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CENTRAL BALTIC
INTERREG IV A
PROGRAMME
2007–2013

Project INNOREG (SFE23)

Model of “The Region of Knowledge”

Tallinn 2013

Contents

INTRODUCTION

Estonia has taken steps to become proactive on global sphere since the beginning of the 21. Century. In 2002, Enterprise Estonia was established, with main objective to raise social welfare in Estonia. The same year, also a strategy called Knowledge based Estonia has been adopted by the government, including Estonian Innovation policy 2002-2006 and 2007-2013 documents, where representatives from the ministry, universities, enterprises, institutions and Enterprise Estonia determined the areas of focus, that would likely raise competitiveness of Estonia on global markets. In 2003 Estonian Republic and Tallinn city founded Tallinn Science Park Tehnopol (Tehnopol), with the aim to create a bridge between science and entrepreneurship. Tehnopol, together with Tallinn University of Technology (TUT), has to constitute a holistic environment with physical campus, services and opportunities offered for research-intensive enterprises. In 2007 Estonian Parliament initiated Estonian Development Fund, with a goal to support changes in Estonian economy and society, which would accelerate the modernization of Estonian economic structure, raise export and create new high-qualification requiring workplaces. Development Fund monitors Estonian development and executes venture capital investments into innovative, growing and high international potential enterprises. These governmental strategic mediums have played a major role for accelerating local enterprises of high potential becoming successful also outer region (Skype, Defendec, Toggl etc.).

Smart Specialization is a new movement in the European Union (since 2012), where the aim is to determine those business areas for every region, where potential growth and created added value would be higher than average, and there is an opportunity to achieve competitive advantage through investments into research and development. Growth areas determined from Smart Specialization have funding priority from the European Commission in 2014-2020 (http://www.arengufond.ee/upload/Editor/Publikatsioonid/Nutikas%20spetsialiseerumine%2020_02_2013.pdf).

Estonia has recognized that the world is in the era of great changes. Technology is being integrated into more areas in the industry as well as in practical appliances. Automatization enables to do increasingly more work and more complicated work, which has been done by humans traditionally. Economic crisis of 2008/2009 has accelerated this trend as enterprises needed to become more effective and technological development has been one of the means. Competition goes over the borders. Companies, that have skills and competences to do more complex tasks, will become more successful, whether the ones, that are not developing smart entrepreneurship, will face challenges in the future. Under the influence of main megatrends and challenges (ageing, individualism, globalization, urbanization, sustainability, finance debt, public debt, emerge of technologies and knowledge), manufacturing sectors are undergoing structural changes. From this perspective, it is necessary to shift the focus from a technology push to a market pull approach (technology platform Manufuture) and try to see value from a multi-disciplinary viewpoint to open up some unexploited opportunities for the companies to create competitive advantages by overcome barriers within a value system, design integrated products and services, work more effectively, co-create value with customers and achieve long-term relationships with customers.

Estonia has taken steps to improve its competitiveness since the beginning of the century. Global trends and regional developments have been monitored and analyzed continuously, which gives us the hope that we are prepared to face the challenges of the near-future.

STRATEGIC AREAS OF FOCUS

Estonia has marked out three main focuses, with eight sub focuses, for Smart Specialization 2014-2020 (http://www.arengufond.ee/upload/Editor/Publikatsioonid/Nutikas%20spetsialiseerumine%2020_02_2013.pdf):

1. Information and Communication technologies (ICT) horizontally through other business sectors:
    a. ICT in manufacturing (automatization, robotics etc.),
    b. Cyber security,
    c. Software development.
2. Health technologies and –services:
    a. Biotechnologies
    b. E-medicine (use of ICT for developing medical services)
3. Effective use of resources:
    a. Material science and –industry
    b. Developing the “smart house” conception (including ICT-solutions as well as efficient construction (passive house))
    c. Healthy food

“Heavy” focuses of Smart Specialization strategy (ICT in manufacturing, effective use of resources in the fields of mechanical engineering and mechatronics) have already been developed and researched under INNOREG project June 2010- May 2013. INNOREG is an international project, focusing on South-Finland and North-Estonian region. Its main objective is to raise competitiveness of mechatronics companies within the region, through creating a technologic platform, innovation center and improvement of collaboration opportunities (http://www.tallinn.ee/est/ettevotjale/g3573s55525). Globalization and continuous increase in competition make it necessary to implement new business models and production structures that would base on mutual interests and collaboration. The project concentrates on raising the region`s scientific-technical potential, competence and reputation.

INNOREG is an international project and intensive collaboration started first between TUT, Tehnopol, Innovative Manufacturing Engineering Systems Competence Centre (IMECC) from Estonian side and Kone Technology Centre in Turku, Machine Technology Turku, Turku University of Applied Science, Turku Vocational Institute and Turku Adult Education Centre from Southern Finland side (http://www.koneteknologiakeskus.fi). Partners in Turku started to form a competence and technology -intensive environment for better competitiveness earlier than Estonia (in 1999) and sensed a need for close partners in order to unite potentials and raise competitiveness of both partners. This is where INNOREG project started.

RESEARCH ON MECHATRONICS COMPANIES

As it is relatively difficult to form a well-functioning partnership between many countries and institutions, a deep-going research and analysis is necessary in order to specify current shortcomings, opportunities and possibilities.

CAPABILITIES IN NORTH-ESTONIA AND SOUTH-FINLAND REGION

In 2011, in the framework of INNOREG project (SFE23), the survey about capability and competitiveness of the mechatronics field in the North-Estonia and South-Finland region was carried out with the author's involvement. The results were divided into general data about the companies and the following seven fields of activity: business environment and management; technological capability; development of products and technology; personnel; ICT solutions; quality assurance and control; cooperation. The objective of the study was to map and analyze the following aspects of the companies:

- main competences, markets and products;
- market geography;
- technological capability of equipment;
- research and development capability;
- personnel competence;
- experience related to participation in cluster-based cooperation.

The basis for executing the study was the completed survey questionnaires. The companies were queried by recognized Estonian and Finnish experts in the mechatronics field. The analysis (HeiVäl Consulting and the INNOREG project expert group, 2011) showed that in the comparison between Estonian and Finnish mechatronics companies, Estonian companies are mainly SMEs and serve more small and mid-sized companies, while the Finnish companies serve more large companies. Thus, Estonian companies should consider more cooperation, cluster and network activities to be competitive. Also the survey showed that in both countries, there is room for development in the implementation of productivity programs at the company level, as well as documented systems for making suggestions that are connected to motivation system. About cooperation, the survey showed that Estonian companies cooperate significantly less than Finnish companies and have practically no experience with cluster-based and quality-related cooperation. The survey showed that the primary objective of participating in cooperation is the development of supply chains, but Finnish companies also place great importance on the development of joint competences and network manufacturing (Kaia Lõun, Company's Strategy Based Formation of e-Workplace Performance in the Engineering Industry. Doktoritöö, TTÜ 2013).

PRACTICAL TRAINING IN NORTH-ESTONIA AND SOUTH-FINLAND REGION

In the second survey in 2012, the study object was to analyze human resources qualitatively in the mechatronics, in North-Estonian and South-Finland regions. The survey gives an overview of:

a. labor competences and levels in different job positions in the field of mechatronics,

b. Additional trainings offered in the field of mechatronics by competences, organized by North-Estonian educational institutions.

The study shows that companies expect educational institutions to have a bigger role in training workers, who meet exactly the needs of a company. At this moment:

- companies need to re-train many of their stuff with competent internal trainings,
- companies wish for more training from the education institutions
- educational institutions think that they are teaching enough of all the competences

Therefore it can be suggested that:

- practical training needs to be structured by competence groups in several companies
- it would be beneficial to organize "roundtables" with companies and educational institutions, in order to gain a better understanding of current and future needs for competences
- weight a possibility to implement "training guaranty" systems, where for example educational institutions would make one year after issuing diploma additional trainings on favorable conditions, at the request of the employer. This system would also give a real-time feedback for educational institutions.
- Involve companies to the development of curriculas in a more active way. Preferably since the end of primary school class level

These results of INNOEG project analysis give an overview of existing differences between the two regions as well as mutual areas that need improvement.

NEW BUSINESS MODELS AND CONCEPTS IN THE MECHATRONIC FIELD

In 2013, in the framework of INNOREG project (SFE23), the survey about global developments and trends in the mechatronics field was carried through and a concept of Factory of the Future (FOF) was explained by Väärtusinsener OÜ. The results state that:

1. More value can be created in Europe by:
    - Developing further efficient automation
    - Developing products with higher added value
    - Re-organizing factories in a new way
2. Efficiency can be a distinctive and competitive factor, because:
    - Resources are limited, but the demand is growing
    - The price of raw materials will increase, recycling will grow
    - Exploitation of advanced materials in manufacturing will become more important factor
3. Need for human-centered manufacturing will grow
    - Mechanisms that support decision-making need to be implemented
4. Companies need to customize both for local and global competition
    - The driving force for new products will be at the same time global and local

- New specific requirements are arising due to environmental focus (e.g. green labeling), and due to the customization and personalization of products (e.g. tailored products)
- In order to maintain market share, companies will need to adapt products to the specific requirements of markets. Therefore, product-driven (market driven) developments will become ever more crucial.

In this document, it is also suggested that Virtualisation and digitalisation of the interrelation between manufacturing and new business models is needed. As products are today virtually designed and tested before being engineered for production, new business models need also to have tools to support the company to design and test them before they are implemented through services and manufacturing processes. Business model innovation is not a one-time event but rather a systematic approach to business that is based on the flexibility of enterprise.
The Demand-driven supply networks are ways to develop, they include:

- Collaborating outside organizational boundaries with sharing information. Focus beyond the enterprise to the network as a whole
- Leveraging information to make better decisions. Collect real-time information by being adopters of technical innovations
- Keeping the customer in mind to create differentiated customer value.

Research, development and innovation are at the centre of the knowledge-based society of developed countries. Society is called a knowledge-based, when knowledge and skills are considered to be the most important strategic resource and reaching the goals in the fields of governance, economy, social life and environmental protection is based on knowledge and analysis. Scientific researches on the edge of knowledge (mainly basic researches) expand the knowledge, give a direction to educational issues, develop values and are solid basis of the future of humankind. However, to solve the practical problems of society, purposeful researches with direct output are needed. Future-oriented scientific researches, which applicability is difficult to assess today, and purposeful researches are closely related, the overlap areas of these two directions are important and constantly changing. Therefore, to find the balance between the two directions of the research, the relations between society and science are especially important. Regardless of the direction of research, frontier research is decisive. Knowledge-based economy is characterized by products and services with high value-added, which is achieved by constant innovation.
To be a successful part of European scientific and economic region, while also maintaining its identity, Estonia has to invest in the expansion and consolidation of their knowledge and skills in three main areas:

- **Researcher-driven research.** The primary objective of these investments is maintaining and raising the level of Estonian education and science. The direct socio-economic output of this investment may occur in a very long period, but it is important for the development of the nation-state and culture, and also for the cohesion with the world's developments.
- **Technology-driven research,** taking into account the economic specialization of Estonia and its partner-countries and also the long term development needs of enterprises.

- **Problem-driven research.** It is mainly applied research and development activities, which help Estonia to conform to different socio-economic challenges and support the implementation of subject field policy (e.g. health, environment, energetics, agriculture etc)

MAIN RESULTS OF THE INNOREG 2010-2013 PROJECT

The main results of the INNOREG 2010-2013 project have been:

- Technology intensive physical environment in Tallinn (modern Flexible Manufacturing System located in specially designed new building in Science Park Tehnopol)
- In-depth survey and analysis about mechatronics companies` capabilities and needs in North-Estonia and South Finland region
- Analysis of new business models and concepts in the mechatronic field, suggestions for developing Technology Platform – Manufuture Estonia
- Implementation of Tallinn Innovation Centre in Mechatronics - Mechatronicum
- Creation of Measurement, Control Centre in Turku and marketing and networking quality services
- Practically functioning clusters in mechanical engineering and mechatronics have been developed both in Turku and in Tallinn
- Preparations for clustering and collaboration with other regions have been made and memorandums of understanding have been signed

The situation and needs in mechatronics companies have been mapped. The technological platform and physical environment has been created, Search for partners with mutual interests has been successful. Strategic areas of focus have been determined. The next step is to start carrying out what has been the aim of the project- raise competitiveness of mechanical engineering and mechatronics companies in the North-Estonian and South-Finland region.

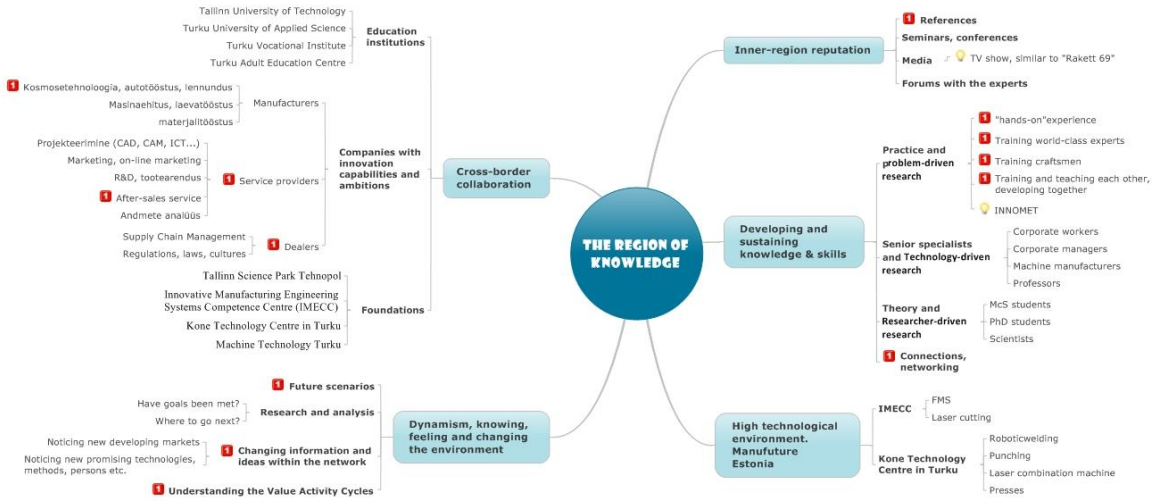
MODEL OF "THE REGION OF KNOWLEDGE"

Based on the strategic focuses chosen and analysis of researches that have been made for Estonia, the following leading principles for creating the model of The Region of Knowledge are brought out:

- Under the influence of main global megatrends and challenges (ageing, individualism, globalization, urbanization, sustainability, finance debt, public debt, emerge of technologies and knowledge), manufacturing sectors will have to undergo structural changes.
- It is necessary to shift the focus from a technology push to a market pull approach, which opens up new opportunities to add value for the customer (create offers that perfectly fit with customer`s production processes/ other values.
- It is necessary to promote, motivate and support cooperation and networking between companies with sharing information. Focus beyond the enterprise to the network as a whole
- It is necessary to develop joint competences

- It is necessary to develop practical well-functioning training programs, possibly including "training guarantee" system
- Companies need to be re-organized in order to be more dynamic, sustainable and innovative
- Need for human-centered manufacturing will grow- it is crucial to know customers, partners and competitors better and implement mechanisms that support decision-making
- Companies need to customize both for local and global competition- it is therefore important to know, feel and understand the environment. Leveraging information to make better decisions. Collect real-time information by being adopters of technical innovations.
- Keeping the customer in mind to create differentiated customer value.
- Estonia has to invest in the expansion and consolidation of their knowledge and skills in three main areas: researcher-driven, technology-driven and problem-driven research

From these leading principles, the following mind map can be created, where red squares indicate the focuses of higher priority and will be discussed further below.



The model of The Region of Knowledge consists of five essentialities:

- cross-border collaboration,
- reputation,
- developing and sustaining knowledge and skills,
- High-technological environment (Manufuture Estonia),
- Dynamism- knowing, feeling and changing the environment.

It is crucial to have well-functioning cross-border collaboration between the education institutions, foundations and companies with innovation capabilities and ambitions. In order to make the network strong and sustainable, it needs to offer values to every member- the network needs to be a "pull center" and the benefits of being within it need to be clear. As manufacturing and mechatronics companies need to undergo structural changes and also

shift the focus from technology push toward market pull, it would be beneficial to invite also service providers and dealers to the network. These companies are often closer to the customers and see what customers value from another point of view. Seeing value from a multi-disciplinary viewpoint opens up some unexploited opportunities for the companies to create competitive advantages by overcome barriers within a value system, design integrated products and services, work more effectively, co-create value with customers and achieve long-term relationships with customers. Empirical evidence shows that as economies become wealthier and reach middle-income status, manufacturing`s share of GDP peakes (at about 20 to 35 percent of GDP). Beyond that point, consumption shifts toward services, hiring in services outpaces job creation in manufacturing, and manufacturing`s share of GDP begins to fall along an inverted U curve (http://www.mckinsey.com/insights/manufacturing/the_future_of_manufacturing). Knowledge, experience and best practice of service providers and dealers could be applicable in manufacturing and mechatronics companies.

As stated in previous researches under INNOREG framework, the overall focus should be on high-technological fields, such as space, car and aerospace industries and material industry. Estonia has got the technological tools and also intellectual potential needed for starting offering those high added value products and services.

Reputation is another important area where to focus. As stated also in the preliminary analysis of Space Service Demo Center of TUT, reference is the first focus to have, because of lack of previous experience and competence. During the starting phase of implementing the model, it is possible to get co-financing from different projects and funds. Therefore it is possible to offer low-cost trial consignments.

Perhaps the most important strategic area of focus is developing and sustaining knowledge and skills as this is the backbone of successful knowledge-based business model. Along with researcher-driven and technology-driven research, it is necessary to focus on problem-driven research and practice. It is important to collect “hands on” experience, train skilled craftsmen and world-class experts. Also it would be good to have a “training and teaching together, developing together” environment, so that the specific knowledge could be transferred. This focus could also be one of the references to potential partners- well functioning and fast developing organization is likely to pull better opportunities towards itself. Over time, service-like activities- such as R&D, marketing and sales, and customer support- have become a larger share of what manufacturing companies do (http://www.mckinsey.com/insights/manufacturing/the_future_of_manufacturing). Therefore it is necessary to develop also knowledge and skills about service.

High-technological environment is a must have for the model of The Region of Knowledge. Founder members of INNOREG 2010-2013 have got sufficient technological capabilities for offering high-added value products. As the model is created around networking and collaboration, technological park should not be an issue in the beginning.

Being dynamic in todays` volatile economy is essential. It is important to know, feel and change the environment at any moment of time. Investing time and resources in developing future scenarios, research and analysis, exchanging information and ideas within the network and understanding the Value System is of high importance. The future of manufacturing is unfolding in an environment of far greater risks and

uncertainty than before the Great Recession. And in the near term, the lingering effects of that recession present additional challenges. To win this environment, companies and governments need new analytical rigor and foresight, new capabilities and the convict to act (http://www.mckinsey.com/insights/manufacturing/the_future_of_manufacturing).

Value is the core concept of integrated product, service and business development and thus a value-centric model of these processes will be beneficial and is much needed. Consumers expect new products to harmonize with their values and lifestyles, and industrial customers expect products to mesh with existing components in a work system or a production process. Value for customers is created throughout the relationship with the company, partly in interactions between the customer and the supplier or service provider. Value propositions are borne by objects which can be products (physical goods), services, experiences, events, persons, places, properties, organizations, information or even ideas that describe quantifiable benefits that individual organizations making an offer promise to deliver (Merili Randmaa, Krestine Mougaard, Thomas Howard, Tim C. McAloone, Rethinking Value: A Value-Centric Model of Product, Servicw and Business Development, ICED11). This concept opens up some new unseen opportunities. In order to make potential interlinks within a system more clear, it is beneficial to analyse actors` activities in 3 perspectives:

- Why the actors are acting like that? (their needs and wants),
- Can they act differently? (their potentials, resources) and
- Why don`t/cant they act differently? (their barriers, restrictions)

When the company has discovered all these 3 perspectives for all the activities and actors within a system, it is more likely able to see the big picture about the situations the customers, itself and other actors within a system are in. It is now possible to see potential interlinks for value co-creation, sharing, transaction and find ways to overcome barriers within a system.

INNOMET IMPLEMENTATION

The NNOMET system http://www.innomet.org/ has been linked to Innoreg project page, including course descriptions.

During the project pilot courses were elaborated for flexible manufacuring systems and their optimal managemenent:

Subject's name: Flexible manufacturing systems and their optimal management

Subject's capacity: 2 ECP

Assessment form: final test

Language: Estonian, English

Teaching semester: spring

Subject's purpose: The advanced training course is targeted at engineering industry enterprises engineers and management stuff, to increase their knowledge and skill levels.

Subject matter: The course includes following topics: Introduction to flexible manufacturing

systems. General description and knowledge of flexible manufacturing systems. Mechanical manufacturing methods. Cutting tools types. Cutting processes mechanics. Different types of lathe, drill and milling benches. Their classification. Manufacturing and technology projection processes for flexible surfaces. The FMS usage experiences, Product production in FMS, FMS main development issues. Machine vision in manufacturing systems. Wireless distributed monitoring systems, standard solutions, components and their usage experience. Flexible surface projection methods. CAD, CAM technologies and their trends. CAM simulation. NC code optimization and control. Uncertainty in measuring (flexible and 3D surface measuring). Flexible manufacturing systems atomization, standard FMS system, RoboFMS system and their controlling technologies. Why to use and invest money to the FMS system. FMS system economical efficiency.

Result: Theoretical knowledge of flexible manufacturing systems, their development issues and economical efficiency for the company.

Estimation criterion: Preliminary examination, test

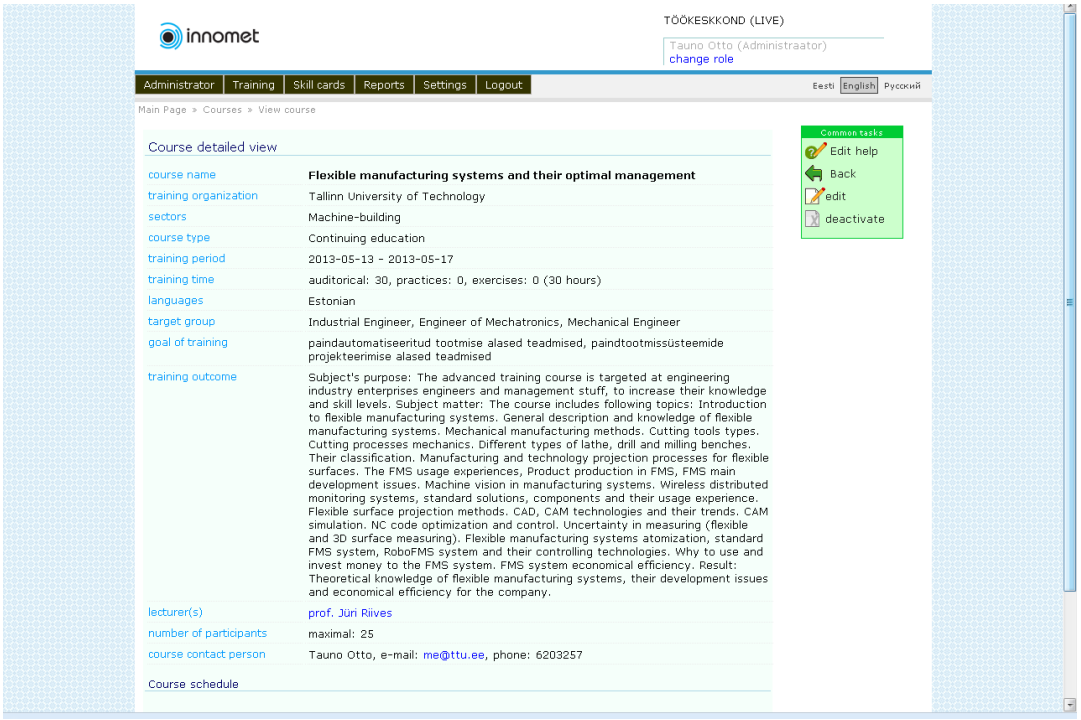
Work capacity of the subject and forms:

	Stationary	Extension
Lectures	0.0	30.0
Practical works	0.0	0.0
Practices/seminars	0.0	0.0

Restrictions on the audience: 30

Self-contained work: FMS design

Public user interface (see screen capture below) makes possible to see available courses, study programs, certification exams and general prognosis of labour force needs. Password protected area needs registration and includes tools for monitoring staff qualification level in terms of skills and knowledge, and advisory search tool for finding corresponding courses and study programs.



COLLABORATION POSSIBILITIES WITH GERMANY AND LATVIA

During the project tight co-operation activities were developed. For increasing the competitiveness it is crucial to modernise the manufacturing base and strengthen the links between academia, research and innovation.

Clusters and international cooperation play a key role building research, technology and development basement for High-Tech Manufacturing.

The main objective of the Memorandum of Understanding is to support high-added-value, knowledge-based competitive sustainable manufacturing in Europe through regional development and cooperation between regions.

The parties have declared to cooperate in the following areas:

- cooperation network and cluster development in the field of mechatronics;
- development of high performance manufacturing structures in the field of Factory of the future;
- development of new business models for driving towards the region of knowledge.

The main initiatives for cooperation are:

- information exchange on the basis of social networks;
- participation in the conferences and seminars taking place in the region;
- discussions about participation in EU projects (INTERREG, FP7, FP8 etc), with an aim to make cooperation in these projects;
- organization of scientific-technical collaboration between universities, competence centres and other such institutions;
- creation of the platform for predisposing better cooperation between companies.

During the project a template of memorandum of understanding was elaborated. Currently one memorandum has been signed between Managing Director Clusterland and Association of Mechatronics (see Annex 1), and next one is prepared for Schleswig-Holstein. Project team have visited Riga Technical University and met with Association of Mechanical Engineering and Metalworking Industries of Latvia **–** association, main activities on the field of industries and future developments**.** President of Association of Mechanical Engineering and Metalworking Industries of Latvia Vilnis Rantins.

Annex 1

MEMORANDUM of UNDERSTANDING

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Werner Pamminger	Jüri Riives
Managing Director Clusterland	Association of Mechatronics
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Austria	Estonia