Industry 4.0 Challenge:

Empowering Metalworkers For Smart Factories Of The Future

4 CHANGE

Erasmus+ Program KA2:

Cooperation for innovation and the exchange of good practices – Sector Skills Alliances

Project No 575813-EPP-1-2016-1-LT-EPPKA2-SSA

Kaunas, 20th March 2018

4 CHANGE

„The overall goal of the project is to tackle skills gaps of metalworkers by addressing the following objectives: to design and deliver a new targeted VET programme based on the current and future skills demand in the metalworking sector, and to develop a self-adaptive work-based learning system in combination with coaching."

Over the last years the European manufacturing sector has engaged in a steady re-industrialisation of the sector, strongly leveraging ICT enhancements. In the light of the fourth industrial revolution (Industry 4.0) with its connected and flexible Factories-of-the-Future, CNC operators represent manufacturing's high-tech future.

CNC operators are
in high demand in all EU .

In the light of the fourth industrial revolution with its connected and flexible Factories-of-the-Future, CNC operators represent manufacturing's high-tech future.

Participating members in Project 4change

I. National sectoral organisations

Engineering Industries Association of Lithuania, LINPRA, Lithuania

Education Network for the Northern German Metal and Electrical Industries, NORDBILDUNG, Germany

Association of Mechanical Engineering and Metalworking Industries of Latvia, MASOC, Latvia

Federation of Estonian Engineering Industry, EML, Estonia

II. VET PROVIDERS

Vilnius Jerusalem Labour Market Training Centre, VJDRMC, Lithuania

North Technical Academy, TAN, Germany

Zemgale Region Human Resource and Competences Development Centre, ZRKAC, Latvia

Tallinn Lasnamae School of Mechanics, TLMK, Estonia

Participating members in Project 4change

III. Accreditation, certification and qualification body

Qualifications and Vocational Education and Training Development Centre, KPMPC, Lithuania

National Centre for Education, VISC, Latvia

IV. Private enterprises

Baltec CNC Technologies JSC, BCT, Lithuania

MTS Mathematical Technical Software Development JSC, MTS, Germany

The overall goal of the project

To tackle skills gaps of metalworkers by addressing the following objectives:

▪ to design and deliver a new targeted VET programme based on the current and future skills demand in the metalworking sector

▪ to develop a self-adaptive work-based learning system in combination with coaching

Main activities in Project 4change

Making Comparative Analysis of Qualification Standards (QSs)

Drawing up a Model Qualification Standard and a Model VET Programme

Designing Training Material for Learners

Designing Training Material for Trainers

Development of E-learning Platform and Multimedia

Piloting

Dissemination and Exploitation

Current and future skills demand in the metalworking sector will consist of these specific industrial requirements:

1 — Advanced technology and digital skills due to increased need for engineers instead of manual workers;

2 — Robotics and CNC operation skills due to technology-driven innovation;

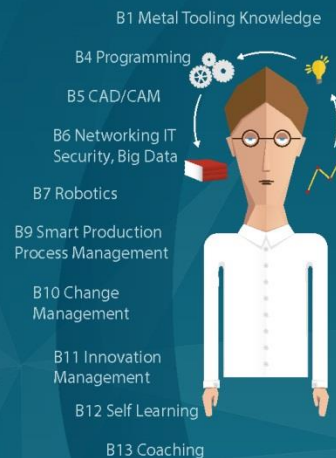3 — Social and entrepreneurial skills due to need for highly motivated work-force to stay competitive;

4 — Green skills due to promotion of energy efficiency.

Educational products developed during this project can be used not only in VET but also during on-the-job training in manufacturing companies
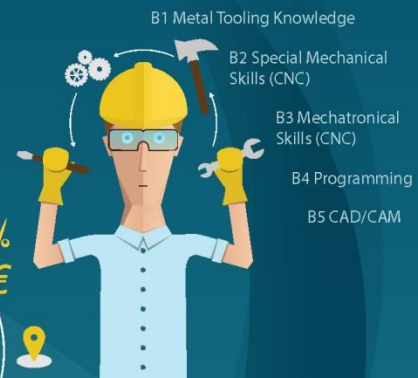
WHITE COLLAR
university degree of mechanical engineering

B1 Metal Tooling Knowledge
B4 Programming
B5 CAD/CAM
B6 Networking IT Security, Big Data
B7 Robotics
B9 Smart Production Process Management
B10 Change Management
B11 Innovation Management
B12 Self Learning
B13 Coaching

NEW COLLAR
college degree in smart production

BLUE COLLAR
VET education in metal industry

B1 Metal Tooling Knowledge
B2 Special Mechanical Skills (CNC)
B3 Mechatronical Skills (CNC)
B4 Programming
B5 CAD/CAM

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Needs of qualification standards: cooperation between labour market and Educational system

EMPLOYERS
Demands of the labour market

EMPLOYEES
Demands of the labour market

DEMANDS OF THE LABOUR MARKET
Current and future need of competencies

DEMANDS

QUALIFICATION STANDARDS

SERVICES

Goals and guidelines of **EDUCATIONAL SYSTEM**

Sustainability demand between Occupational and Education Standards

The relationship between educational and occupational standards
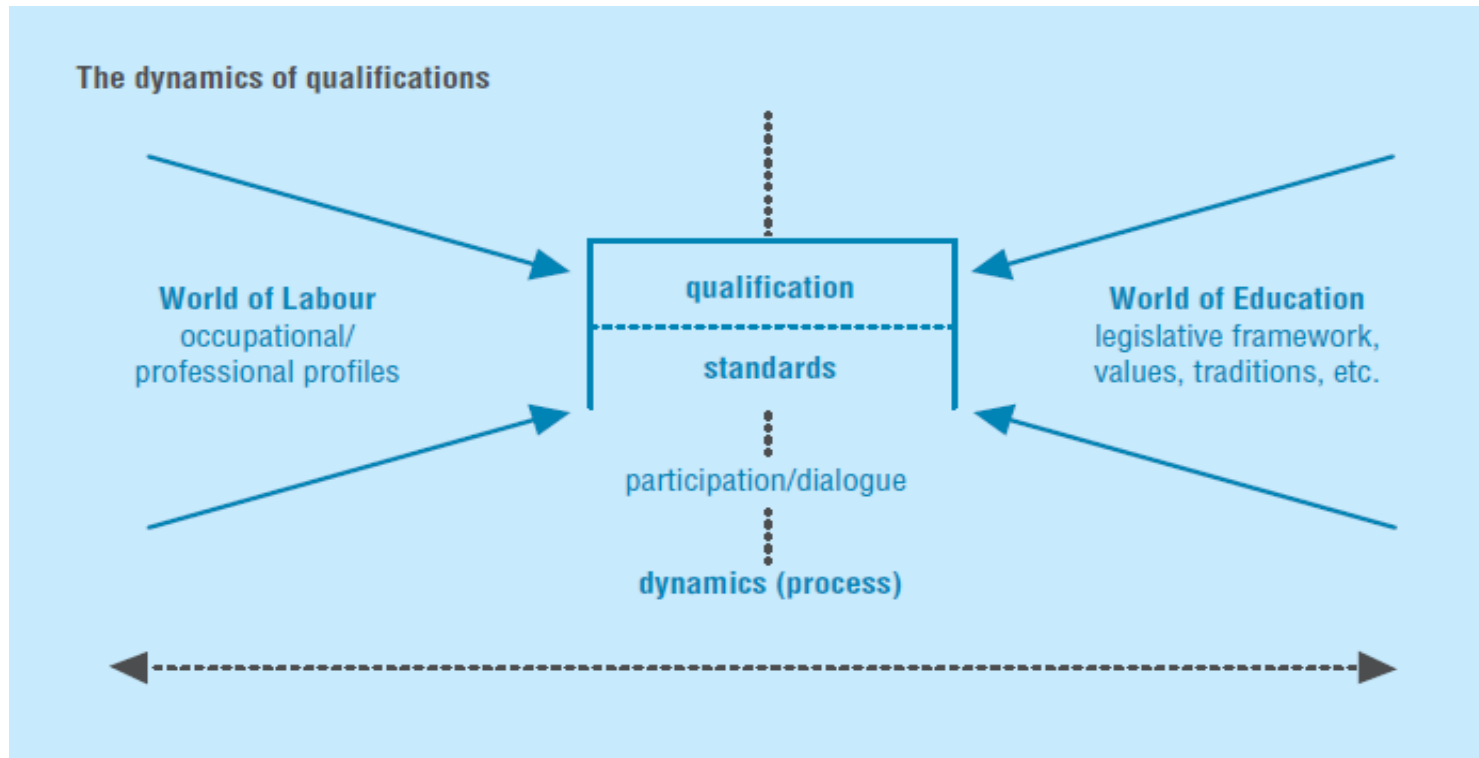
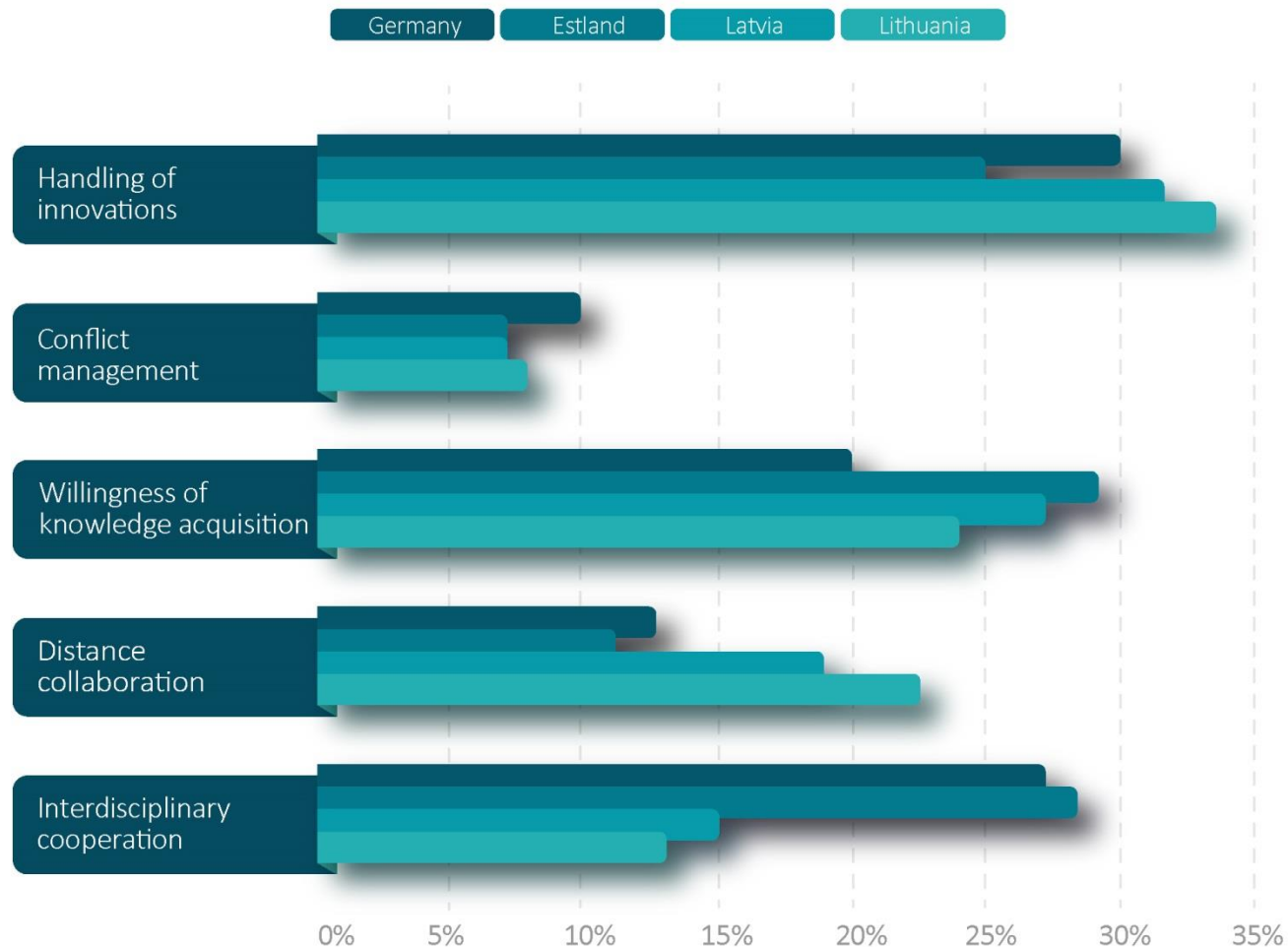Survey performed in 80 manufacturing companies from Lithuania, Latvia, Estonia and Germany

Which competencies should be developed already in the initial vocational training to simplity the implementation of industry 4.0?
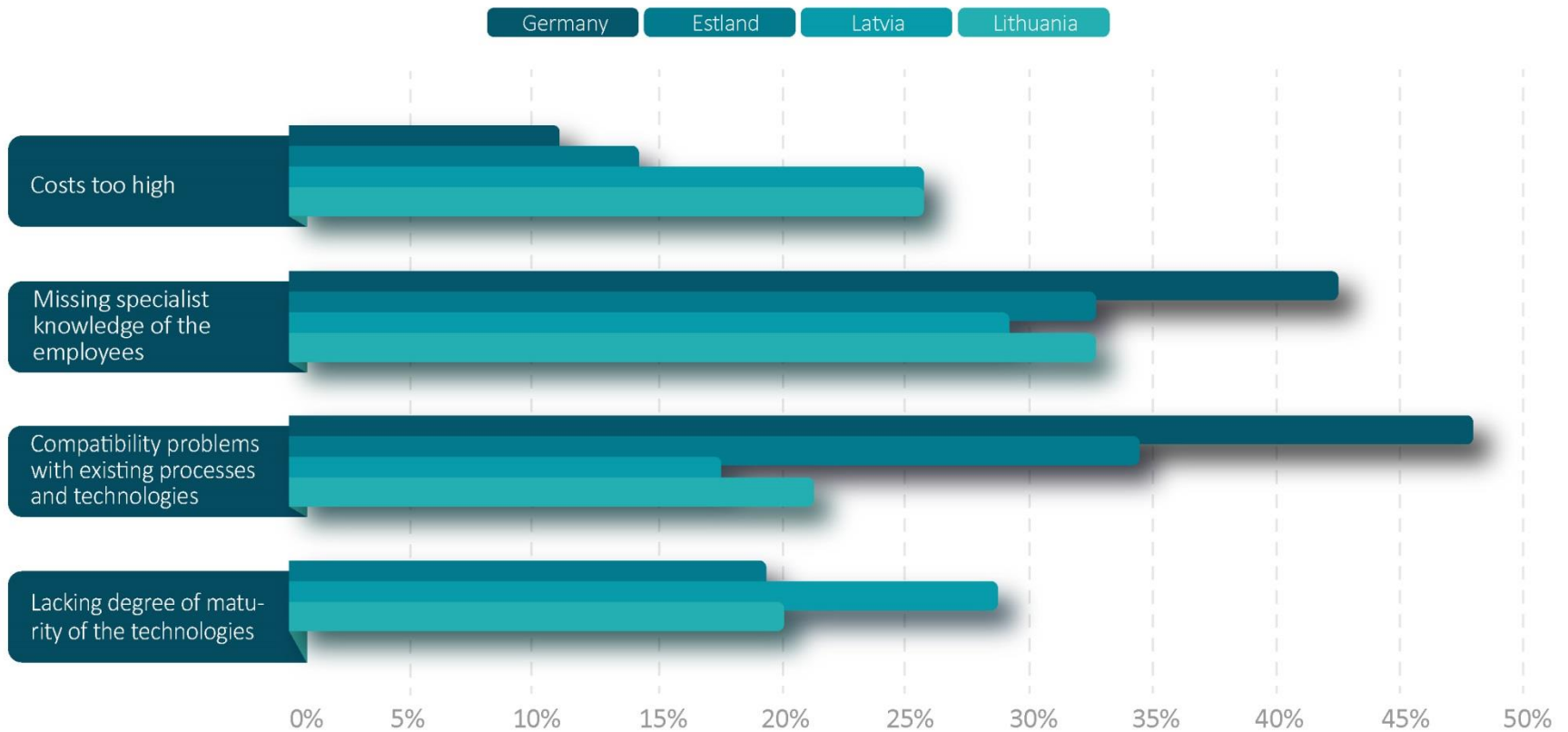
Legend: Germany | Estland | Latvia | Lithuania

Categories: Knowledge Management, Robotic, IT skills, Electrotechnical and mechanical skills, Special mechanical skills

X-axis: 0% to 20%
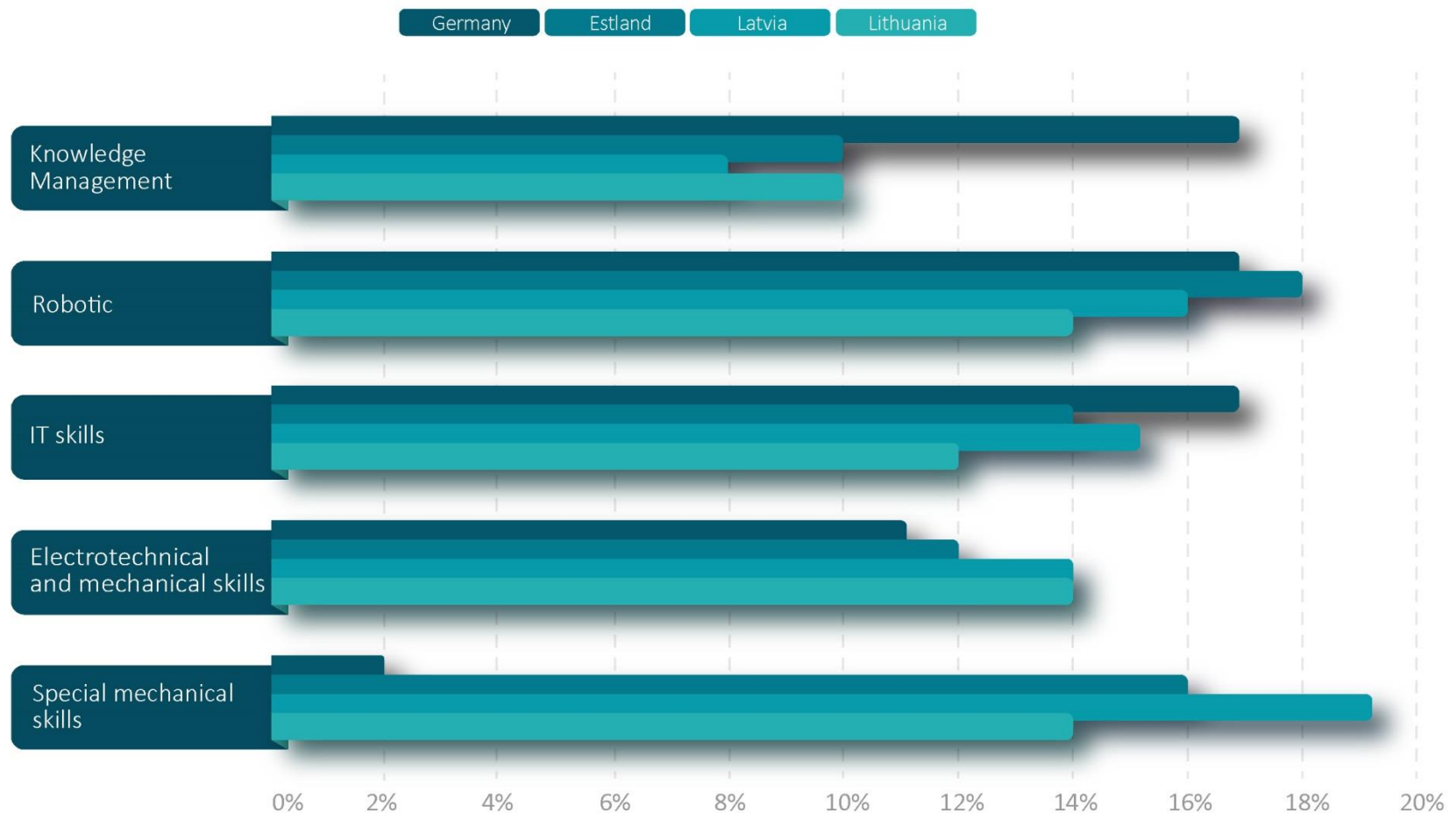
Which competencies will be important for the professionals in your enterprise in the future for implementation of industry 4.0?

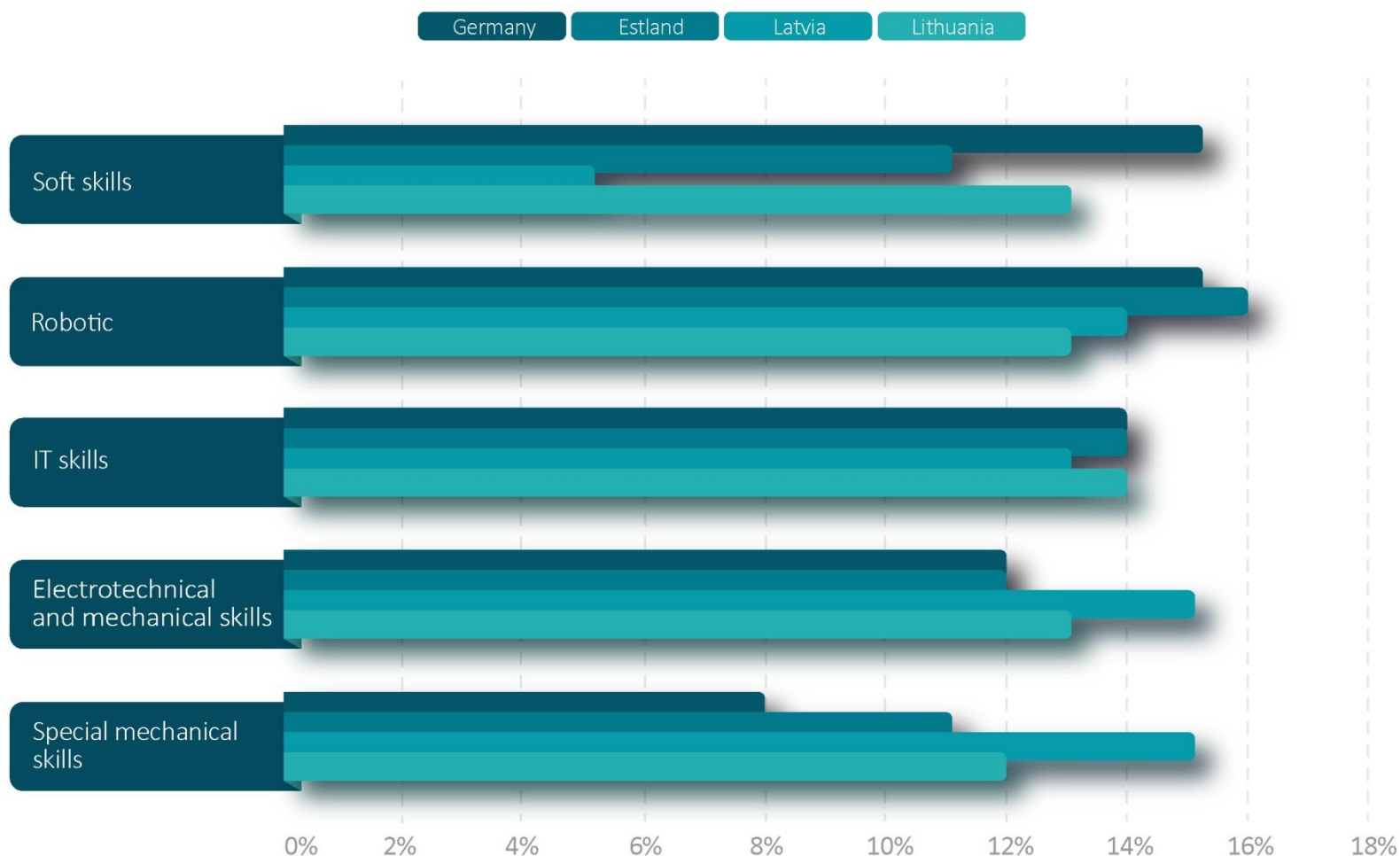Legend: Germany | Estland | Latvia | Lithuania

Categories (top to bottom):
- Soft skills
- Robotic
- IT skills
- Electrotechnical and mechanical skills
- Special mechanical skills

Axis: 0% 2% 4% 6% 8% 10% 12% 14% 16% 18%

Which soft skills do you hold for especially relevant for the implementation of industry 4.0 for trainees as well as for professionals?

Legend: Germany, Estland, Latvia, Lithuania

- Handling of innovations
- Conflict management
- Willingness of knowledge acquisition
- Distance collaboration
- Interdisciplinary cooperation

0% 5% 10% 15% 20% 25% 30% 35%

What is in your point of view the main challenge for implementation of industry 4.0?

Which qualification and competence standards are expected in your opinion to the professionals in yor enterprise in the future for implementation of industry 4.0?

Comparative Analysis of Qualification

WP1 focused on investigation of current situation in metalworkers VET in Germany, Lithuania, Latvia and Estonia, that would **act as a tool** in next WPs

The **first Analysis** established:

- Occupation profile of metalworkers in 4 countries
- Best practice examples
- Criteria and recommendations for developing a model QS and model VETprogramme

Comparative Analysis of Qualification Standards

The **second edition** of Analysis was necessary to in order to have a clear justification for the Galaxy model and modules, as well as student and teacher materials.

Additional material was collected:
- Technologies, that transforms industrial production
- Implementation of digitization process in enterprises
- Teaching forms, methods, life-long-learning, apprenticeship
- Analysis of VET legislations in every partner country

Final version of WP1 is available:

http://change4industry.eu/en/pages/documents/project-workpages/wp1-comparative-analysis-of-qualification-standards/wp1-final-version.html

Drawing up a Model Qualification Standard and a Model VET Programme

Developed Galaxy model qualification standard and VET curriculum for metalworkers' professional profile that is adapted to the industry environment and aligned according to the requirements of legal framework of each country

Basis of Methodology and Road Map (1)

KEY ELEMENTS OF QFs (*)	STRATEGIC EQF OBJECTIVES			
	INCREASE TRANSPARENCY	PROMOTE LIFELONG LEARNING	INCREASE MOBILITY	MODERNISING EDUCATION AND TRAINING
Level descriptors and the extent to which they are known and used	EQF/NQF learning-outcomes-based levels are referred to in certificates and diplomas, in national education, training and employment databases.	Level descriptors are used as a reference point by all lifelong learning providers and stakeholders.	Level descriptors used as a reference point by labour market as well as education and training stakeholders are comparable across institutions and countries.	Learning-outcomes-based levels are used as a reference and calibration-point when developing new qualifications and when reviewing and renewing existing ones.
The learning outcomes principle and the extent to which it is implemented	Learning outcomes approach has been implemented by all education and training sectors, for initial as well as continuing education and training.	Decisions on access, exemptions and recognition – including validation of non-formal and informal learning – refer to learning outcomes.	The extent to which the learning outcomes/ competence approach is presented in a format which is understood by society at large and by employers in particular.	The learning outcomes approach informs the articulation of standards, programmes, curricula, assessment and teaching.

The introduction of qualifications frameworks covering all types and levels of qualifications	The relationship between all types and levels of qualifications are demonstrated by the qualifications framework.	The qualifications frameworks increase communication and cooperation between levels, institutions and education as well as economic sectors.	The qualifications framework covers all qualifications and certificates relevant to employers and job-seekers.	The qualifications framework forms an integrated part of national education and training policies.
The involvement, acceptance and ownership of relevant stakeholders	Stakeholders from education and training, employment, civil society and other relevant sectors are aware of, committed to and actively use the framework.	The framework aids cooperation between stakeholders in lifelong learning, for example in the form of efficient and effective delivery of validation of prior learning.	The qualifications framework is known to, and seen as relevant and credible by, labour market stakeholders.	The qualifications framework has led to a broadening of participation and involvement in the governance of education and training (governance).

http://www.cedefop.europa.eu/en/publications-and-resources/publications/2221

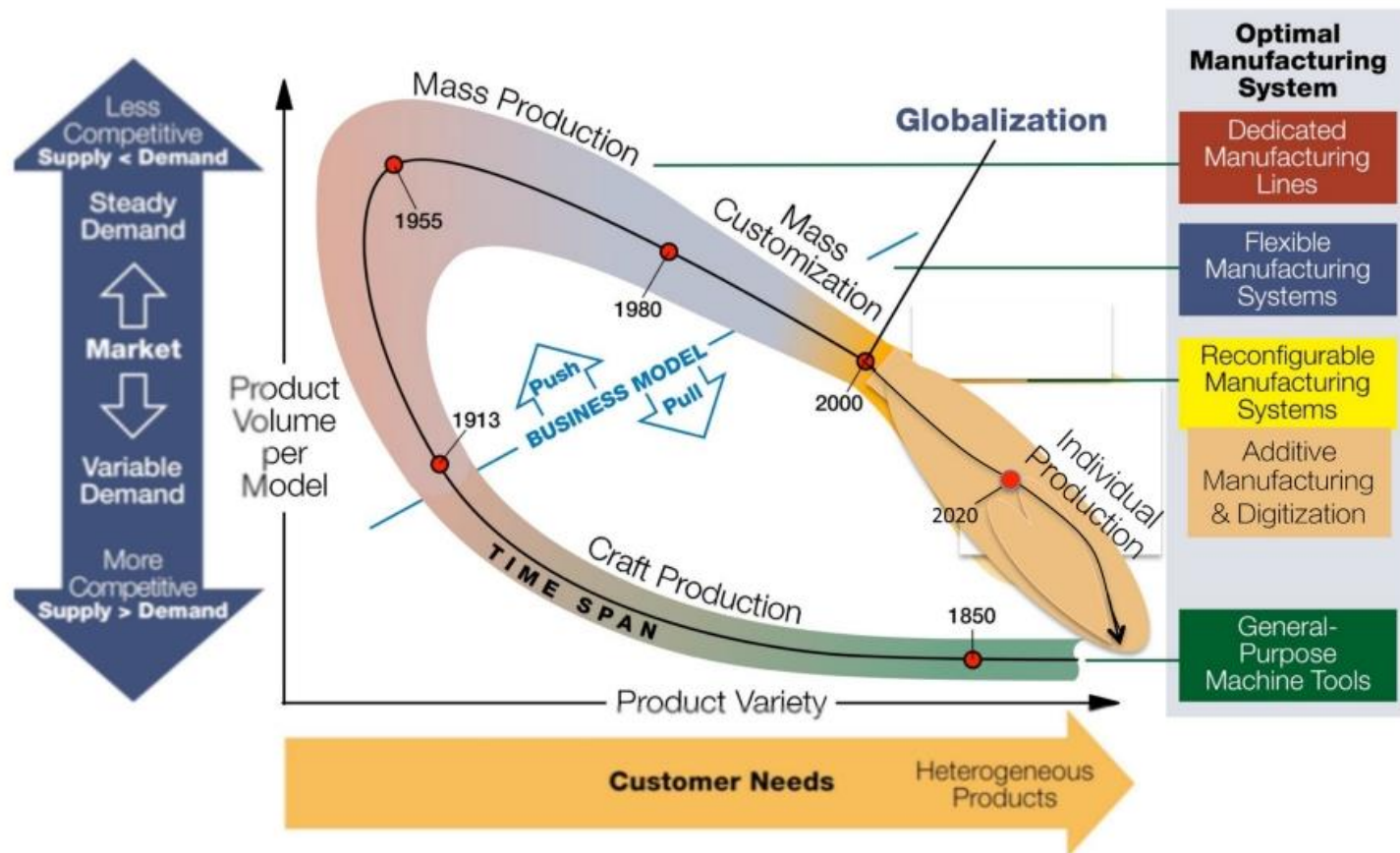# Galaxy model of core sets of competencies
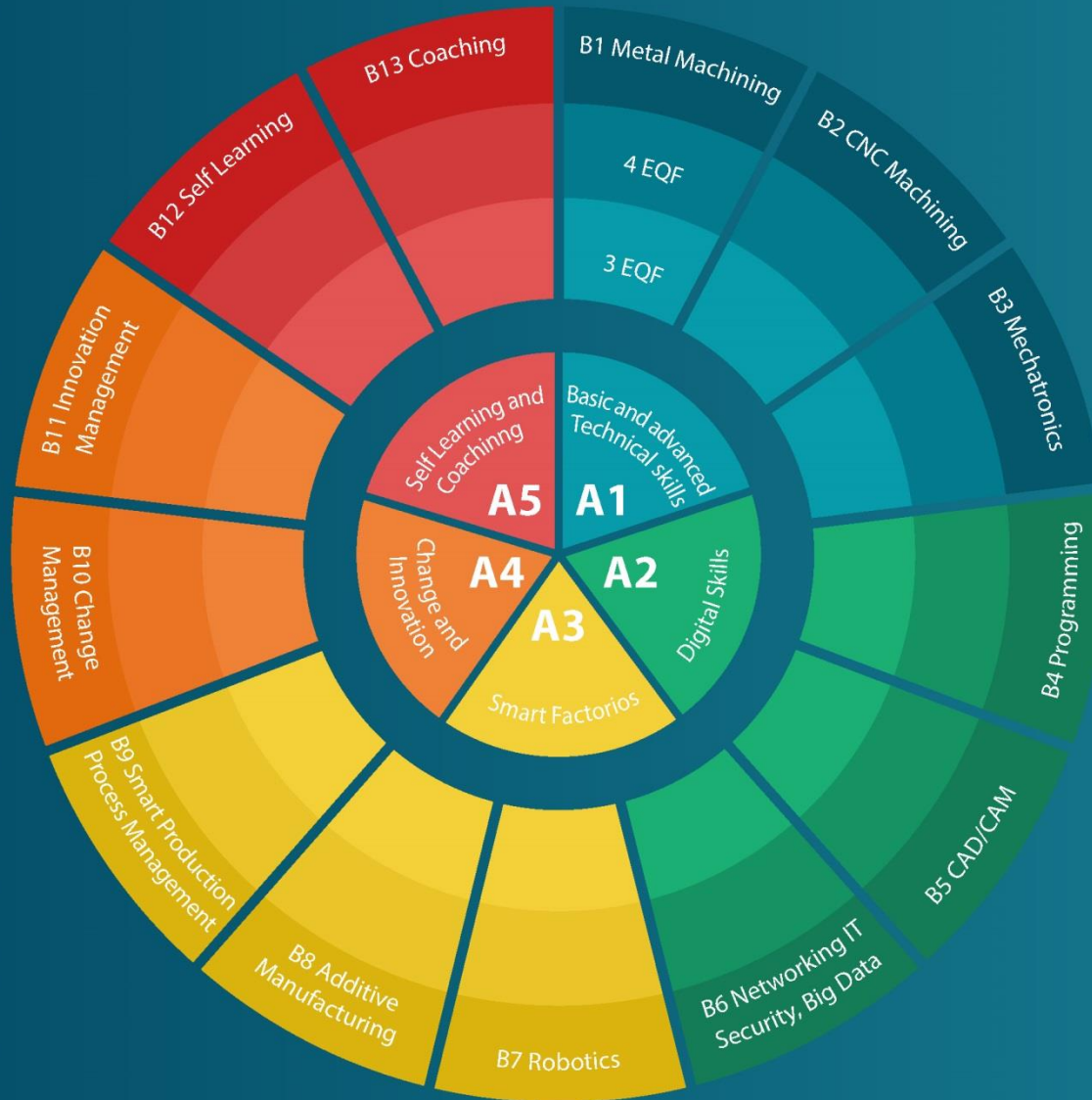
Core sets of competences of Galaxy model

A1 Basic and advanced technical skills

B1 Metal Machining (3-5 EQF)
B2 CNC Machining (3-5 EQF)
B3 Mechatronics (3-5 EQF)

A2 Digital skills

B4 Programming (3-5 EQF)
B5 CAD / CAM (3-5 EQF)
B6 Networking, IT security, Big data (3-5 EQF)

A3 Smart factories

B7 Robotics (3-5 EQF)
B8 Additive manufacturing (3-5 EQF)
B9 Smart production process management (3-5 EQF)

A4 Change and innovation

B10 Change management (3-4 EQF)
B11 Innovation management (3-4 EQF)

A5 Self learning and coaching

B12 Self learning (3-4 EQF)
B13 Coaching (3-4 EQF)

Possible different ways of skills development

WORK ORGANIZATION LEVEL - UNDER SUPERVISION / AUTONOMY / RESPONSIBILITY	COMPLEXITY OF TECHNOLOGIES		
	UNIVERSAL MACHINES AND HAND TOOL WITHOUT CNC	CNC CONTROLLED MACHINES	NETWORKED AND INTEGRATED PRODUCTION TECHNOLOGIES
RESPONSIBILITY FOR WORKPLACE UNDER SUPERVISION	BASIC TECHNICAL SKILLS AND KNOWLEDGE	• PERFORMING SPECIALISED OPERATION WITH CNC MACHINES • SPECIAL MECHANICAL SKILLS	
MULTIFUNCTIONAL MACHINES AUTONOMOUS WORK		• DIGITAL SKILLS • ROBOTIC (APPLICATION) • MECHANICAL SKILLS	USER FUNCTION OF INDUSTRY 4. TECHNOLOGIES/APPLICATION
INTEGRATED WORK PROCESSES AND FINAL RESULT	RESPONSIBILITY OF SIMPLE WORK PROCESSES	PERFORMING SIMPLE MANUFACTURING OPERATIONS WITH CNC EQUIPMENT	• SMART FACTORIES • PROCESS MANAGEMENT • BIG DATA • NETWORKING SECU RITY

Possibility Industry 4.0 principles implement into Skills 4.0

# Project Include ENTREPRENEURIAL SKILLS DEVELOPMENT

Into action

Resources

Ideas & opportunities

ENTREPRENEURSHIP COMPETENCE

- Mobilising resources
- Financial & economic literacy
- Motivation & perseverance
- Mobilising others
- Self-awareness & self-efficacy
- Taking the initiative
- Spotting opportunities
- Planing & management
- Creativity
- Coping with ambiguity, uncertainty & risk
- Vision
- Working with others
- Valuing ideas
- Ethical & sustainable thinking
- Learning through experience

Galaxy model adaptation to LT standard EQF3

- LKS/EQF 3 Bazinės Gamybos Technologijos **(B1)**

- LKS/EQF 3 Specialiosios mechanikos žinios **(B2)**

- LKS/EQF 3 Apdirbimo programos SPV staklėms **(B4)**

- LKS/EQF 3 CAD/CAM **(B5)**

- Metalo apdirbimas
- Specialiosios mechanikos žinios (CNC)
- Apdirbimo programos SPV staklėms
- CAD/CAM
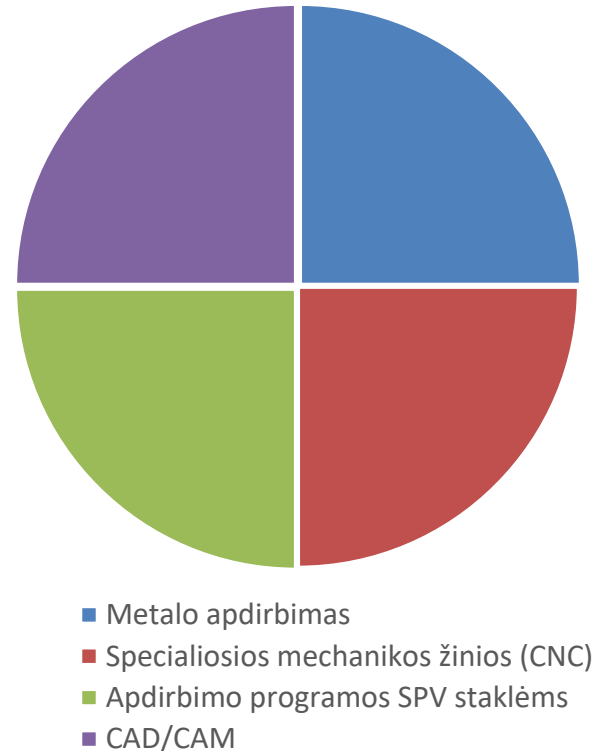
Galaxy model adaptation to LT EQF4

- LKS/EQF 4 Pažangios Gamybos Technologijos **(B1)**
- LKS/EQF 4 Specialiosios mechanikos žinios **(B2)**
- LKS/EQF 3 Mechatronikos žinios **(B3)**
- LKS/EQF 3 Apdirbimo programos CNC/SPV staklėmis **(B4)**
- LKS/EQF 4 CAD/CAM **(B5)**
- LKS/EQF 3 Robotika **(B7)**
- LKS/EQF 3 Sparčioji prototipų gamyba **(B8)**

- ■ Metalo apdirbimas
- ■ Specialiosios mechanikos žinios (CNC/SPV)
- ■ Mechatronikos žinios (CNC/SPV)
- ■ Apdirbimo programos CNC/SPV staklėmis
- ■ CAD/CAM
- ■ Robotika
- ■ Sparčioji prototipų gamyba
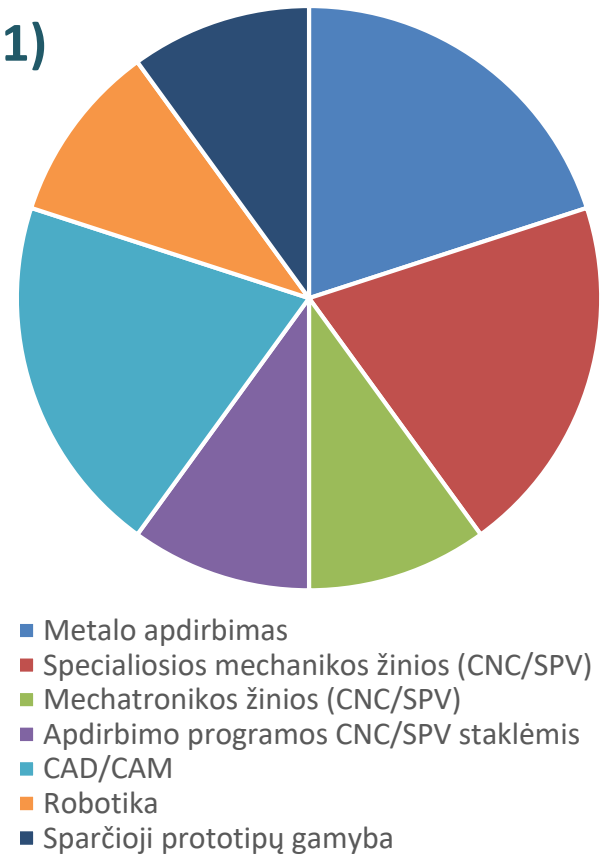
- LKS/EQF 5 Sumanios Gamybos Technologijos **(B9)**
- LKS/EQF 5 Specialiosios mechanikos žinios **(B2)**
- LKS/EQF 4 Mechatronikos žinios **(B3)**
- LKS/EQF 5 Apdirbimo programos CNC/SPV staklėmis **(B4)**
- LKS/EQF 5 CAD/CAM **(B5)**
- LKS/EQF 3 IT ryšiai, saugumas, duomenų bazės **(B6)**
- LKS/EQF 4 Robotika **(B7)**
- LKS/EQF 3 Sparčioji prototipų gamyba **(B8)**
- LKS/EQF 3 Sumaniosios gamybos procesų vadyba **(B9)**
- LKS/EQF 3 Pokyčių valdymas **(B10)**
- LKS/EQF 3 Inovacijų vadyba **(B11)**
- LKS/EQF 3 Mokymasis ir mokymas **(B12)**
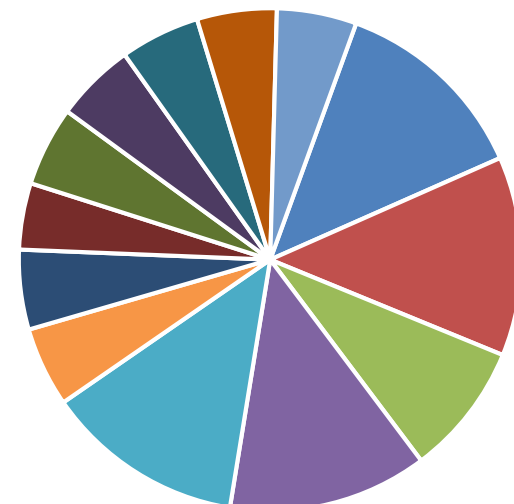
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- Apdirbimo programos CNC/SPV staklėmis
- CAD/CAM
- IT ryšiai, saugumas, duomenų bazės
- Robotika
- Sparčioji prototipų gamyba
- Sumaniosios gamybos procesų vadyba
- Valdymas
- Inovacijų vadyba
- Mokymasis
- Mokymas

Training Material for Learners

Textbook provide the latest approach to machine tool technology, modern integrated manufacturing, CNC systems, smart manufacturing in Factories of the future and entrepreneurship

and **Workbook** include exercises based on industrial practice and sample solutions

Training Material for Trainers in the VET institutions and in-company trainers

Trainers Manual next to basic and specialized technology content, also includes innovative coaching techniques for metalworkers

Set of **Verification tests** (both theoretical and practical) and Educational posters will be used for the provision of training

Development of E-Learning Platform

https://**cnc4change.org**/

The E-learning platform will act as an on-line training tool for learners, trainers, VET institutions, manufacturing enterprises and individuals aiming at acquiring metalworkers profession

It is established as an Open Education Resource system with a focus on accessibility and easy sharing

EDUCATIONAL CONTENT

INFORMATION RESOURCES

TESTS

Learn anytime, anywhere

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Log in

ABOUT US

BCT yra inovatyvi įmonė gaminanti tikslius mechaninius komponentus. Mūsų detalės yra naudojamos automobilių, įvairios paskirties mašinų gamybos, medicininės reabilitacinės technikos ir energetikos pramonės šakose.
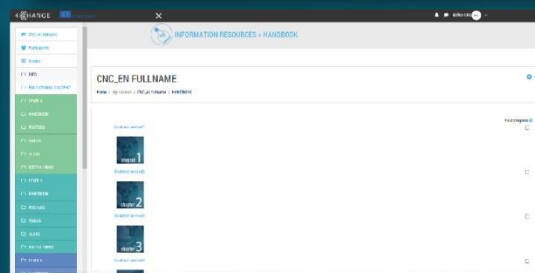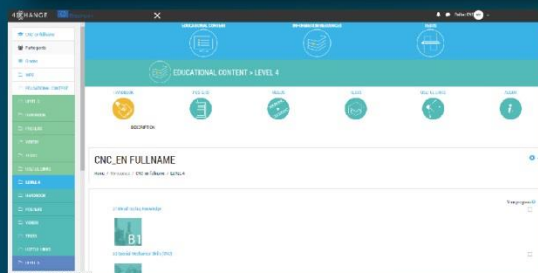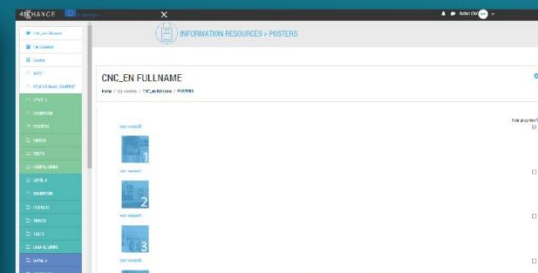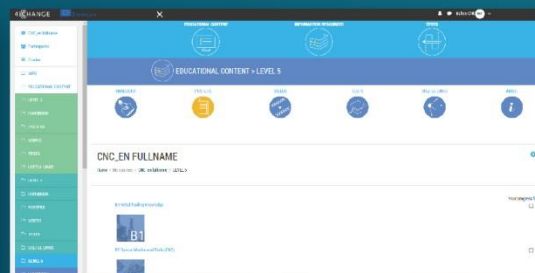
Innovative e-learning platform

All developed in project Didactic material implemented Additionaly:

- Virtual lessons for practical learning about application Industry 4.0 in advanced metal factories

- Media material (10 video clips)

- Specially developed for learning quality evaluation
   testing system for learners

Media material in e –learning platform

- Needs of digital skills in smart factories

- CNC turning - Top Turn

- CNC milling - Top Mill

- NC editor

- NC test

- Direct measurement of tools and workpiece inside CNC machines

- Maintenance of CNC machines

- Safety requirement in Job with CNC machines

Virtual lessons - exercises for practical learning (1)

- Internet of Things
- Using of Cloud technologies
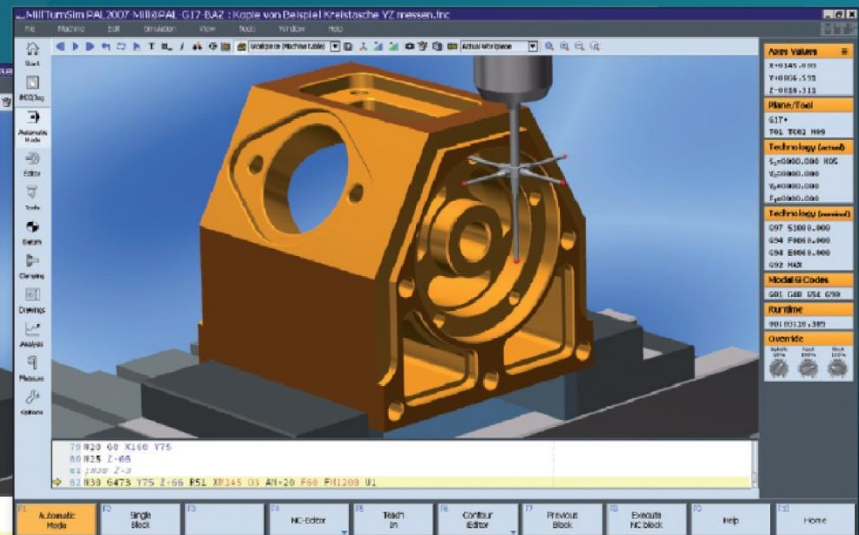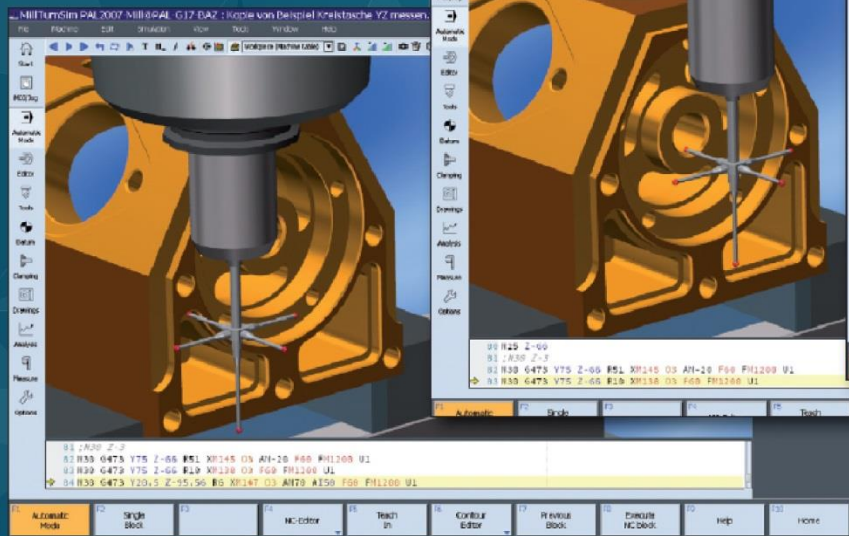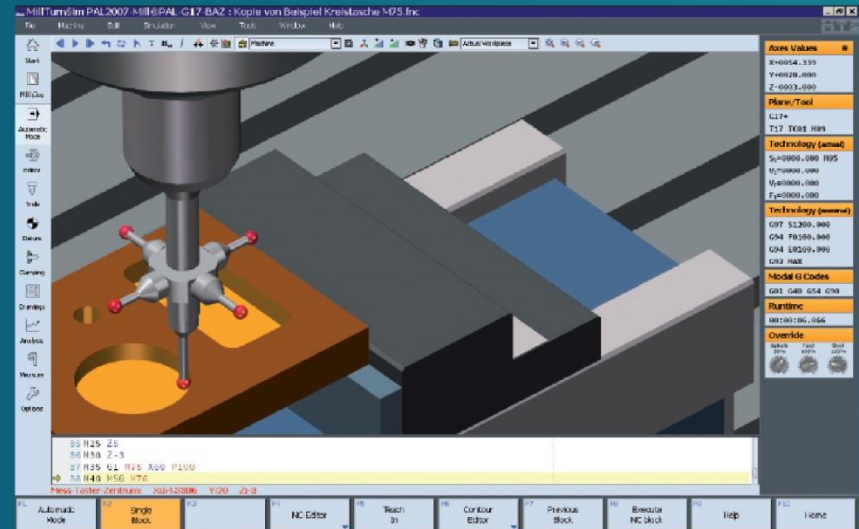- Cybersecurity
- 3D printing technologies
- Identification of Big data
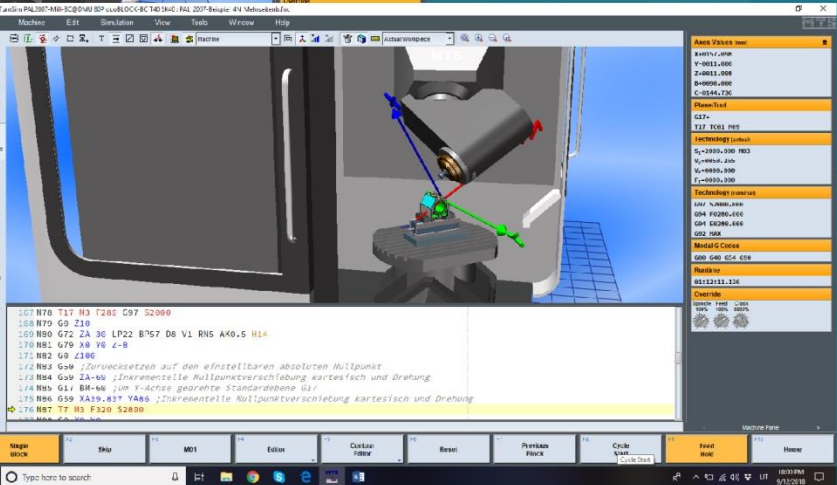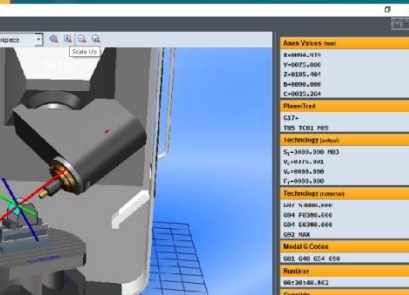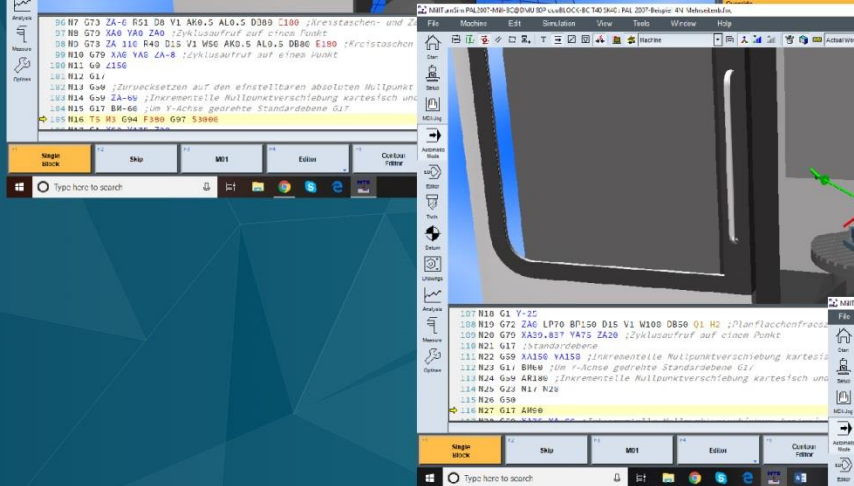- Robotics
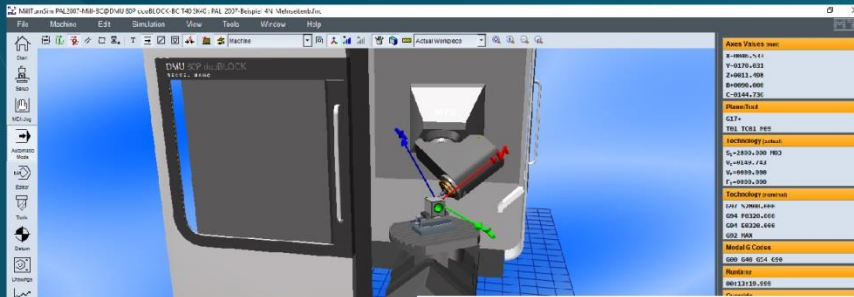
Robot and CNC machine in action
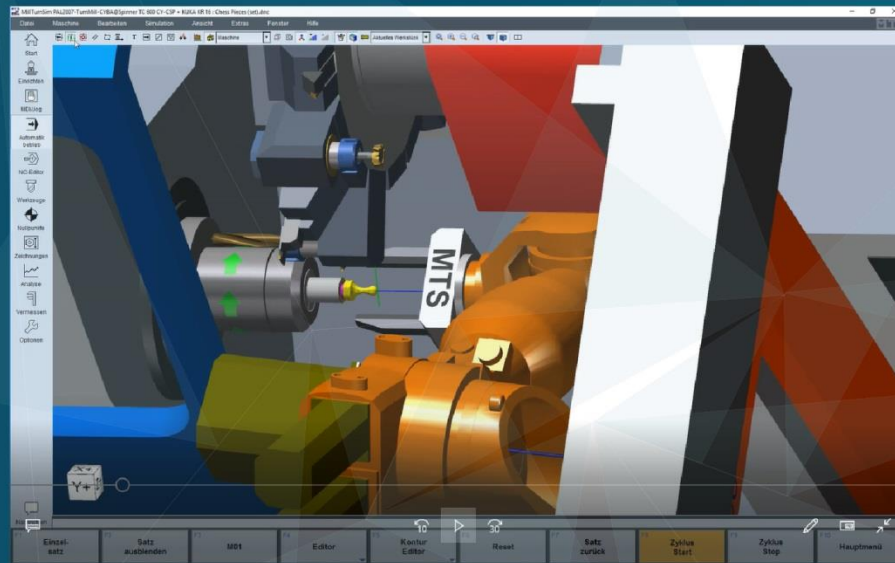
Robotized MTS-CNC manufacturing cell for Industrie 4.0
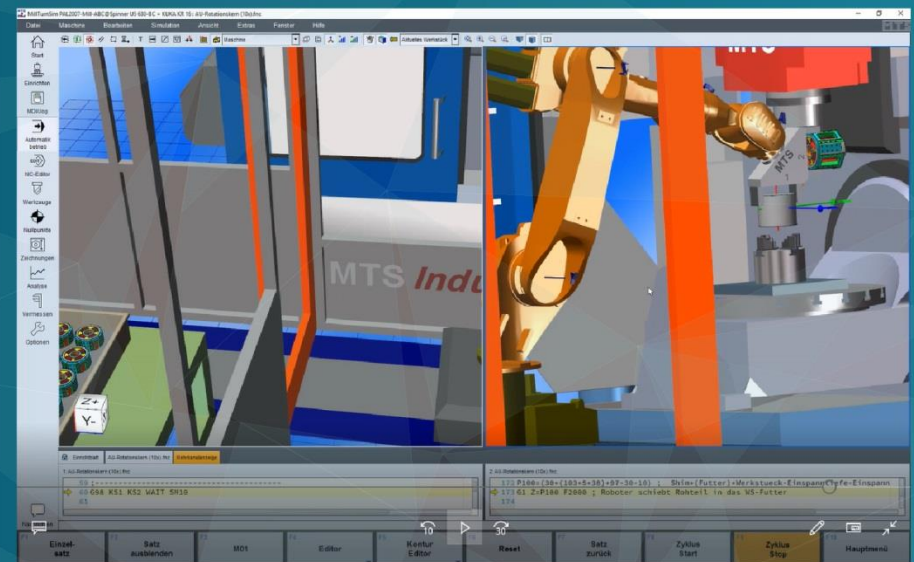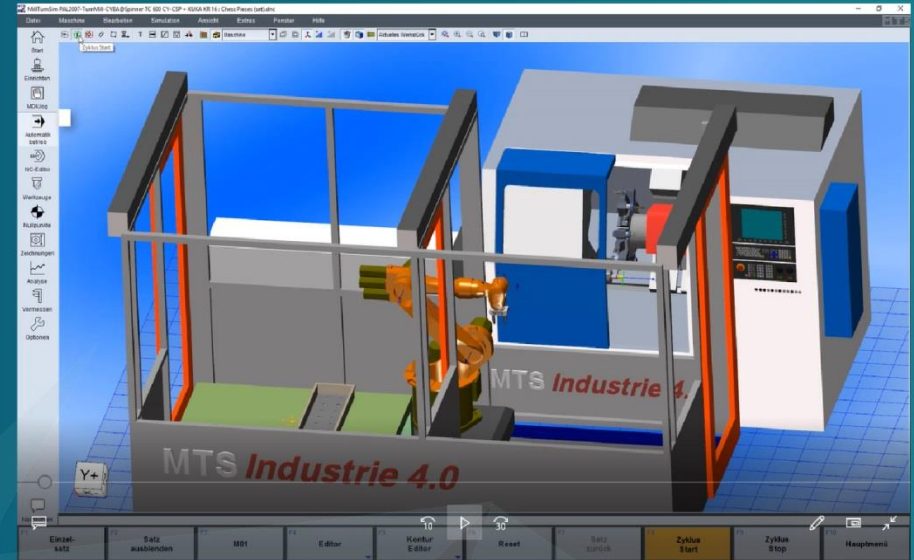
Direct measuring operation of the workpiece during machining process, integrated into MTS-CNC milling simulation software

Workpiece machining process simulation on the 5-axis machining centre DMG Mori 60 eVo-BC T40, integrated into MTS-CNC milling simulation software using MTS-CNC software

Piloting

Trainers from VET institutions and master metalworkers from manufacturing enterprises (in-company trainers)

Learners from VET institutions and metalworkers from manufacturing enterprises

Exploitation and dissemination

- Active collaboration with all stockholders:

  - Associations

  - Business units

  - Government institutions

  - VET providers

Thank You for attention

Learning platform
https://**cnc4change.org**/

Project web page address
http://**www.change4industry.eu**/