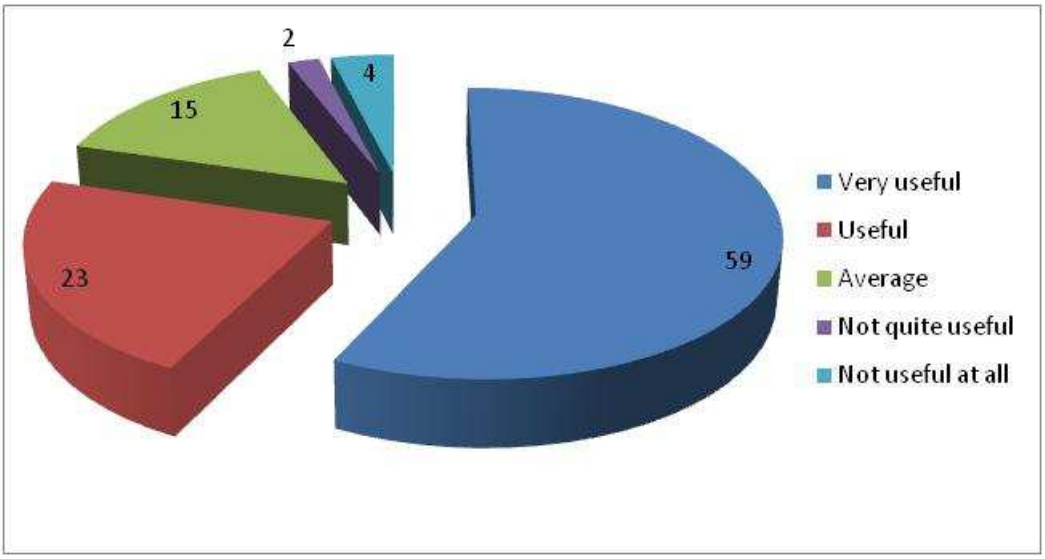
13.5 Embedded systems in mechatronics



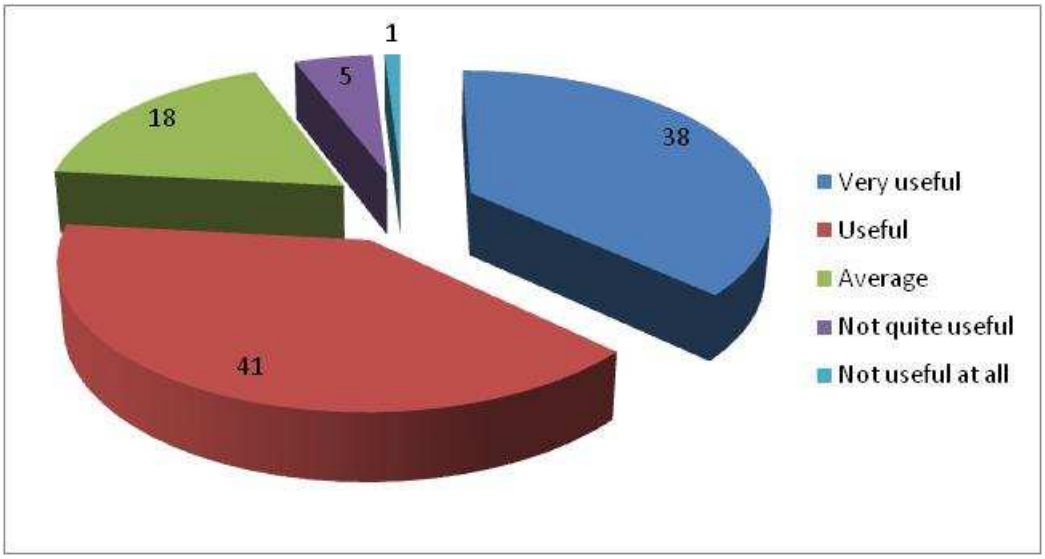
13.6 Communication interfaces and protocols



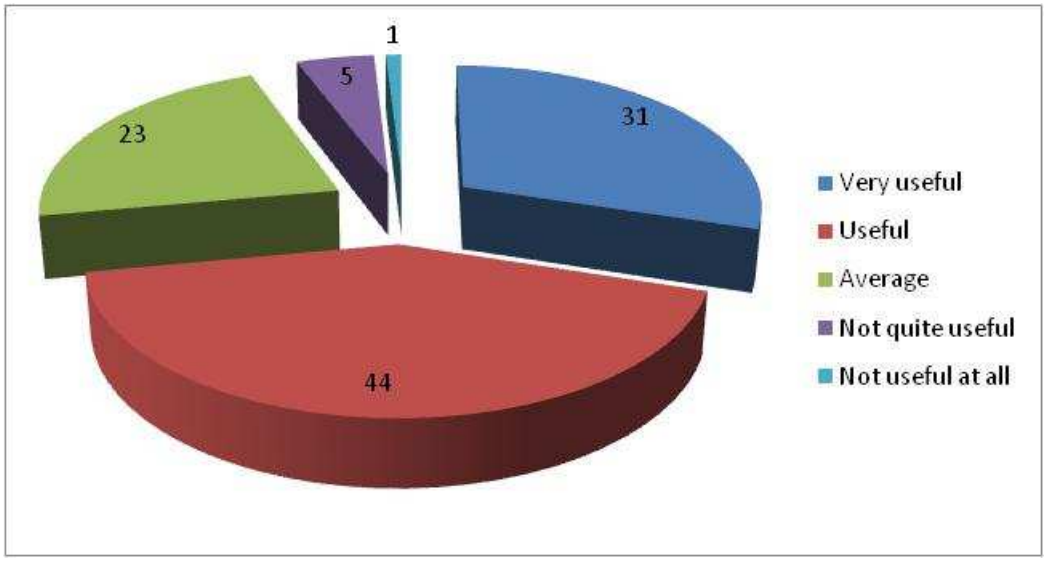
13.7 PLC systems



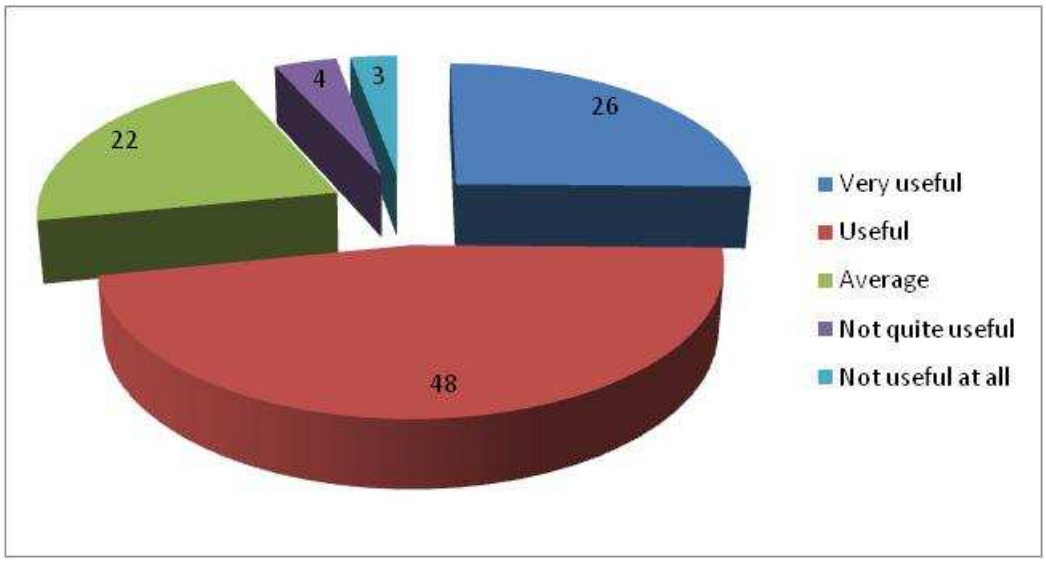
13.8 Measurement and data acquisition



13.9 Sensors in mechatronics



13.10 Actuators in mechatronics



The answer to question 13 shows that generally the selection of subjects for the training at the application stage has been made fairly. These topics may be the basis of a training course and may, in the future, be extended to cover new issues in the event of interest expressed by interested parties.

Question 14. Do you suggest considering additionally some other technical topics?

Poland:

- Networks & Communications protocols, Internet of Things and Industry 4.0
- management and collection of industrial data
- Industrial automation, Lean workshops, construction, design and construction of machinery, methodology for improvement of the production process
- Machine safety
- System integration
- Security systems, scanners, curtains, measurements
- Programming of welding robots
- Construction of work stations, co-operating devices
- Robotics / automation in explosive areas, PLC programming using higher level languages
- Implementation of robotics in product assembly, costs associated with the implementation of the robot
- Human co-operation with machines, robotics and automation of posts
- Complementary - additional use of robots in the production process

Estonia:

- robot and high languages C++, C#
- Programming
- PC and PLC communication protocols
- Build of 3D objects and systems
- Robotics, Programming with C#, Phyton languages
- Mathematics and Physics in Mechatronics
- Materials and Materials processing
- Co-operating machines

Greece:

- Autonomous control
- Industrial Engineering, Software Engineering, Communications Protocols, ICT
- Embedded Real Time Control (including reliability/power/cost issues), Motion Control, Distributed Computing Systems Programming

Question 15. Do you have any comments and/or suggestions regarding the topics mentioned in questionnaire?

Poland:

- Actuators in mechatronics - training could further mention IoT (Internet of Things) in sensors used in mechatronics.

Estonia:

- The topics should have questions more based on reality and specifics
- Building automation
- AC and DC circuits

Greece:

- I would add Hands-On experience as necessary part of the training activity. By Hands On experience I mean the interaction with real Hardware, so that the student has the opportunity to apply the methodology that is taught in earlier level and face the challenges of communication with real equipment (that can't be faced in a safe Simulation environment)

4 Recommendations and conclusions

This report provides specific information on the status-quo and understandings from the point of view of real SMEs belonging to the manufacturing sector operating in partners' countries and on actual needs, requirements & preferences of the MechMate target groups.

Based on the analysis of the results obtained from the conducted by project partners research and questionnaires collected during the CCGs we can say that the courses focused on the project topics will be useful and should be a good tool to support the target groups in introducing the innovation and mechatronic-based technologies to their companies.

The most important recommendations that arise from the analysis of survey results collected during CCG by project partners:

- Training materials should be prepared to teach how to use a training system designed primarily for people with poorer computers,
- the greatest emphasis should be placed on asynchronous forms of communication because they are preferred by the majority of respondents,
- resources should be provided to encourage potential users of the system to work on-line, primarily indicating the benefits of using such services,
- self projects, simulations and team exercises were the most chosen answers so those should be primarily included in training activities,
- practices were chosen as most effective way of out-of-class learning and they should be in the first place considered for implementing in the course.

5 Appendix 1: Focus Group guidelines and questionnaire

5.1 Focus Group guidelines

Goals: To collect new training needs and possible professional skills' gaps about automation, technology transfer and managerial practices for the growth of SMEs, a better employability and the promotion of the entrepreneurship. It will be useful to develop also MechMate Learning Methodology.

Target groups: MechMate project target groups.

How to manage a FG:

- Invite at least 10 relevant people from different organizations to participate in discussion and to fill in the questionnaire;
- Distribute the following questionnaire;
- Collect the feedbacks after the FG and insert them on the report within February 28^{th,} 2017 – template for the report will be distributed by PIAP;
- After reporting the results of the Focus Group received feedbacks will be discussed and conclusions will be included in the report summarizing all connected with O1 activities;

5.2 Focus Group questionnaire

Nowadays European countries need to invest in new innovative mechatronic based technologies of their production processes in order to sustain competitive position on the global market. These new, smart technologies, based on innovative, robotics and mechatronics drives have deeply changed the industrial production and energy conservation principles. In order to make use of the improved technologies, SMEs need highly qualified staff, competent in operating with the new mechatronics based technologies & solutions and competent in managing advanced manufacturing processes.

The MechMate project seeks to develop interactive training materials of industrial mechatronics systems. All material will be hosted on an interactive web-based platform. The proposed e-learning educational approach will be easily transferable to wide variety of manufacturing SMEs as well as vocational and higher educational institutions.

Target groups:

1. What is your age?
□ < 25
□ Between 26 - 45
□ > 45

2. What is your sex?
□ Female
□ Male

3. What is your education level?
□ Primary education
□ Lower secondary education
□ Upper secondary education
□ Bachelor
□ Master
□ Doctoral

4. What is your job position?
□ Manager
□ Executive
□ Middle manager
□ Consultant
□ Office-worker
□ Skilled worker
□ Unskilled worker
□ Student
□ Other *(please specify)* _____

5. Are you working at the moment and if yes for how long?

□ I have been working for my company less than 2 years
□ I have been working between 2 and 5 years
□ I have been working for more than 5 years
□ Unemployed

6. How would you rate your computer skills in general?

□ Poor
□ Average
□ Good
□ Very good
□ Excellent

7. If you have the opportunity to attend a course this year, which kind of course would you pick up?

□ Online course
□ Classroom course
□ Blended learning
□ I would rather not take courses this year

8. Which form of registration to a course would you prefer?

□ Online form
□ E-mail
□ Mobile SMS

9. When do you think is better to evaluate the competences?

□ Before a class or a course
□ During a class or a course
□ After a class or a course
□ Before, in the middle and after a class or a course

10. What type of communication with others would you prefer?

□ Online forum
□ Video conference
□ Audio conference
□ Chat
□ E-mail
□ Other *(please specify)* _____

11. What kind of practical tasks should be included in training activities?

□ Self-projects
□ Simulations
□ Team exercises
□ Success stories

☐ Case studies
☐ Other *(please specify)* _____

12. How effectively can out-of-class work help your learning?

☐ Assignments
☐ Readings
☐ Practices
☐ Other *(please specify)* _____

13. Please rank if the following subjects could be consistent and useful with your daily activities:

Training subject	***Very Useful***	***Useful***	***Average***	***Not quite useful***	***Not useful at all***
Mechanics and machine elements	☐	☐	☐	☐	☐
Fundamentals of electrical engineering and electronics	☐	☐	☐	☐	☐
Signals, systems and control in mechatronics	☐	☐	☐	☐	☐
Digital Systems	☐	☐	☐	☐	☐
Embedded systems in mechatronics	☐	☐	☐	☐	☐
Communication interfaces and protocols	☐	☐	☐	☐	☐
PLC systems	☐	☐	☐	☐	☐
Measurement and data acquisition	☐	☐	☐	☐	☐
Sensors in mechatronics	☐	☐	☐	☐	☐
Actuators in mechatronics	☐	☐	☐	☐	☐

14. Do you suggest considering additionally some other technical topics?

15. Do you have any comments and/or suggestions regarding the topics mentioned in questionnaire?

If you want to receive further information about project activities please leave your contact data below:

Surname and first name:

_____

E-mail:

_____

Name of your organization:

_____

Business sector:

_____

Thank you very much for your time.