Innovative development of human resources in enterprise and in society

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Content:

FOREWORD

Mechanical engineering is a strategic industry: it is a high added-value, knowledge-intensive sector that supplies all other sectors of the economy with machines, production systems, components and associated services, as well as with technology and knowledge they need. Mechanical engineering covers also a wide range of sub-sectors, including manufacturing of lifting and handling equipment, machine tools, woodworking machinery, transportation vehicles, cooling and ventilation equipment, pumps and compressors, engines and turbines, agricultural machinery, machinery for paper and paperboard production, etc.

Mechanical engineering is an innovative key industry that has a great impact to the innovation capacity of all other sectors in the economy. To maintain European welfare-model, the changes taking place in EU economy and society presuppose more devotion to the economy's competitiveness. To raise competitiveness, in the beginning of 2005 European Commission made an suggestion for partnership focused on promoting the economic growth and generating positions between European Union member-countries.

In the spring 2005, new Lisbon strategy or of economic growth and employment was acclaimed by government leaders of member-states. Implementation of this agreement is essential not only springing from the national level, but also every company should regard seriously to development of competitiveness with an aim to survive in continuously changing environment. This paradigm of information society is characterized in best way by following three trends:

1. Continuous decrease of resources and rise of the prices for resources (labour force, raw materials, energetic resources etc);
2. Customers' demands regarding quality are continuously rising, supposing at the same time continuous decline of the products' prices;
3. Realisation times shorten, but production volumes rise.

From the viewpoint of the company's sustainability and competitiveness, the very important factors are high productivity, including labour productivity, and speeding up the innovation process. Any of the operational stages of the business chain, including marketing, R&D, purchasing, finance, production, sales, and supportive services, contribute to productivity. Behind of all these operations taking place in the company are organization, technology, and humans. The influence of the human factor is guided through human resource management. The objective of the INNOMET was to turn attention to the humans' impact on the productivity and the methods for increasing the productivity and efficiency of activities in the company through determining and estimating the needed competences in the certain working environment.

In most industries, it is possible to buy machinery and equipment on the international marketplace that is comparable and access to machinery and equipment is not differentiating factor. Ability to use these effectively is the key-factor of success. A company that has lost all of its equipment but retained the skills and knowledge of its workforce could be back relatively quickly. A company that has lost its competences, while keeping its equipment, would never recover.

Integrated web-based information system – INNOMET – was developed through the INNOMET project. INNOMET is an acronym for development of the innovative database model and information system for adding innovation capacity of labour force and entrepreneurs of the mechanical engineering and apparatus building sector. The objective of the information system is to enable evaluation of actual competences of the company's employees (e.g. production manager, foreman, CAD engineer, CNC operator, welder, etc) and to compare them with needed competence level that was previously defined by the company. Due to the INNOMET system it is also easy to find appropriate courses for raising competency of the employees, to book the courses, and also to take vocational exams.

INNOMET as a trans-national project has had two periods:

- INNOMET I – 2003 – 2004
- INNOMET II – October 2005 – March 2007.

The following organizations of seven countries have contributed to the INNOMET:

- Federation of Engineering Industry, Estonia;
- Tallinn University of Technology, Estonia;
- Tallinn Enterprise Board, Estonia;
- Budapest University of Technology and Economics, Hungary;
- IAL Piemonte Training Institute for Workforce, Italy;
- Association of Mechanical Engineering and Metalworking Industries, Latvia;
- ALFAMICRO, Portugal;
- Royal Institute of Technology, Sweden;
- Vocational Training School of Turku, Finland.

I would like to thank all partners for their contribution. We are sure that the system generated is efficient tool to realize life-long learning process and to raise competitiveness of the companies due to obtaining clear information about the employees' ability and knowledge needed to fulfil the company's objectives in the international market.
Further development of the INNOMET system enables to turn it more universal and user-friendly and we hope to see growing popularity and extending use of the system.
There were numerous organizations and institutions participating in the INNOMET - many thanks to all for contribution. I sincerely thank all the experts, scientists and enterprise managers who spared no effort to help us. And last but not least - this book could not be possible without support of EU Leonardo da Vinci program.

Jyri Riives

INDUSTRY INFORMATION SYSTEMS DEVELOPMENT TRENDS IN THE XXI CENTURY

Torsten Kjellberg

1. BUSINESS REQUIREMENTS IN THE XXI CENTURY

IT systems in companies have to meet and support evolving requirements from future business developments which are focusing on:

- Globalisation
- Partnership
- Increased cooperation in product realisation
- Increased cooperation in manufacturing (outsourcing)
- Shorter product life cycles
- Support product life cycle, service
- Support product upgrading
- Trace individual product configurations
- Support product retirement

2. DEMANDS ON INFORMATION LOGISTICS AND MANAGEMENT

It will become a key competitive advantage to be able to effectively support the product realisation, life cycle and whole business process with right information to the right persons and partners, at the right time, in right format and at a right and useful detailing level. One tool to realize this information logistics for product data is for a company to install a Product Life cycle Management system, PLM for storing and providing the information. Another important step is to realize information integration over key application systems for a company and its partners. Standards for product and resource data communication, STEP and also tools for systems integration are then important.

Manufacturing today can be characterized as a heterogeneous data creation environment.

It is essential for manufacturing companies to be able to reuse their information both regarding the product and the manufacturing system. Reuse of information is today hampered by different data formats, information inconsistencies and lack of key information, which was not taken into account when applications were developed.

Management of information during the product life cycle is necessary as a means to decrease lead-time, cut cost, increase quality and better meet customer requirements and has long focused on the management of <u>product</u> data in Product Lifecycle Management (PLM) systems (see Fig. 1). Neutral formats for PLM from product requirements to end of life are being developed within STEP AP 239, PLCS (Product Life Cycle management System). Important developments to support collaborative engineering is that the STEP standard for product data now also can handle dimensions and tolerances and product structure information through open PDM and PLM services, also approved by the Object Management Group, OMG. Recent PLM work has also taken some manufacturing aspects into account, but only from a product perspective.

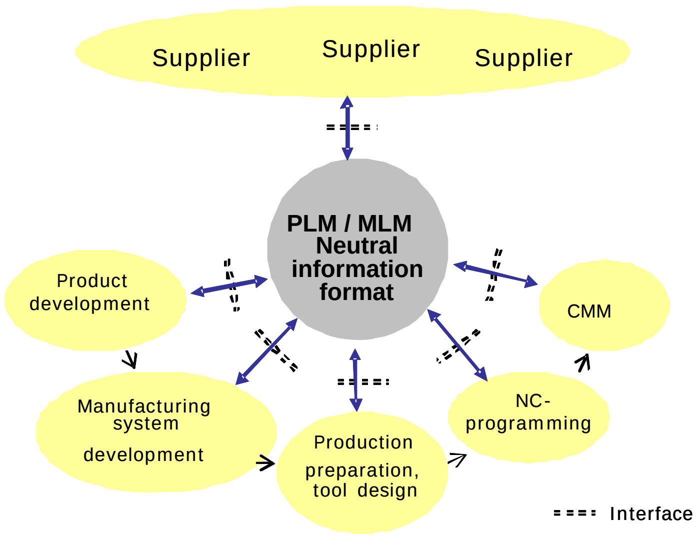

Figure 1 The information platform of PLM / MLM is supporting all activities in development and through the whole life cycle process

Research and development concerning Manufacturing system life cycle data Management *(MLM or MDM)*, has to date resulted in concepts for representing and interrelating products, processes and resources. In research and commercial developments an infrastructure for *MDM* is being developed. However, today there does not exist a consistent information and data management platform for <u>manufacturing</u> system life cycle management developed from a more holistic view on product realization. A fundamental difference between product and manufacturing system information management, driving the *MDM* research, is the need for managing process and resource information and the interdependences between products, processes and manufacturing resources.

3. VIRTUAL PRODUCTS AND VIRTUAL MANUFACTURING

Virtual products and virtual manufacturing will be one basic requirement of tomorrow's world-class manufacturing. Manufacturing of customer-oriented products has to fit into the traditional concept of low-cost serial production, but with a retained, or even increased, degree of customer adaptation. This is well illustrated by mass customisation. Short lead times, rapid change-over, fast ramp-up cycles to full production rate, as well as high product quality from the very start, all represent partial objectives to be attained within a production scenario in which the customers, and their demands, are central. This basically entails:

- Modular products, in which as many modules as possible are re-used in new product generations and programs – same function or customer requirement should have the same solution.
- Re-use of tested and approved product solutions.
- The re-use of tested and approved manufacturing technologies, appliances, tools and equipment, to as great an extent as possible- modular manufacturing systems.
- Flexible manufacturing equipment that can be quickly and easily re-configured for new products and product programs.
- The testing and quality assurance of new manufacturing processes prior to their introduction.
- The digital and/or software re-configurability of manufacturing equipment, to as large an extent as possible.
- The continuous follow-up of the manufacturing system, in order to ensure information acquisition of the following:
    - which manufacturing processes perform problem-free and with high productivity and product quality.
    - which processes offer rapid and problem-free change-overs.
- That the problem-free manufacture of components, with regard to quality as well as product flow, is assured at an early stage of the development process.

4. IT TRENDS IN PRODUCT REALIZATION

Important IT trends within product realisation and product life management are:

- A Common realisation processes supported by a work process management
- Effective Communication of data/information between companies
- Make information available to all project members
- Increasing demands on reuse of information
- Manage information in a secure way
- Configuration management of products as well as of manufacturing systems
- New types of information must be possible to manage and utilize as information about:
    - Product individuals and their realization

    - Product requirements, manufacturing and manufacturing system requirements
    - Definition of Concepts, Normalized terminology of products their realization, life cycle and retirement regarding both service and environment aspects.
- Support competence development and knowledge management for the products and their life cycles which is the base for company life.

5. TRENDS IN IT SUPPORT FOR HUMAN INTERACTION AND COMMUNICATION

Humans are and will always be the key resource in product realisation. Their ability to cooperate towards a common goal are of utmost importance.
In engineering the subject or problem at hand influences cooperation and problem solving. How well informed involved people with different background can be in order to be able to evaluate "all" consequences of the decisions to be made is a key issue. Different methods and tools to create a common and in depth understanding of the problem at hand, of possible solutions and their consequences are then becoming important. Stereo graphic technologies will evolve.

At many places tools for digital modelling of products, manufacturing resources and processes have been developed and also tools for human to human interaction by modelling besides principles and tools for man - model interaction.
To support human to human communication and negotiation we have developed a prototype of a 3D stereo interaction table at KTH, Fig 2 below.

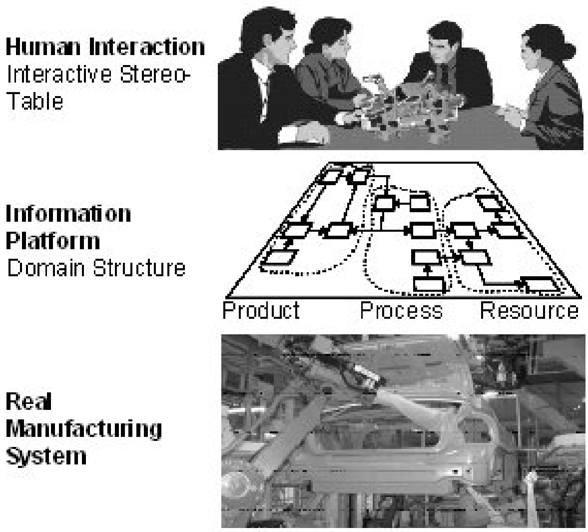

Figure 1 Negotiation between design and manufacturing

It makes it possible for the group of people to sit around the table, to see and interact with the digital model on the table and with each other. There is no need for any spectacle and people can see the same 3D model, look around it and at the same time directly see the others reactions, mimics, gestures and having eye contact with them.
This technology can also be applied for over Internet interaction. Each separate group having their table and having the others virtually on the other side.
Here the Figure 2 can illustrate the negotiation between design and manufacturing regarding how a new car design can be manufactured in an existing robot welding cell.
The model of the welding cell together with the car model, models the problem at hand. Together in this problem space different solutions can be tested and evaluated. In this development also man model interaction plays an important role. Models that through, perception and also by simulation and analysis tools can give answers to important questions for the group.

6. CONCLUSIVE VISION OF INFORMATION SUPPORT IN PRODUCT REALIZATION

The overall vision is that in tomorrow's world-class manufacturing company, engineers will have information and knowledge about products, development methods and procedures about manufacturing processes and resources - with relations to products - accessible at their fingertips. The goal for this vision is effective reuse of information and knowledge to support competent engineers to work and cooperate to meet the requirements of tomorrow. Competence, information and knowledge has to be managed in a company dedicated way as key company resources. Information must be decoupled from the IT tools that generate and use it. Product and manufacturing information and knowledge must outlive the tools that have generated it.

TAXONOMY OF TERMS AND DEFINITIONS FOR COMPETENCE MANAGEMENT

Torsten Kjellberg, Mattias Larsson, Per Johansson, Lasse Wingård

1. INTRODUCTION

The INNOMET I project was a success although it left a number of questions unanswered. One has to do with the definition of the core concepts *knowledge*, *skill* and *competence*. The INNOMET I system may be used to describe educational objectives of courses and for companies to specify their requirements on competence required for a certain profession or job, but it doesn't provide any explanation about the meaning of the content. Unless INNOMET defines these basic concepts there is an obvious risk that the information that goes into the system will not be uniform, and as a result, misinterpreted. Hence, it would not be possible to compare the curricula or learning outcomes of two courses, nor would it be possible to compare two professions.

Innomet I was concerned with a number of issues as illustrated by the following statements.

Within Innomet I and Innomet II a large number of knowledge/skills/competences are mentioned. Are all these really unique? Need for standardized skill definitions?

Course descriptions are not modularized.

It is difficult to compare educations, on a European as well as a local level. European initiatives such as ECTS (European Credit Transfer System) have increased the transparency but this is not enough. Schools around Europe follow the system when it is suited for them.

The questionnaires will not be uniform unless we define and structure the underlying concepts.

How to verify that the students and employees respectively have achieved the required competence and knowledge?

How to harmonize the curricula and professions of the different countries using the INNOMET II system?

2. THEORETICAL FOUNDATION FOR THE DEFINITION OF SKILL, KNOWLEDGE AND COMPETENCE

First of all we need to define what we mean with the terms skill, knowledge and competence. A good starting point is to look at the definition of these terms in a dictionary. However, first of all let us look into the proposed title of this work package: *"The INNOMET ontology of competencies and skills"*. Is that a properly formulated title? The terms *taxonomy* and *competences* have also been frequently used above. Is there any difference in meaning?

2.1 Competencies/Competences or Competency/Competence

Competence means ***having legal or practical ability to perform.*** **Competency** means the same thing, but is less frequently used except in educational argot (jargon), where **Competencies** are ***the various skills students are to be taught and teachers are to be prepared to teach***. The plural form **Competences** occurs infrequently. In one article we found a distinction between ***technical competences*** (interpreted as for example the ability to apply certain methods to a work task) and ***behavioural competencies*** (interpreted as for example the ability to function well as a member of a team) [reference].

With this as background we suggest that we use **Competence(s)** as we focus on technical education and knowledge, albeit improved behavioural competencies might be another goal.

What is the difference between competence and skill?

Once again, according to a dictionary:

Competence: Possession of a satisfactory level of ***relevant knowledge and*** acquisition of a range of ***relevant skills*** that include interpersonal and technical components.

Knowledge: Familiarity, awareness, or ***understanding gained through experience or study***.

Skill: ***Ability***, proficiency, facility, or dexterity that is ***acquired or developed through training or experience***.

∴ **Competence=Knowledge+Skills**

What is the difference between taxonomies and ontologies?

The terms taxonomy and ontology are used with more or less care, and sometimes as synonyms, therefore we also need to clarify the difference between them:

Taxonomy is defined as (1) *Division into ordered groups or categories* and (2) *The classification, or categorization, of things*.

For example, *A Web taxonomy would* ***classify*** *all the sites on the Web into a* ***hierarchy*** *for searching purposes*

Ontology is defined as (1) *The structure of a system* and (2) *A systematic arrangement of all of the important categories of objects or concepts which exist in some field of discourse, showing the relations between them.*

For example, *An ontology is typically a* ***hierarchical structure*** *containing all the relevant* ***entities and their relationships*** *and rules within that domain*

In this project we will focus on taxonomies, as these are more basic and general. To be able to develop an ontology you first need a taxonomy.

3. AN OVERVIEW OF TAXONOMIES

In an effort to define the skill levels a number of taxonomies have been studied. These are the Bloom Taxonomy of Educational Objectives [ref], Anderson's Revised Taxonomy, the SOLO "Structure of Observed Learning Outcomes", and the Feisel-Schmitz Technical Taxonomy. Blooms taxonomy is a classification system used to describe the way student should "behave, think, and feel" after participating in a course. Anderson's Revised Taxonomy is a modernized version of Blooms taxonomy. Feisel-Schmitz Technical Taxonomy is as the name implies adapted to technical issues, whereas the SOLO taxonomy describes level of increasing complexity in a student's/participant's understanding of a subject. In all cases the assumption is that each level embraces previous levels and adds something more.

All taxonomies are developed to describe goals/objectives of courses/education programmes in terms of knowledge and skills acquired by any student/participant fulfilling the course/programme requirements, but from slightly different viewpoints.

3.1 The Bloom Taxonomy of Competencies and Skills

The Taxonomy of Educational Objectives was created by Benjamin Bloom in the 1950's [2]. This classification system was used to describe various kinds of thinking after participating in a course expressed in measurable observable formats (instructional objectives). Bloom's taxonomy of educational is divided into three overlapping domains: the cognitive, affective, and psychomotor domain of which the first one is the most commonly used. The taxonomy is one of the most commonly used methods for course planning and assessment.

In the process of developing curricula (e.g. objectives of a course) (cf. Table 1) it is possible to identify the patterns of Blooms verbs that accompany any technical topic. It provides a sequential model for dealing with topics in a curriculum and suggests a way of categorizing levels of learning. Thus, in the cognitive domain, training for a technician may include knowledge, comprehensions, and applications but not analysis and above, whereas full professional training may be expected to include analysis, synthesis, and evaluation as well.

3.2 Anderson's Revised Taxonomy

During the 90's Lorin Anderson (a former student of Benjamin Bloom) worked on a revised version of the taxonomy that was more up-to-date.

It has some changes in emphasis. The revised taxonomy is a more applicable to for course planning (i.e. curriculum planning, education, and assessment) and competence planning (i.e. competence inventory).

Table 1 The levels of the cognitive domain with associated verbs

Level	**Illustrative Verbs for stating specific learning outcomes**
6. Evaluation	Appraise, compare, conclude, contrast, criticize, describe, discriminate, explain, justify, interpret, relate, summarize, support.
5. Synthesis	Categorize, combine, compile, compose, create, devise, design, explain, generate, modifies, organize, plan, rearrange, reconstruct, relate, reorganize, revise, rewrite, summarize, tell, write
4. Analysis	Differentiate, distinguish, identify, illustrate, infer, outline, point out, relate, select, separate, breakdown, categorize, diagram, inventory, outline
3. Application	Change, compute, demonstrate, discover, operate, predict, prepare, produce, relate, show, solve, use
2. Comprehension	Convert, defend, distinguish, estimate, explain, extend, generalize, give examples, infer, summarize, predict
1. Knowledge	Label, name, describe, list, match, identify, outline, reproduce, select, state

Table 2 Anderson's version of the levels of the cognitive domain with associated verbs

Level	**Illustrative verbs (examples)**
6. Creating (*Evaluation*)	design, construct, plan, produce
5. Evaluating (*Synthesis*)	check, critique, judge, hypothesise
4. Analysing (*Analysis*)	compare, attribute, organise, deconstruct
3. Applying (*Application*)	implement, carry out, use
2. Understanding (*Comprehension*)	interpret, exemplify, summarise, infer, paraphrase
1. Remembering (*Knowledge*)	recognise, list, describe, identify, retrieve, name

In a attempt to exemplify the levels of understanding according to Anderson's revised taxonomy we have given some sample sentences and matching activities, containing one or more of the illustrative verbs.

Table 3 Samples

Level	**Sample sentences to promote things specific to each level of the taxonomy**	**Potential activities and products**
6. Creating (Evaluation)	Will a design theory support the creation process?	PRODUCE production drawings for a specified product
5. Evaluating (Synthesis)	Is the drawing complete?	JUDGE/CHECK the details of the drawing
4. Analysing (Analysis)	What drawing views do I need to understand the product?	ORGANISE/COMPARE drawing views to ensure they are not redundant
3. Applying (Application)	Does the company have any drawing standards?	USE the company rules and standards
2. Understanding (Comprehension)	Why are the views in a drawing positioned as they are?	EXEMPLIFY the difference between ISO and ANSI standards
1. Remembering (Knowledge)	How to position the views in a drawing?	Make a LIST of the main building blocks of a 2D drawing,

3.3 The SOLO taxonomy (Structure of Observed Learning Outcomes)

The SOLO taxonomy shows what the learning outcome should be on each level. In each step the level of understanding raises. All students/participants do not get through all the stages, neither does the teaching/training. In some cases "less training" gets them all the way.

Since the SOLO taxonomy is using a different way of describing the learning come it may be hard to compare it with Bloom's and Anderson's taxonomies. The following figure has a number of verbs defined to each of the levels. Again, though, a single verb does not tell you what level you have reached.

Table 4 The levels of learning outcome as described in the SOLO taxonomy

Extended abstract level	• students make connections beyond the immediate subject area • students generalise and transfer the principles from the specific to the abstract
Relational level	• students demonstrate the relationship between connections • students demonstrate the relationship between connections and the whole
Multi-structural	• students make a number of connections • the significance of the relationship between connections is not demonstrated
Uni-structural	• students make simple and obvious connections • the significance of the connections is not demonstrated
Pre-structural	• students are acquiring pieces of unconnected information • no organisation • no overall sense

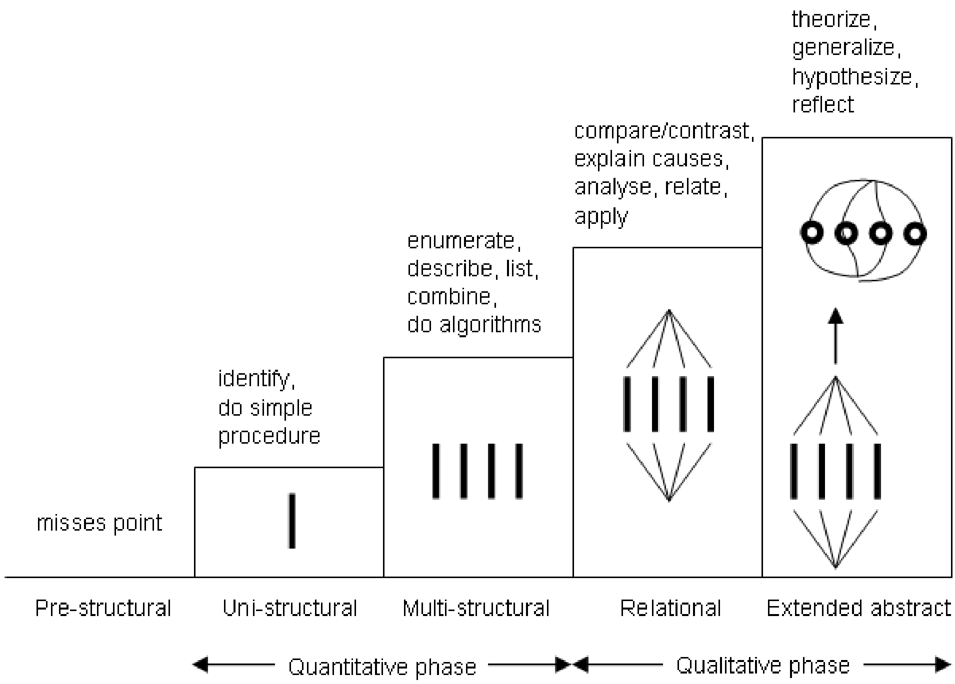

Figure 1 The learning outcome as described in the SOLO taxonomy with verbs

3.4 The Feisel-Schmitz Technical Taxonomy

The Feisel-Schmitz taxonomy is similar to the Bloom taxonomy, but it is adapted to technical applications. The Explain and Compute levels are contradictory to Blooms taxonomy. For some technical applications one does not need to fully understand a task in order to fulfil its requirements. Following a number of given rules and procedures can be good enough to get the desired result.

It is somewhat difficult to find references to this taxonomy. Therefore the description is short.

Table 5 The levels of the Feisel-Schmitz technical taxonomy

Judge	To be able go critically evaluate multiple solutions and select an optimum solution
Solve	Characterize, analyze, and synthesize to model a system (provide appropriate assumptions)
Explain	Be able to state the outcome/concept in their own words
Compute	Follow rules and procedures (substitute quantities correctly into equations and arrive at a correct result, Plug & Chug)
Define	State the definition of the concept or is able to describe in a qualitative or quantitative manner

3.5 Constructive Alignment (Biggs)

It is not enough to specify proper curriculum objectives for a course to get a good learning outcome from completing the course. It is also necessary to define proper teaching/learning activities and proper assessment tasks. When these three factors support each other, we have achieved what Biggs call *Constructive Alignment*, which, according to Biggs, leads to a quality learning result. The Figure 2 on the following page tries to visualize the principle of constructive alignment by describing how educational objectives, teaching/learning activities and assessment methods are related.

However, we believe that not only courses could be described in terms of constructively aligned objectives, activities and assessment methods. The same should apply to the description of the ability to successfully take on a working task, or the description of how to specify and evaluate the competence required in a certain profession. Therefore, according to our belief, the principle of constructive alignment should be considered in specifying the competence modules, as they are described later in this book.

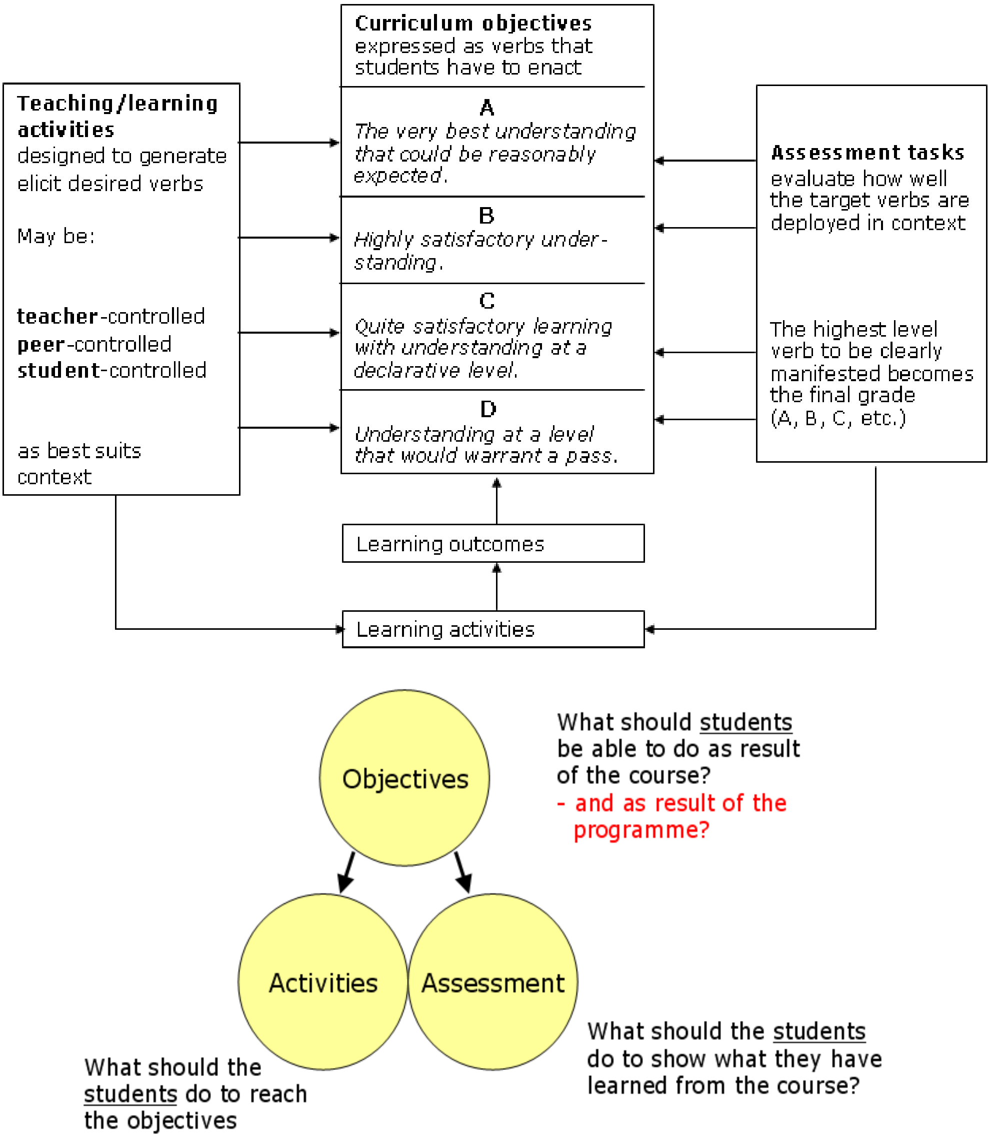

Figure 2 The principle of constructive alignment by describing how educational objectives, teaching/learning activities and assessment methods

4. HOW TO USE TAXONOMIES?

Taxonomies are used to formalise the terminology used for specifying levels of competence and skill and stating goals of courses and education programmes.

Is there any significant difference between specifying levels of competence and skill, and formulating goals of courses?

We believe there is not – provided that the goals of courses are expressed as the knowledge and abilities a student/course participant should have after completing the course requirements.

All taxonomies are similar. In all cases the assumption is that each level embraces previous levels and adds something to the next level. Lower levels in taxonomies typically deal with knowledge – higher levels describe skills, given that we use the definitions of knowledge and skill we stated previously in this chapter. There is no need to make a distinction between general and professional skills and competences. These are handled by the levels. The typical verbs used in the taxonomies can not be unambiguously assigned to a specific level of competence. A single verb can appear on several levels. It is the combination of verbs that shows what level one has reached.

5. SUMMARY

This chapter provides a foundation for a discussion about and a specification of workplace skills, personal competence and educational objectives and their relations. The report may serve as a guideline for employers, teachers, human resource personnel, researchers, or anyone that is interested in advanced vocational education. However, the main purpose of this document is to provide the necessary input to the INNOMET II system – the tool for competence inventory and course development. The starting point of the work described in this report is the skills framework defined by the INNOMET I project (a predecessor to INNOMET II).

This work has expanded the definition of *skills*, defined by INNOMET I, by introducing and defining the terms *(foundational) knowledge*, *(applicable) skill*, and *(professional) competence*, based on definitions found in literature. In the previous framework these terms were all hidden in the definition of a *skill*, but it was almost impossible to tell the difference. All of these terms can be seen as elements of a taxonomy of competences and skills, where the terms can be related to the different levels in graded scales. These scales can serve as a common input and reference point for the above categories of personnel as they consider the following:

- Identifying the knowledge and skills required for a certain job
- Estimating the knowledge and skills of current or future workers
- Describing individual skills
- Identifying the educational objectives and assessment methods for developing and evaluating the proper knowledge and skills

The report includes a survey of a number of taxonomies used for defining educational objectives, from which a proper taxonomy for the INNOMET II project is suggested. Using such a taxonomy of competence to develop descriptions for different categories of educational objectives, work tasks and professions, an approach introduced in this part of INNOMET II is to find related groups of common elements in these descriptions, which can be used to form so-called *competence modules*.

A further idea in order to simplify this process is to have a computer-based so called *Competence Template*. That is a digital form in which the knowledge, skills and competence required for a certain type of job or profession, or achieved in a certain educational activity, can be entered, using the pre-defined terminology of the taxonomy. By using such a template, one can eliminate some of the problems of using different terminology for describing the same level of competence and one can also provide help by giving clear definitions of the meaning of different words in terms of the level of competence that they describe.

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HUMAN RESOURCES DEVELOPMENT PROCESS IN THE COMPANY, BASED ON COMPETENCE CHARTS

Jyri Riives, Tauno Otto, Kaia Lõun

INTRODUCTION

Globalization of the economy is going at a fast pace. Forces fuelling globalization are creating new production and market structure. Flexible production processes and structure are increasingly required by extremely dynamic markets where product life cycle is very short and where discerning customers with higher purchasing power and more differentiated and international tastes are demanding much more product variety, high quality and value for money. Thus, in the increasingly globalizing economy, competitiveness means the ability to constantly take the most advantageous position or niche in the rapidly changing market environment. The major determinants of the ability to sell products and services in the international market are no longer mainly relative cost advantages. More and more, competitiveness is based on quality, flexibility, short order handling and production times, technical superiority, services, and product differentiation. Though, in the final analysis the underlying determinant of competitiveness, whether at national, sector or enterprise level, is raising total productivity that combines the notion of efficiency and effectiveness. Productivity is one of the key factors affecting the overall competitiveness of a company. It is no wonder then, that the factors that improve competitiveness of nations and enterprises are similar and parallel to the factors that are very important for total productivity improvement.

Any of the operational stages of a business unit, including purchasing, marketing, finance, sales, production, and supportive services, contribute to productivity. Behind of all these operations taking place in a company are organization, technology, and humans. The influence of human factor is directed through human resource management. The humans' impact on productivity and the methods for increasing the productivity and efficiency of work through determining and estimating the competencies of the employees in the certain working environment are described in this paper.

1. HUMAN CAPITAL AND PRODUCTIVITY

Human and social capitals constitute the foundation of sustainable competitiveness and productivity involvement. The personnel shall be considered as valuable resource and the basis of productivity in an organization.

The conception of "human capital" comprises the personnel's knowledge, skills, talents, and know-how that have an effect on the company's productivity and, hence, the operations of the organization in the market. Skills and knowledge that people gain during their lives and that they can utilize in production of commodities and services are described as Human Capital. In the same way, a group or a team at the working place possesses human capital that is formed of common skills and mental capacity. Whole organization gains advantage of the human capital that it can use for a greater productivity. Human capital is a part of a greater whole called the

intellectual capital of the company.
If properly utilized, the intellectual capital will bring a meaningful added value to the organization. The intellectuality changes into added value if the drifting thoughts, information, and data can be arranged into coherent models. A coherent model can be, for instance, a mailing list, customer register, process description, or another usable item of information. Intellectual capital can be found in people, structures, and customers. Intellectual capital can, in this manner, be divided into three parts: Human Capital, Structural Capital, and Customer Capital (Koivuniemi, 1999).
Next, we discuss human factor influence on productivity and circumstances having influence on labour productivity.

1.1. Impact of Human Resources on Achieving a Company's Productivity and Competitiveness

There are three levels of environment in a company where we can analyse labour productivity (Lõun, 2005):

1. Productivity at personal level. The simplest system is: Human - Machine (see Fig. *1.1).* The human's skills, knowledge, and experiences influence how many pieces it is possible to produce during a certain time period using a certain machine with certain technological capabilities.

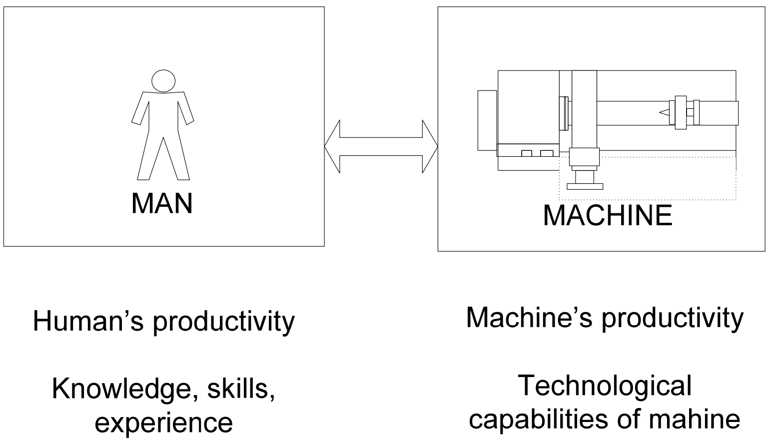


Figure 1.1 Human-machine system

$$\text{Labour productivity} = \frac{\text{Output}}{\text{Man}-\text{hours}} \quad \left[\frac{\text{EUR}}{\text{h}}\right] \quad \left[\frac{\text{piece}}{\text{h}}\right] \qquad \textbf{(1.1)}$$

Productivity is possible to calculate (see formula 1.1) by:
1) how many pieces the worker produced during fixed time (man-hours), or
2) the output value in EUR divided with man-hours.

Man-hours may be considered:

a) man-hours compensated;
b) man-hours spent at the work place;
c) man-hours actually worked, omitting man-hour losses due to vacation, accident, sickness, and so forth.

2) Productivity at department level (see Fig. *1.2* and formulas *1.2* and 1.3).

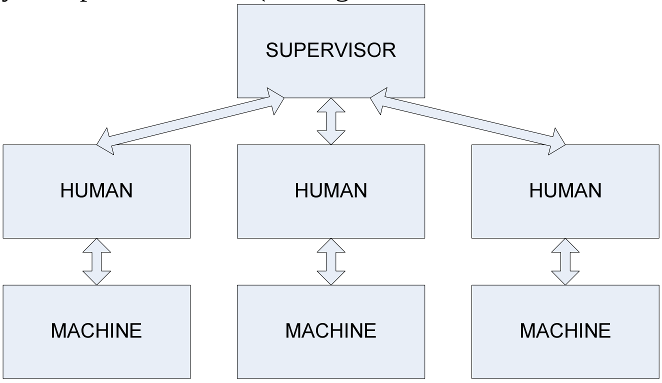


Figure 1.2 Supervisor-human-machine system

$$\text{Productivity} = \frac{\text{Output}}{\text{Costs}} \qquad (1.2)$$

Costs include wages, material cost, and shop-floor costs.

$$\text{Labour Productivity} = \frac{\text{Output}}{\text{Number of employees}} \qquad (1.3)$$

In formula (1.3) number of employees may be considered:
a) total number of employees in department, or
b) number of so-called production workers only in the particular department.

3) Productivity at organization's level (see Fig. 1.3 and formulas *1.4* and 1.5)

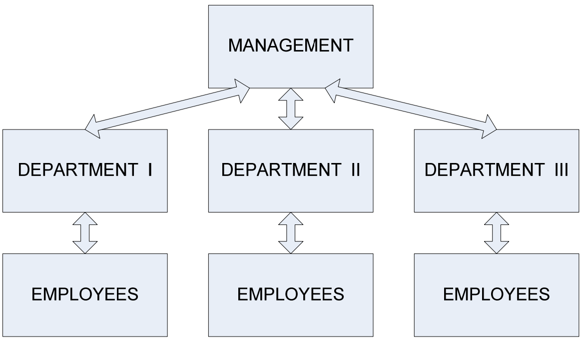


Figure 1.3 Simplified organization's structure

$$\Pr oductivity = \frac{Piece\ time}{Cycle\ time} \tag{1.4}$$

Cycle time: order preparation, purchase of materials, production preparation, production, distribution, transportation.

$$\Pr oductivity = \frac{Total\ output}{Total\ input} \tag{1.5}$$

$$Labour\ \ productivity = \frac{Output}{Man - hours} \tag{1.6}$$

In formula *(1.6),* we can also consider man-hours of all employees of the company, or only of all production workers.

As it was seen, calculating labour productivity may be quite complicated because of several measurement methods. The controversies in these measures concern:
(1) the extent to which labour, of whatever kind, is responsible for its performance;
(2) the relevance of the once quite sharp division between production workers and others; and
(3) the division between workers and management of the benefits of improvement in processes and management.

In general, the interpretation of these issues depends on whether the job is worker paced, machine paced, demand paced, or material paced (Adam and Dogramaci, 1981 p.34). One example concerns the shift from worker-paced skilled machining to numerically controlled and thus substantially more machine-paced work. Further, this development affected the division between production workers and others in that the jobs once done on the shop floor were moved to the office. Thus, the use of computer numerical controls (CNC) led to the transfer of the set-up function from the machinists to computer programmers who (not coincidentally) were office people and thus not members of the shop union. The details of the above incident should not obscure the important point that categories of labour can be substantially manipulated and thus differences in the productivity of production and other employees must be viewed with considerable care.

It would be realistic for a company to begin modestly and to go forward incrementally. After some experience, it may find that a labour-productivity system is adequate to its needs, especially when used in conjunction with accounting information and other extant data sources. Among the other plausible deterrents to the extension of the battery of productivity measures are: inertia, limitations on the supply of required data and in-house quantitative skills, flagging or uncertain top-level commitment or support, lack of managerial sophistication, and expectation that additional benefit would not warrant additional cost (Adam and Dogramaci, 1981 p.19).

To have comparable results, it is essential that in productivity analysis the company would use the same methodology during comparable periods. The comparability of the results is even more important than the result of single calculation, because taking one period's calculations as base values, later comparing the results with these, it shows the trend of improvement or deterioration. To ensure comparativeness, utilization of "deflation" technique would be useful.

2. ORGANIZATION AND MANAGEMENT

An organization is a group of people that works in the name of achieving common goals. Any institution or enterprise may be an organization. The organization model has been indicated in Fig. 2.1. Below a brief overview of the components of the model has been given.

1. Objective:
    - organization policy;
    - organization strategy.
2. People:
    - their skills and knowledge;
    - perception of their reality and values.
3. Technology:
    - machinery;
    - processing information.
4. Structure:
    - tasks;
    - roles.
5. Culture:
    - organization values;
    - management style.
6. Environment:
    - microeconomic and macroeconomic environment, social, political and economic pressure.

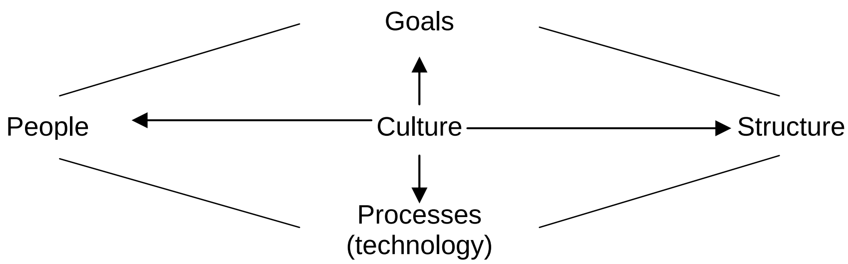


Figure 2.1 Organization model

Management is a process that enables organizations to achieve their objectives by planning, organizing, and controlling their resources, including gaining the commitment of their employees (motivation).

Management takes into consideration six activities:
1. Technical activities, e.g. production;
2. Commercial activities, e.g. buying and selling;
3. Financial activities, e.g. securing capital;
4. Security activities, e.g. safeguarding property;
5. Accounting activities, e.g. providing financial information;
6. Managerial activities, e.g. planning and organizing.

An organization depends on the people working in it. If a new employee is recruited, the employee and the organization enter into a psychological contract with one another where each party undertakes to make a certain contribution in the name of the common goal. The obligations of a person and the response of an organization have been indicated in Fig. 2.2.
An organization expects primarily the following from an employee:
– high efficiency of work;
– creativeness and renewal proposals;
– loyalty.

Employee's contribution	Company's contribution
– Effort	– Payment/salary
– Abilities	– Security
– Loyalty	– Benefits
– Competence	– Career opportunities
– Time	– Status

Figure 2.2 Relationship between employee and organization

In industry competitiveness is achieved largely owing to technological development, qualified labour, existence of expertise and effective use of such possibilities.
The level of competence of an employee has strong influence on the productivity of his or her work and thus the competitiveness of the entire organization. Labour-related productivity is affected directly by the employee's knowledge, skills, experience, motivation and the desire to apply them in a team. Hence there exists a need for evaluation of the competencies to determine the required and existing level of skills and knowledge.
An effectively working organization must be well-organized and its employees must be qualified and motivated. It must be able to quickly adapt to the changing environment (flexible and self-learning) and be able to solve intra-organization conflicts (a smooth process of constant improvement).

3. ENSURING COMPETENCE IN THE ORGANIZATION

The application environment of human resources development is business. Business controls resources (energy, raw material, equipment, people, information, etc.). Through production activities resources are coupled with purposeful work, whereby after achieving the desired production results (products, services) there will be resource losses in the production processes or activities not related to the objective. Everything that is necessary for preservation or amendment of the system condition is a resource.

The labour quality (in the meaning of resource) is evaluated based on the professional standard. The measure of social (human) resource skills, knowledge and personal qualities is the professional standard. The professional standard is a document that sets out the requirements for knowledge, skills, experience, values, and personal qualities.

The professional standard is central document that, on the one hand, is connected to the study program of education institutions and, on the other hand, the position of the company and requirements established thereto. Connection between professional standard and study and implementation process has been illustrated in Fig. 3.1.

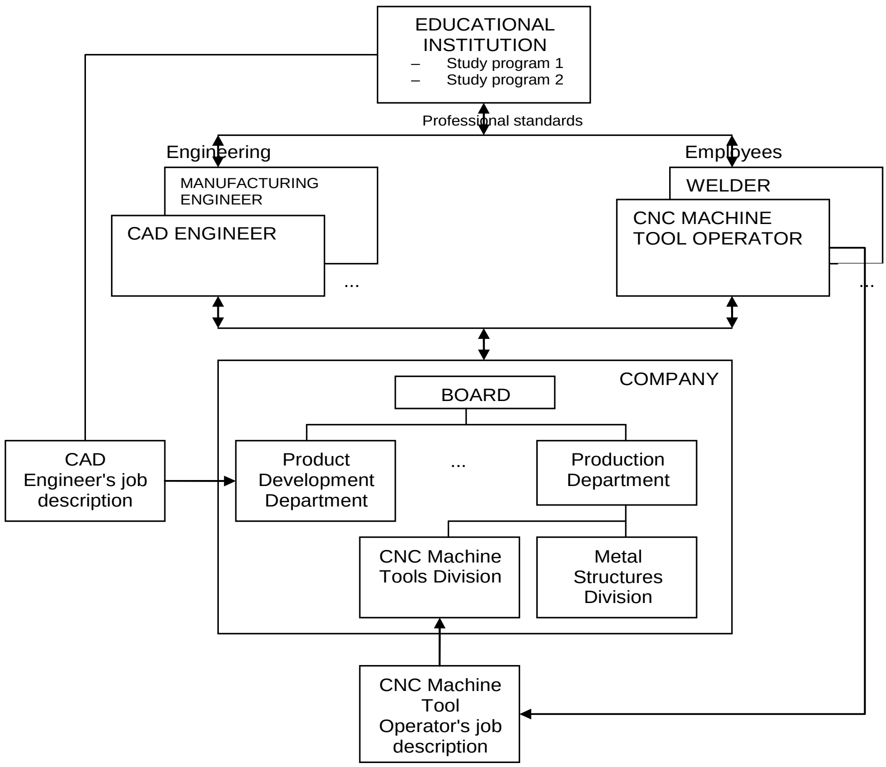


Figure 3.1 Connection between professional standard and study and implementation process

Professional standard is used:

- for establishing the qualification requirements for employees;
- for developing school curricula and training programs;
- for development of professional examination requirements and proving and evaluating the professional qualification;
- for establishment of a basis for comparing documents proving the international qualification.

3.1. Competence Charts Compilation Process

A company is a set of structural units. Structural units perform duties given to them acting pursuant to the field of activity and strategic objectives of the company. The duties of each structural unit (sub-unit) must ensure effective achievement of the goals (Fig. 3.2).

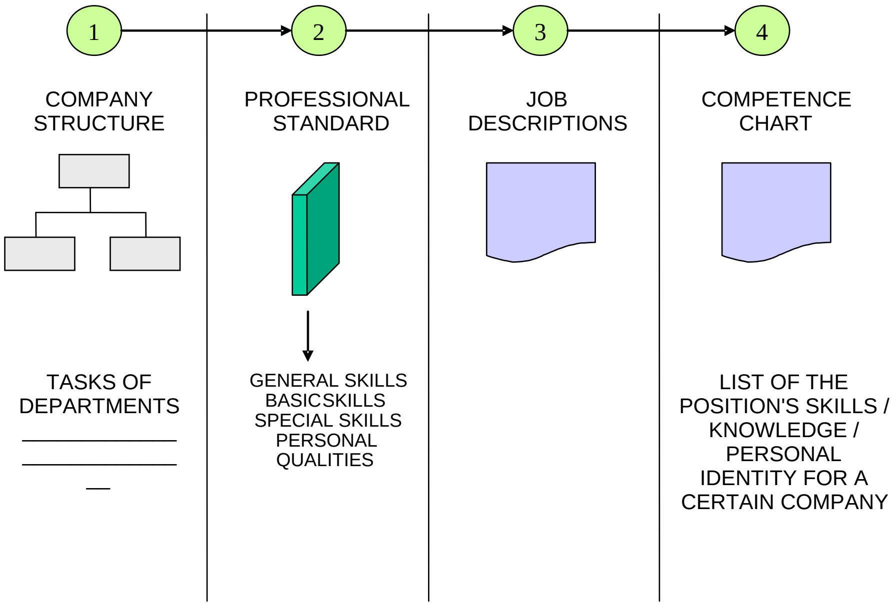


Figure 3.2 Basics of description of the knowledge and skills

With regard to one and the same job, the competence chart may be quite different in different companies according to the specifics of the company. Competence charts are drawn up based on the employees or jobs of the company. Standard competence charts have been developed during INNOMET project and available to users, so companies have it easier to draw up their own competence charts.
Example of a competence chart for a certain machine building company (for CNC machine tool operator) is given in Fig. 3.3.
In the INNOMET system the user can directly use standard competence charts or draw up individual competence charts with regard to a specific job or person in the company (see Fig. 3.4).

1. CNC Machine Tool Operator		
Qualification / Skill	**VT (1-5)**	**PT (1-5)**
1.1. General skills / knowledge		
1.1.1. General knowledge of CNC machine tools		
1.1.2. General knowledge of mechanical engineering technology		
1.1.3. Knowledge of occupational safety		
1.1.4. Economic knowledge		
1.1.5. Knowledge of designing control programs for CNC machine tools		
1.1.6. Language skills		
1.1.7. Computer skills		
1.2. Basic skills		
1.2.1. Knowledge of technological capacity of CNC machine tools		
1.2.2. Skill of setting technological zero points		
1.2.3. Skill of designing control programs		
1.2.4. Knowledge of processed materials		
1.2.5. Reading skills of working drawings		
1.2.6. Knowledge of production technology		
1.3. Special skills		
1.3.1. Skill of organisation of production at the workplace		
1.3.2. Specific machine tool programming skills		
1.3.3. Skill of pre-initialisation of cutting instruments		
1.3.4. Ensuring and securing quality		
1.3.5. Skill of using productive cutting modes		
1.4. Personal qualities		
1.4.1. Sense of duty		
1.4.2. Precision and correctness		
1.4.3. Ability to work independently		
1.4.4. Sense of liability		
1.4.5. Ability to concentrate		

Figure 3.3 Competence chart for CNC operator

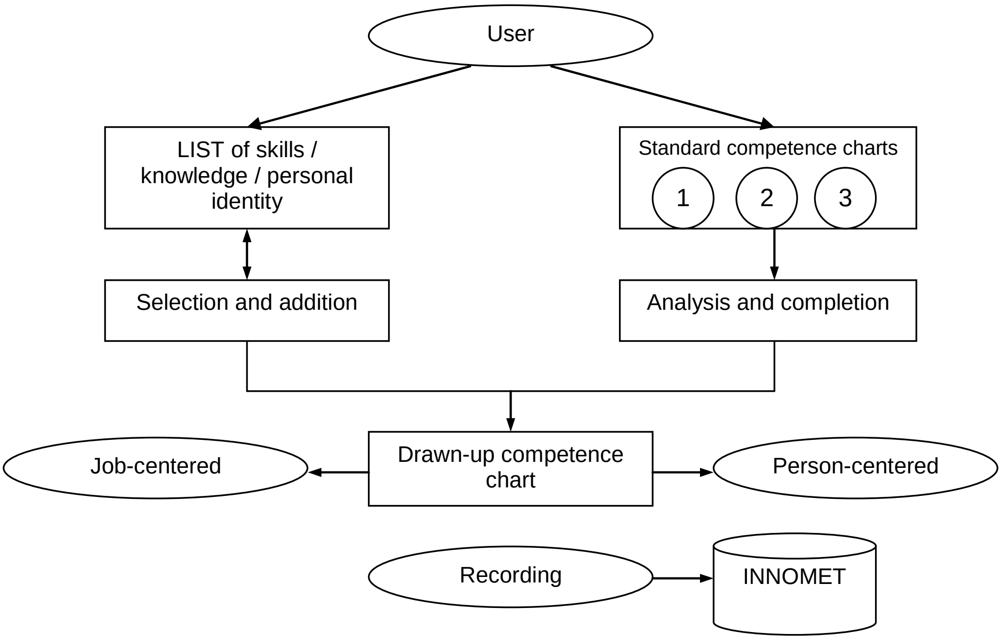


Figure 3.4 Principles of drawing up competence charts

3.1.1. Description of Skills and Knowledge

The competence charts constitute internal key documents in the field of estimating the competence of the personnel. The competence charts comprise 3 key information fields (see Fig. 3.5):

a) list of competencies (description of skills and knowledge);
b) results of estimation of needed levels of competencies;
c) results of estimation of existing levels of competencies.

The list of competencies is drawn up on the basis of the professional standards (external documents) and central job descriptions of the respective job (internal documents).

Depending on the company, the list of competencies may be longer and more detailed or more laconic and easy to make. Drawing up a list of competencies with regard to a job or an employee is primarily the duty of the Human Resources Manager and head of the sub-unit. A list of competencies may be drawn up also by competent consultants outside the company (see Fig. 3.5). Upon compilation of the list of competencies, different fields of competence (e.g. general mechanical engineering knowledge, knowledge of the production technology, machine tool operation skills, selection of tools and effective use of tools, etc.) may be treated with equal weight or, based on the strategic duties of the company, be focused on some specific field during a specific period of time.

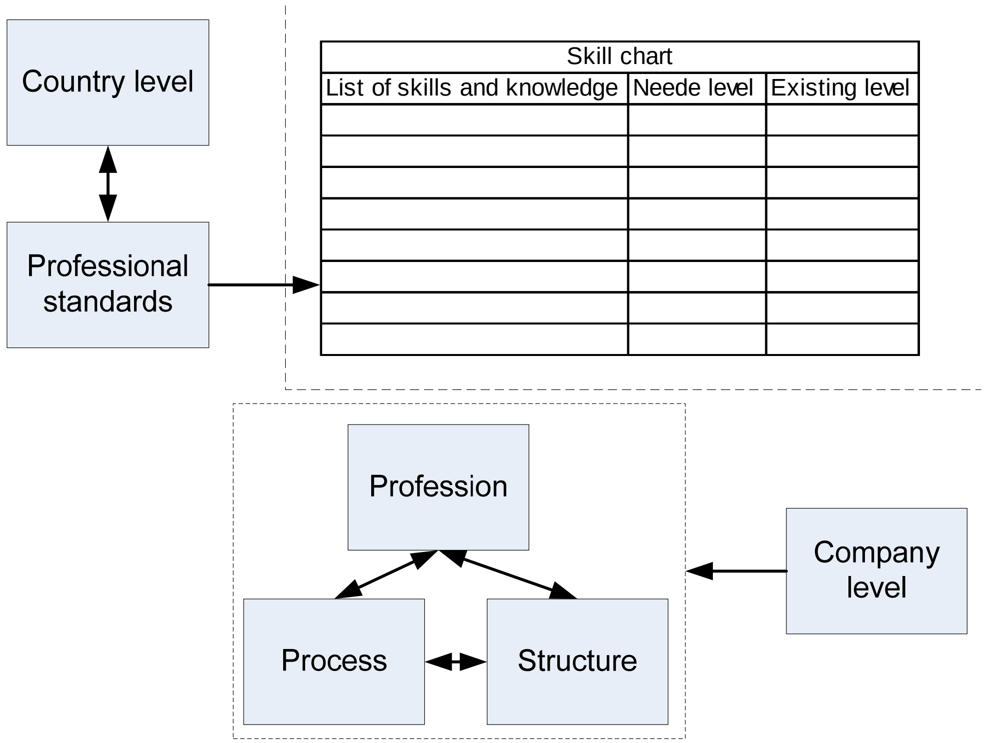


Figure 3.5 Compilation of competence chart: description of the list of skills and knowledge

For instance, in the given financial year the emphasis has been put on increasing the productivity in the company and therefore the competence chart of the employees pays more attention to the skills and knowledge that allow for using the company's competitiveness through developing productivity. Therefore competence charts are not some absolutely permanent documents, but are based on the strategic needs of the company and the requirements established to the specific job.

3.1.2. Estimation of Needed and Existing Levels of Competence

Estimation is direct process of making a decision. If it is not possible (or wise) to make up an accurate mathematical model, the process of making each decision is empirical and largely based on interpreting the source information and the competence of the decision-maker. However, in the case of competence charts the decision is, to a certain extent, relative, general, and can be adjusted over time and therefore it is not counter-indicated to make decisions by way of expert assessment.

The required level of competence shows primarily how extensive the skills and knowledge of people holding the respective position should be in various fields of competence (see Table 3.1).

The basis for the evaluations is:

– the complexity of the structure of the company;
– the complexity and diversity of the processes;

– the complexity and diversity of the products;
– the requirements for the quality;
– production type.

Table 3.1 Evaluation of the required level: Taxonomy / expert assessment

Evaluation	Description of taxonomy
0	No need to evaluate.
1	Very simple products. The products do not have any special quality requirements or special functionality (e.g. a steel frame for reinforced concrete).
2	Simple production processes and products. Employees constantly perform the same operations. Little flexibility.
3	Products with constructive qualities and clearly defined quality requirements. Processes with medium complexity.
4	Complicated and important products. High product quality requirements. Complicated equipment and production processes.
5	Very complicated and important products. Very high product quality requirements. Complicated or very complicated and expensive equipment. Very complicated and diverse processes.

If we establish unreasonably high requirements with regard to an employee, we need to take into account that various jobs require various skills and knowledge that have to be motivated.

From the point of view of clear limitation of the relationship between the employer and the employee it would be wise to specify the required levels of skills and knowledge as precisely as possible. High requirements of the needed level also require specific training and finding education opportunities by employers.

The main objectives of evaluation of the existing level of knowledge and skills of the personnel are:
– to identify specific level of each employee (or sometimes also so-called average level of the given job in the company);
– to identify strengths and weaknesses of each employee;
– to allow people to improve their work through detection of shortcomings and making references thereto;
– to involve employees better in achieving the company's objectives;
– to motivate employees;
– to identify the need and areas for training and development;
– to collect information for further planning;
– to take existing resources into account and use them skilfully.

3.2. Requirements for the evaluation system

Each evaluation system should comply with the following requirements:
- the criteria of coping and not coping with work must be clearly distinguishable;
- it must be clear whether evaluation takes place for administrative purposes or in order to encourage people to work better as a team. Only one of those objectives can be established at a time;
- one work performance can be viewed from various points of view (supervisor, subordinate, colleague) and thus the results of evaluation are very different;
- the support of the organisers and all those involved in the programme is very important;
- the evaluation system must be practical, i.e. understandable and easily usable both for managers as well as employees.

3.3. Methods of personnel evaluation

The methods of personnel evaluation have been indicated in Fig. 3.7. Evaluation methods can be divided into behaviour-oriented and goal-oriented methods based on what is evaluated. Most of the methods described are behaviour-oriented. The goal-oriented evaluation method is management through objectives.

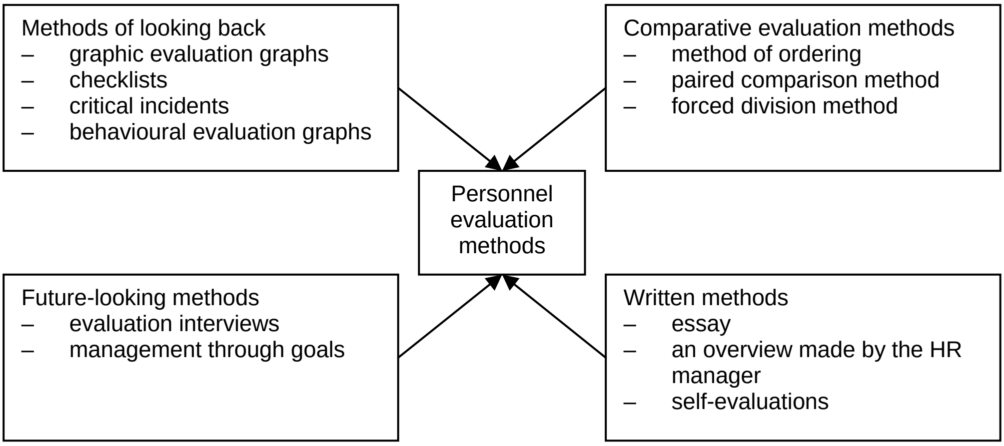


Figure 3.7 Methods of personnel evaluation

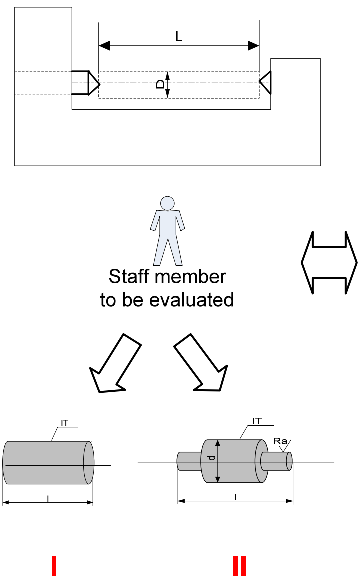
Descriptions presented in Table 3.2 may be useful for evaluation of the existing level in the INNOMET system.

Table 3.2 Evaluation of the existing level: Taxonomy / expert assessment

Evaluation	Description of taxonomy
0	Knows nothing of the matter / Don't need to know
1	Remembers something (unrelated pieces of information)
2	Understands the basics (can draw visible and simple conclusions)
3	Can use, organise and analyse (sees connections)
4	Can evaluate (criticise, value, establish hypothesis) – sees the "forest behind the trees"
5	Excellent command of the topic (is able to generalize) – nothing can surprise

The requirements for the needed level should ideally comply with the existing knowledge and skills of the employee (see Fig. 3.6).

Estimations of needed level



Competence chart

Area of competence	Needed level		Existing level
General skills – Work safety rules – Language skills	I 3 3	II 3 3	 3 3
Basic skills – Knowledge of materials – Skills of reading technical drawings – Skills of use lifting equipment	 4 3 3	 4 4 4	 2 5 5
Specific skills – Knowledge of selection inserts – Knowledge of manufacturing technology – Skills of measurement technology	 2 2 2	 4 3 3	 3 3 3

Figure 3.6 Competence chart composition

4. CONCLUSIONS

To achieve a kind of strategy alignment, a company must engage in a two-step process. First, managers have to know and understand totally how value is created in their company. Secondly, it must be clear, how the knowledge and skills of the employee will affect the quality and cycle times of the processes inside the company.

Going back from the value creation to the competences, we have to take into consideration, that in human resources management it is necessary to put in order the competence development process generally in the first and then secondly to show relationships of HR value drivers (competence charts) with business outcomes. The described basic elements of competence charts compilation and human resources development are realised in the INNOMET system.

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INNOMET SYSTEM FUNCTIONALITY AND SOFTWARE DESCRIPTION

Jyri Riives, Tauno Otto, Markus Keerman

1. INTRODUCTION

The primary objective of the INNOMET system is to increase the responsiveness of educational institutions to business demands and to improve the access of educated specialists into labour market. For that purpose it is proposed to introduce an integrated virtual database system for educational and industrial needs in the sector, which includes links to existing educational opportunities, e.g. different levels of study programmes, as well as private sector qualified labour force and mapping of the industrial needs for human resources. The main objective of the INNOMET system therefore is to supply enterprises and educational institutions with the updated information related to the needs, structure and qualification as well as about the opportunities of finding/requesting needed courses.

The INNOMET system with corresponding homepage is realised in all project partners' countries. Each partner is responsible for further development and implementation of INNOMET system and database in their region. With the INNOMET as a transparent and integrated system it is possible to compare and value skills and qualifications both in the industry and in education programmes (outcomes of learning) in all different levels and therefore enable transfer of competencies among countries, regions and also among sectors in the longer term.

2. INNOVATIVE DATABASE MODEL FOR ADDING INNOVATION CAPACITY OF THE MACHINERY SECTOR

INNOMET is an acronym for development of the innovative database model for adding innovation capacity of labour force and entrepreneurs of the metal engineering, machinery and apparatus sector. Previous research showed need for a virtual database system linking educational and industrial organisations, including links to existing educational opportunities, e.g. different levels of study programmes, to the qualified labour force in private sector, mapping at the same time the industrial needs for human resources [1].

The INNOMET system as such identifies the bottlenecks (lack of qualified labour force, development problems related to human resources) of the educational and training system vis-à-vis the existing private sector labour force needs. Therefore, with this project, the quality of both education programmes and cooperation between education institutions and private sector companies will be improved through interaction and networking.

In development of the INNOMET system was targeted to supply enterprises and educational institutions with the updated information related to the needs, structure and qualification as well as about the vacancies of finding or requesting needed courses. INNOMET is considered as an eBusiness tool. eBusiness has changed market relationships dramatically. The basis for market relationships has evolved from transaction-based relationships, to contract-based relationships. eBusiness has facilitated the evolution of business from vertically integrated firms, in which all value chain activities are performed within the firm, to selective sourcing, in which some value activities are outsourced to eBusiness partners [2]. In case of Innomet educational organisations take place in supply chain as outsourcers of vocational training, enabling enterprises to increase productivity through skilled workforce, or broadening the production engaging retrained workforce.

2. PROCESS DECRIPTION

In the INNOMET system there are separate processes which are tightly connected with each other (see Fig. 1).

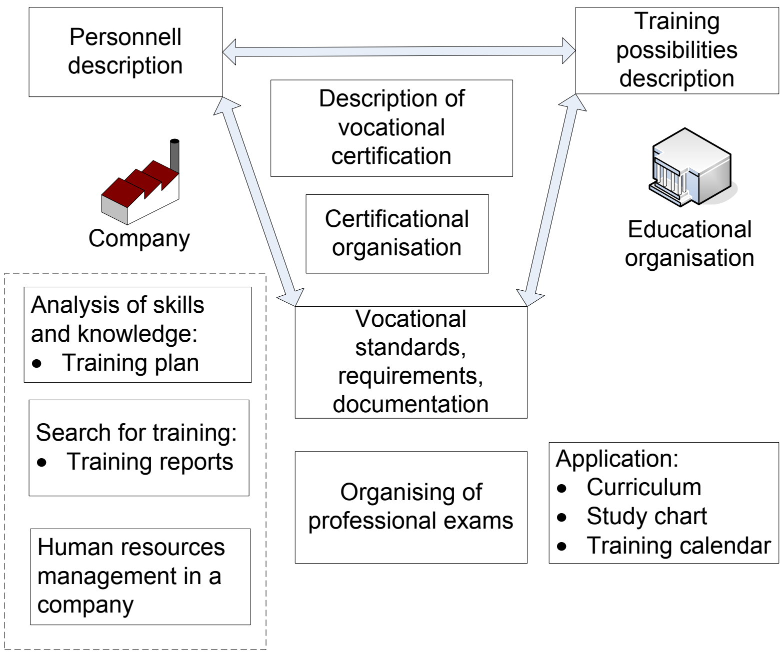


Figure 1 The INNOMET system associations

The processes are:

1) Determination of the Human Resources (HR) competence and the training needs in the company, taking into consideration the strategy of the company and operating needs.
2) Matching the training needs with the possibilities and carrying out the real courses through the system.

3) Fixing the needs for professional examinations and developing the national professional award system in the field of machine building and apparatus industry

In the first stage of the process are determined training needs according to competency charts of the company [3]. Competency charts are filled personally for each employee or vocation (e.g., CAD engineer, CNC operator, welder, etc.). The competency charts can be filled through Internet in every enterprise, whereas sensitive information of enterprise will remain undisclosed. The analysis is based on average indicators of vocations, industrial fields (toolmaking, machine-building, etc.) or on regional basis. The existing (EL) and needed levels (NL) are estimated in scale 0-5, where 0 means "the skill has no importance" and 5 means "the skill is has high importance". In case the EL<NL, there exists need for additional training.
The second stage includes arrangement of training courses according to the mapped needs. The input is obtained from analysis of all Estonian educational organisations of the sector. The training activities are organised based on unified training calendar and corresponding documentation. Before the Innomet system implementation the training courses were organised independently by tailor-made course plans. New monitoring system enables to automate organisational work by adding value through different queries, statistical calculations and prediction mechanisms. Estonian qualification system in terms of Innomet is described in Fig. 2.

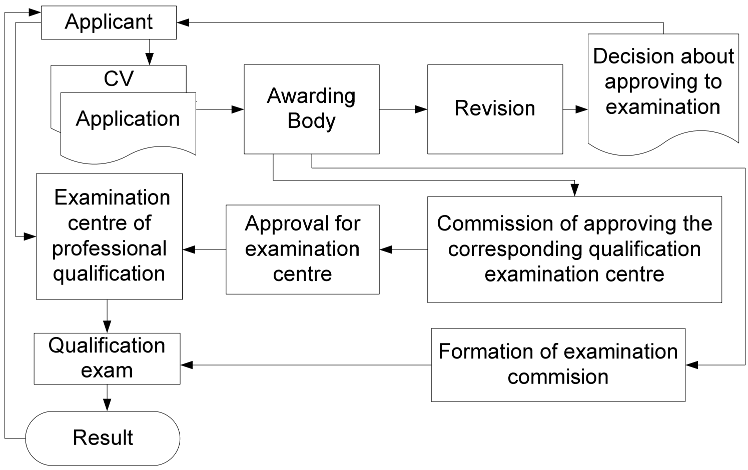


Figure 2 Estonian qualification system

The third stage is based on Qualification Law, Estonian vocational qualification system and qualification standards approved by Qualification Council of Machinery, Metal and Apparatus Engineering. The taxonomy of terms accords to Estonian vocational training terminology.

3. INNOMET INFORMATION SYSTEM

The first part of the INNOMET system (see Fig. 1) is considered with describing the human resources situation in a company. The process of enterprise-centred mapping and analysis of skills/knowledge is presented in Fig. 3.

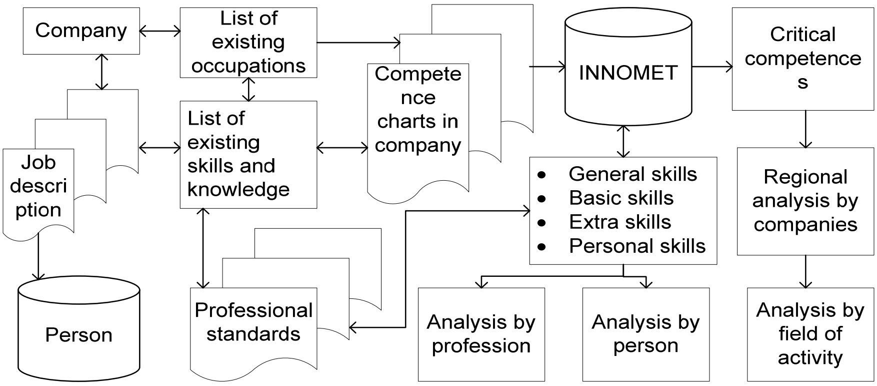


Figure 3 Enterprise-centred mapping and analysis of skills/knowledge

In terms of current development the scope of information system includes the following functionalities:

1. management of users and user assessment rights
2. management of classificatory (skills, vocations, different definitions)
3. management of organisations according to the type (industrial enterprise, educational organisation, awarding body)
4. compilation and management of questionnaires for staff members according to the INNOMET methodology
5. management of staff competency queries
6. management of enterprise staff members
7. evaluation of competencies and evaluation results
8. generalisation of evaluation results over enterprise, sector, vocation, region or state
9. management of vocational exams
10. management of curricula
11. management of vocational courses
12. management of manpower requirements and further education data

The system includes expert tool for deciding the needed competence level. In principle, the scales can be combined by own experience, by using the opinion of technical consultant or by integrated expert system. The expert system tool is based upon short questionnaire concerning production and management data. The estimation can be given for engineering staff, management staff or workpeople. There are always three options to choose, total number of questions should not exceed ten. The average expert value *AVERAGE* is calculated as follows:

$$AVERAGE = \frac{\sum_{i=1}^{k} E_i}{k} \qquad (1)$$

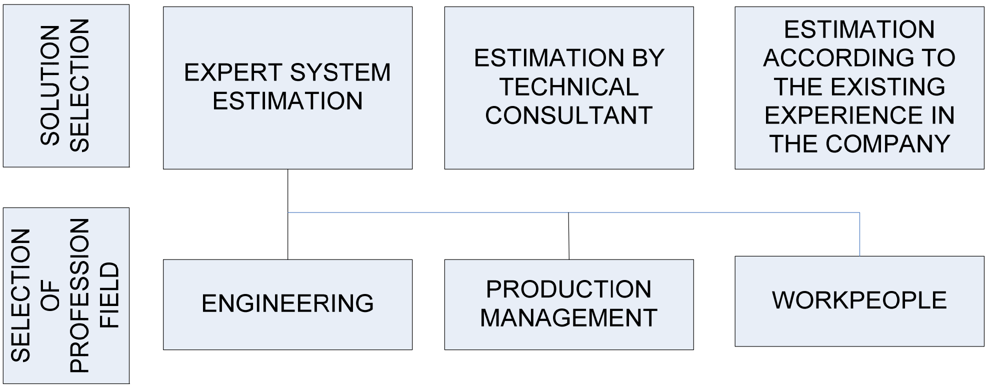
where k – number of questions, E – expert estimation for the question i.

Exemplary expert tool for estimation needed level of competence depending seven main parameters is described in Fig. 4.

PRODUCTION MANAGEMENT			
Situation description			
1	Number of various production processes		
	1-3	4-7	over 7
	1-2	3-4	5
2	Average number of operations in the process		
	less than 5	5-12	over 12
	1-2	3-4	5
3	Average number of workers in the production area		
	less than 50	51-150	over 150
	1-2	3-4	5
4	Average durability of the technologies in use		
	More than 10 years	5-10 years	Less than 5 years
	1-2	3-4	5
5	Number of different products per year		
	Less than 20	21-50	Over 50
	1-2	3-4	5
6	Annual turnover (million EUR)		
	Less than 2	3-7	Over 7
	1-2	3-4	5
7	Use of Production Planning Systems		
	Not at all	BSC/Simple ERP	ERP/6σ/ Lean Manuf.
	1-2	3-4	5

Figure 4 Expert estimation tool for production management, where
BSC - Balanced Scorecard; ERP - Enterprise Resource Planning; PPS - Production Planning System; 6σ - Six Sigma; LM - Lean Manufacturing

The use of this model is described in Fig. 5. Parametrical model for generating outputs of human resources development is given in Fig. 6. Data in the system (Fig. 6) includes lecturers' CV database, archived study programmes, training calendar, and web-based data about educational organisations.



SELECTION OF SOLUTION

Expert estimation [1…5]		
Situation description		Expert estimations
Number of various production processes	4	4
Average number of operations in the process	5	3
Average number of workers in the production area	80	3
Average durability of the technologies in use	6	3
Number of different products per year	32	4
Annual turnover (million EUR)	6	3
Use of Production Planning Systems	simple frame mode system	2
AVERAGE		3,14

Figure 5 Determination of the needed level of competence for the competence charts

The Innomet system as such identifies bottlenecks (lack of qualified labour force, development problems related to human resources) of educational and training system according to existing private sector labour force needs. Therefore, also the quality of both educational programmes and cooperation between educational institutions and private sector companies could be improved through interaction and networking. Direct impact for different target groups is following.
In a typical supply chain some of the supply processes are driven by the forecast [4]. Innomet system predicts needs for future training and curricula changes.
Management of qualification exams in the information system is described in Fig 7. Currently there are two main Awarding Bodies in Estonia – KOO-MET for workers level and EMIL (http://innomet.ttu.ee/emil) for engineering level.

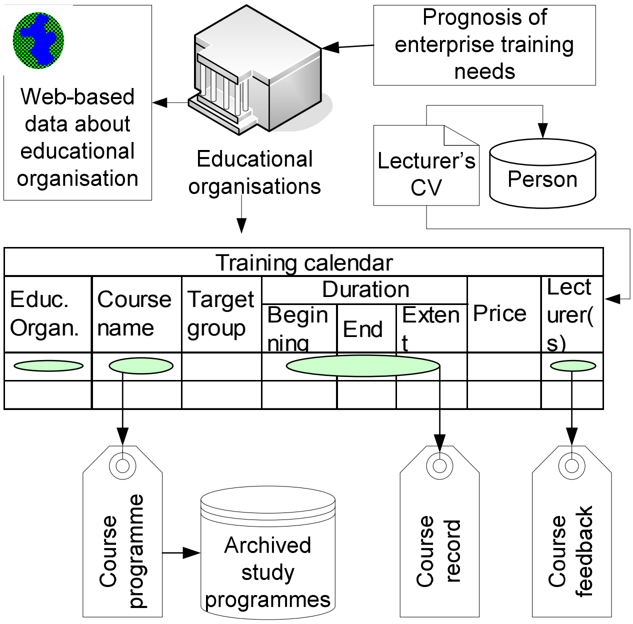


Figure 6 Data feeds for the advisory system

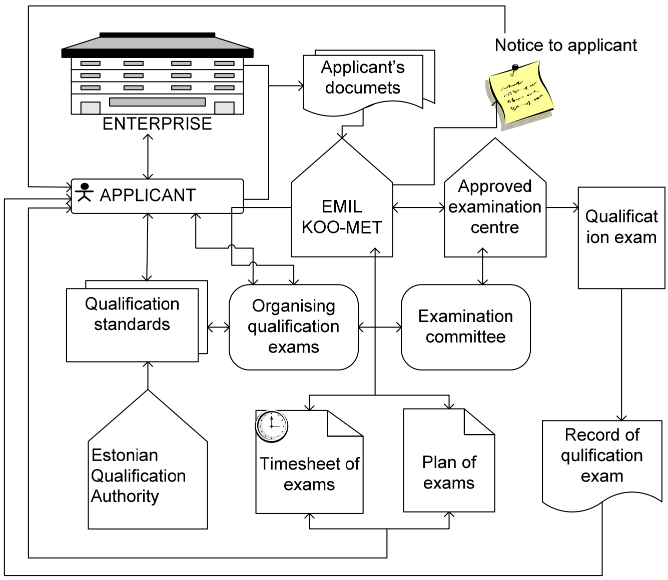


Figure 7 Management of qualification exams in the information system (EMIL, KOO-MET – Awarding Bodies)

Offered dynamic and updated recommendations in internet-based form (generated reports) presented to the vocational and higher educational institutions as proposals

of changes of study programs have a concrete impact on the existing vocational and higher educational system. This will result in increased quality and competitiveness of the vocational and higher education system.
The Innomet system provides cost effective information exchange medium for the educational institutions (training providers) as well as companies (potential re-training clients). The system improves direct contacts and links between academic world and companies to cooperate in terms of common research (e.g., thesis topics, study projects), traineeships, and job offers/seeking.

In longer term the developed system on the WWW (see Fig. 8) helps companies in finding needed re-training courses more easily and provides constant implications to study programmes focusing on the market need – preparation of most needed qualified specialists.
For educational organisations the system is a basis for curricula development in terms of existing educational programmes and flexible re-training courses based on industry needs. Taylor-made courses can be compiled and offered through the system, crossing borders of separate organisational information systems.

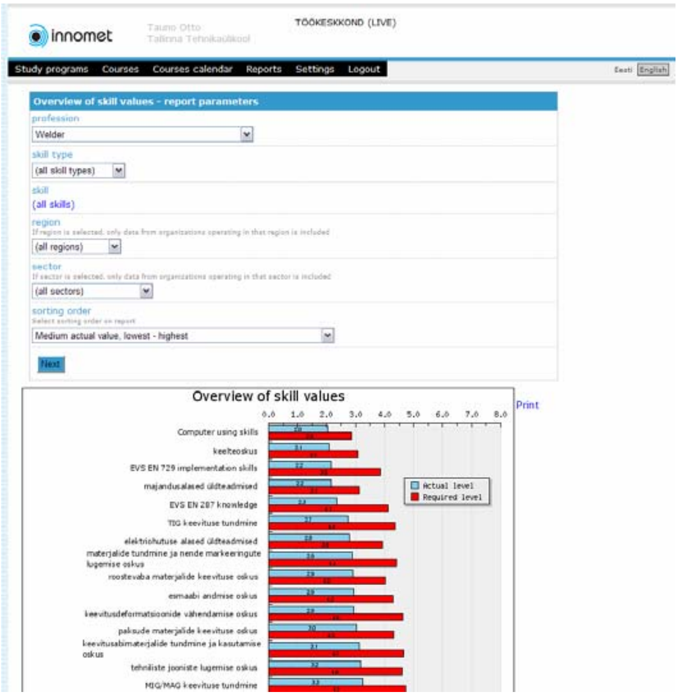


Figure 8 Enterprise-centred mapping and analysis of skills/knowledge

During period 2005/2006 terms several new courses were developed, using the best lecturers both from universities and industrial sector (e.g., courses ‘ERP Systems’, ‘Modern Technologies, Materials and Measurement Techniques’). It improved

considerably open dialogue between educational institutions, private sector and other related organisations.
Better efficiency and transparency of needed education and training in the sector of machinery, metal and apparatus engineering is based on measurable private sector labour demand. Academic world can more easily adapt and update current study programmes according to the private sector labour force demand. For education and planning purposes, co-operation platform with information system help to streamline higher and vocational educational programmes to respond better to market needs. This will lead to better skill and competence profile of students and trainees and better competitiveness of human resource in general.

4. DISCUSSION

With the Innomet as a transparent and integrated system it is possible to compare and value skills and qualifications both in the industry and in education programmes in all different levels and therefore enable transfer of competencies among countries, regions and also among industrial sectors in long term.
Current development has proved interest and need for such a system, having advantages as:

- Informativity (large and multilevel data feeds)
- Flexibility (possible to interact to changes in economic environment)
- Operativity (always relevant)
- Versatility (number of various tasks can be solved)
- Farsightedness (enables to predict changes in future)
- Dynamism (enables to monitor processes in different time intervals)
- Universality (the system is adjustable for other industrial sectors).

The Innomet system is in implementation phases at machinery sector in Estonia. On international cooperation the work continues toward development of unified templates for European labour market.

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TESTING AND SUPERVISING OF INNOMET SYSTEM

Ferenc Boór, Mikó Balázs

1. INTRODUCTION

"There is no security on the Earth. Only opportunity"
/Douglas Mac Arthur/

The main goal of INNOMET project is introducing a tool to ensure particularly qualified labour force for enterprises in the subject sector in terms of local and European needs, and also to increase the responsiveness of education institutions to business demands and following to improve the access of specialists both from vocational and higher education level on the labour market.

For this purpose an "Innomet Prototype Solution" (hereinafter; "IPS"), as a demo version of the recent phase Innomet system has been developed for preliminary test and further development. The aim is to develop **WEB-based info-source** INNOMET **database and functionality** as publicly used internet site targeted to the vocational and education institutions and companies, industry associations and other support organisations in the sector.

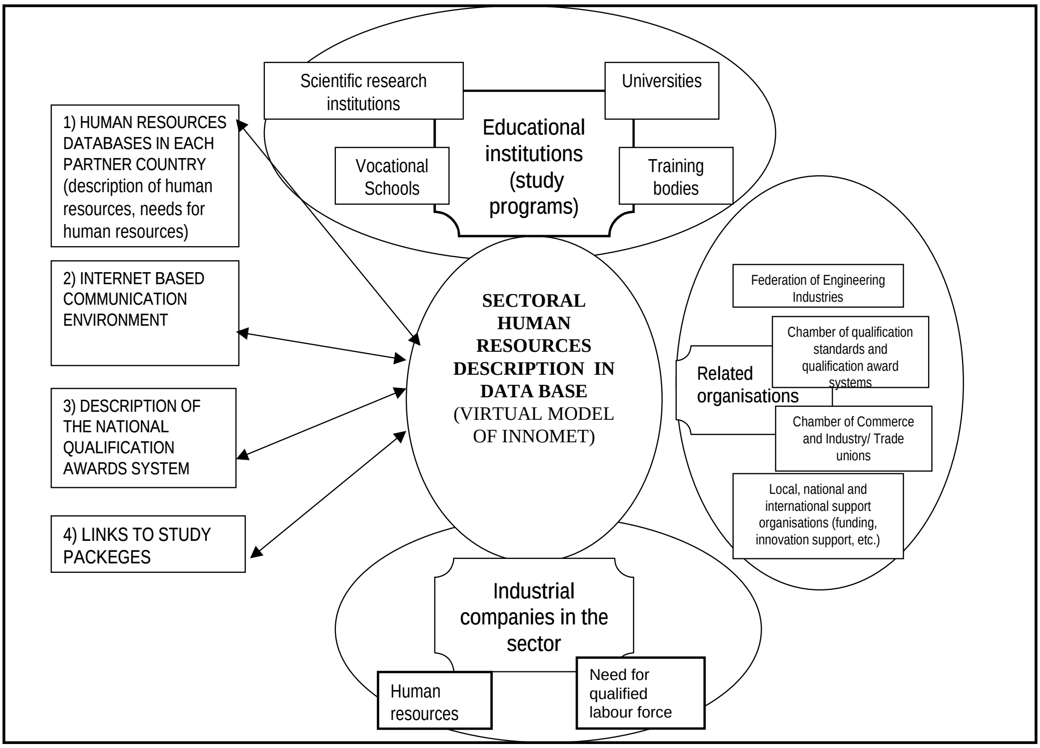

Figure 1 Concept of Innomet

The “final” version of the **Innomet system**

- will include real time database (existing educational opportunities – different levels of study programmes; industrial needs for human resources based on the employee qualification standards) and
- will work as an integrated real time advisory system
- and via Internet as a web-based solution (available on the Internet in English as common language and in respective language versions)
- and useable in the different partner regions.

The Innomet actors – developers, participants, users – must work closely with their internal and external partners (i.e. Innomet and Network partners) to successfully implement Innomet system in their region within native language and special economic and cultural system of human force development and innovation. To yield the expected advantages, to determine and to apply key product functionality of the Innomet system application (hereinafter; SYSWARE[1]) is possible via detailed analysis and simulation of local system environment. Even the INNOMET system cannot be considered as global solution for human force development, following it cannot be realised without testing and validation of Innomet Sysware (including its first prototype: the common IPS).

Generally system developers and quality assurance engineers test their products via its using approach. Instead, more formal methods are required for successful defect detection and containment. All these functional testing techniques provide more measurable success criteria, however, they are perceived as too difficult and costly to implement.

Simultaneously with the development of IPS and with later implementation and application of Innomet Sysware another tool, a “System Testing and Verification Tool” (hereinafter: TESTWARE[2]) – as a certain part of the prototype INNOMET project solution – has been developed for ensuring the goals of improvement, to gain benefits of Innomet system application within different conditions.

Testware is the software beyond the Sysware; including the documentation, test procedures, data, and environment that are designed and developed on the basis of requirements and prototype achievement. Testware is used to verify and validate the product, so the current state of Innomet conformance to future customer requirements. Testware can be considered marketable along with the system elements, which are tested.

The most relevant component of the Innomet Testware is the testing document applied in different phases as a frame of testing and verification approach before and over an Innomet Sysware implementation. The Testware is not a mere but the primary mean by which the Sysware testers communicate to the developers what

[1] i.e. implemented INNOMET system being applied for solving local labour force innovation within a defined environment

[2] i.e. implemented Test Plan for a predefined test organisation using relevant SYSWARE

they intend to do. Test planning is a job that should involve all testers and key players from across the entire project team.

2. THE TEST PLAN DOCUMENT

"If you cry 'forward', you must unambiguously make plain in what direction to go."

/Anton Chehov/

The *Test Boundary Conditions* are those situations at the edge of the planned operational limits of the Sysware. In this chapter the Innomet Testware functionality developed in 2003 during the Preliminary Test Development of Innomet I (pilot project of Innomet II) is used for illustration to complement the narrative for the following subparagraphs.

All standard documents including Test Plan with its contents or each section can be tailored to a specific project, to the particular application and additional contents may be added to any section. This plan shall consist of the sections as those have been developed as Innomet Test Plan (Figure 2). Some or all of the contents of this section could be contained in another document, which is then referenced above.

Albeit Test Plan is the most relevant document but it is not a stand-alone one of testing. The Testware itself includes its documentation, which the testers are working with. These test documents should be also identified and prepared preliminary within the Test Plan.

Innomet Testware contains the sample and overall test reports about testing activities having been fulfilled during system development as well as the updated system requirements and intermediate reports of monitoring and supervising testing activities.

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Figure 2 Formal contents of Innomet Test Plan

3. DEVELOPMENT OF TEST PLAN

Even the Introduction paragraph of Test Plan discusses the system history and overview, the testing purpose and scope, definitions, acronyms, abbreviations, references, and provides an overview of the Test Plan.

“The main goal of testing” subsection; describes the Innomet system scope, the domain fields of Innomet Sysware to identify the items being tested, the features to be tested, the testing tasks to be performed, the personnel responsible for each task, and the risks associated with this plan.

In order to create a testable **INNOMET system** a **database test-version is being introduced** as an open access type system, that structure includes two main parts:

1 the education institutions, study programmes, re-training programmes and links to E-learning platforms of the sector in detail;

2 private sector – human resources and labour force demand taking into account present situation and strategic development of manufacturing sector.

Test Glossary subsection; serves as a glossary for the document. All technical terms definitions, acronyms, and abbreviations used in the Innomet Testware are defined to provide the reader with quick access to the definitions of technical descriptors used throughout the document.

Referenced documents and Acknowledgement subsection; serves the same purpose as a bibliography.

Testing Scope subsection; describes how the test plan covers the IPS testing activities of the system being tested. This section clarifies the test philosophy and strategy as well as the testable aspects, users, functions and documents of Innomet Sysware and proposes methods for working with documents. In addition, depict the testing of multiprogramming functionality, external interfaces, security, recovery, and performance. However, as an overview of the Test Plan[3], this subsection briefly describes each of the remaining sections in the document as well as the contents of each appendix.

Basically two terms – in the test boundary condition – that Sysware testers use to describe how they approach their testing are

- Black-Box Test (within the tester only knows what the Sysware is supposed to do) and
- White-Box Test (sometimes called clear-box testing - within the tester has access to the programs code and can examine it for clues to help testing).

Two other terms used to describe how Sysware is tested are

- Static Test (which refers to testing something that is not running, so as to examine and review only) and

[3] It can occur as a separate subsection of Introduction field of a formal Test Plan in general.

- Dynamic Test (is what you would normally think of as testing, so as to run and use).

In addition there are two fundamental approaches to test;

- Test-to-Pass (when you really assure only that the Sysware minimally works, you do not push its capabilities, you do not see what you can do to break it, you apply the simplest and most straightforward test cases)
- Test-to-Fail (sometimes called Error-Forcing – when test cases are designed and running with sole purpose of breaking the Sysware to assure that it does what it is specified to do in ordinary circumstances to find bugs by trying things that should force them out).

In the frame of the INNOMET project and with consideration of the Innomet Sysware functionality the proposed strategy may only be Dynamic Black-Box Testing to Pass. Forcing errors and bugs may be out of place to target within the recent Testware.

The respectable viewpoints of the test can be attributes into six categories at least. The categories are as follows:

- Functionality or/and Capability
- Reliability or/and Security
- Usability and Architecture
- Efficiency or Performance
- Maintainability or Manageability
- Portability or Flexibility

All of these respects are defined by the sub-characteristics belonging to the considerable aspects of future evaluation. The main attributes and characteristics of testing are summarised in the following table with respecting on the current state of IPS (tool), database structure and documents.

Attributes	Sub- characteristics			
Functionality or Capability	Adequacy	Interoperability	Precision	Fulfilment
Reliability and Security	Maturity	Error handling	Recoverability	
Usability and user oriented Architecture	Understandability	Operability	Learnability	
Maintainability or Manageability	Transparency	Changeability	Testability	
Efficiency or Performance	Time consumerism	Utility	Efficiency	
Portability or Flexibility	Replaceability	Adaptability	Instalability	

Note: the grey level in the background marks the relevance of the sub-characteristics

Figure 3 Testable aspects of a web-based Innomet Sysware (in 2003)

From the initial analysis of testability of the above listed attributes the ***usability*** seems to be most relevant to the recent Testware development. Usability of the IPS (tool) is how appropriate, functional, and effective that interaction is. The important traits common to a good User Interface are; follows standards and guidelines, intuitive, consistent, flexible, comfortable, correct and useful.

The target user group of the full Innomet solution can be either individuals searching particular jobs or courses, exams, or organisations requiring labour sources or providing considerable services. Therefore the users can be registered or public rulers in the future Innomet.

In the chapter all the functions and belonging actions (procedures) are listed and detailed in order to have the testable IPS understood well and to map the eventually necessary development or/and modifications before our external network partners enter the system.

№	Functions	Activities	Right user	Relevant data requirements	Comments
1.	**Course management** (in current user organisation)	Add, Edit[4], Delete[5] courses, sessions; Assign skills, periods, study programs; Confirm	Edu	Study programs and courses names	
2.	**Study program management** (in current user organisation)	Add, Edit, Delete, Confirm	Edu	Study programs and courses	Part of course management
3.	**Certificate exam management** (in any organisation)	Add, Edit, Delete, Confirm	Cert	Certification exams	
4.	**Questionnaire management** (in current user organisation or selected by Admin)	Select firm (Admin); Add, Edit, Change, Copy, Close, Reopen Questionnaire; Select, Add, Edit, Delete skill and -type, profession, level, row; Confirm	Firm, Admin	Profession and skill list	

Figure 4 Overview of IPS Functions from the Test Plan 2003

The testable documentation can make up a huge portion of the overall achievement. Here is a list of components that can be classified generally as documentation:

- Packaging text and graphics
- Marketing material
- Warranty/registration
- End User Licence Agreement
- Labels and stickers
- ✓ Installation and set-up instructions
- ✓ System analysis and requirement specifications
- ✓ User’s manual
- ✓ Online help
- Tutorials’ wizards, computer based training
- Samples, templates
- ✓ Error messages

Testing the documentation can occur on two different levels as efforts of

- Static test (within the documentation is non-code, such as a printed user‘s manual; thinking of it as technical editing or technical proof-reading).
- Dynamic test (within the documentation and code are more closely tied, such as with an online manual with hyperlinks).

In the recent frame of development both methods of testing including the pipe marked (✓) and relevant documents to test (i.e. user's manual, system analysis and requirements specification, on-line help and error messages) are the parts of the Innomet Testware.

The main strategy of the Preliminary Development Plan is

- „***Dynamic Black-Box Testing to Pass***" within
- "***Integrated*** (i.e. dynamic and static) ***Documentation Test Effort***"

Dynamic Black-Box Test to Pass of IPS

The testers are using IPS as a customer would, and they are testing it without knowing exactly how it works. They are entering inputs, receiving outputs, and checking the results. To do this effectively requires some definition of what the IPS does namely, a Requirements Document and Product Specification. These documents are to define the details the testers must know about.

The Testware is to provide tools for testing the IPS (tool) usability without forcing to fail the system, so to detect all error events and fault opportunities. This can be the target of another project dealing with testing and validation right after finishing the system development.

Testing specifications

Topics included for this section as a minimum are the testing approach, the test deliverables, schedules, and the pass/fail criteria. From the mapped scope of test attributes the following evaluation factors can be applied as a template viewpoint in the testing activities for all cases of stand-alone testing process.

Test attribute	Test question	Answer
Adequacy1	The function is adequate to an INNOMET requirement (D2.1)	Yes (R[7])/No
Adequacy2	The function is adequate to user role assigned	Yes/No(U)[8]
Adequacy3	The function is adequate to the documentation	Yes/No
Interoperability	The Help and error messages are relevant particularly to the function	Yes/No
Errors	The function is rather foolproof	Yes/No
Understandability	The ergonomy (name, attendant text) of the function is enough for understanding the content behind	Yes/No
Operability	The function fulfils the requirement or requires further development	Yes/No
Learnability	The function is coming natural (evident as much as possible) to the user how to use	Yes/No
Testability	A common user is able to make sure of whether the result is satisfied	Yes / No

Figure 5 Item pass/fail Criteria of Innomet Testware

Documents Testing

Integrated – static and dynamic – test method is proposed by the Innomet Testware for testing recent IPS' documentation. The relevant document pieces of IPS ("Innomet User's Manual" and "Innomet System Analysis") must be verified

- with the "Innomet Requirements Specification" and
- with the On-line documents (user interface, On-line help, error messages and use-case identifications); and
- with the response of IPS functions.

Deliverable Documents of Test

- Test Development Plan
- Source Questionnaires for Testing Database Structure
- Updated "Innomet Requirements Specification"
- Overall Report of Test

Testing identifications

In the testing identification chapters the Test Plan decomposes the testing activities into test cases and test procedures, identifies general conventions the testers are forced to follow and the unique identifications to both the test cases and procedures and supplies a reference between the test case and procedure to the requirements. Test input data and test output data are identified as deliverables. Test tools (e.g., module drivers and stubs) can also be included.

Appendices

Appendixes are used to provide more detail information than the document paragraphs narrative. In the Innomet Testware both sample test case reports and the Test Case Report forms are defined as a template for testing documentation.

4. ORGANISING AND SUPERVISING OF TEST

"Management is the art of getting three men to do three men's work."

/William Feather/

Testing organisation includes the IPS developer team as well as those Innomet partners, who did not participate directly in the development process of the programs and database structure. BME-Hungary coordinated and organised the test development and all partners with its close and regional Innomet network partner institutes and companies (EML, TCEB and TUT-Estonia, KTH-Sweden, TuAKK-Finland, IALP-Italy) of project Innomet I and new partners (LMA-Latvia, Alfamicro-Portugal) of project Innomet II have been involved or/and are to be involved in the preliminary and further steps of testing approaches.

Testing staff training is absolved within the user training actions of IPS

- on the Budapest project meeting of Innomet I (December 3rd-6th , 2003)
- on the Cascais project meeting of Innomet II (October 20th-21th , 2006)
- and via internet co-ordination

The testing process is defined by the Innomet Preliminary **Test** Development **Plan** (PTDP), which contains all test activities and Test Case Report (TCR) forms which are necessary to perform the test of Innomet Prototype System (IPS). The testing process is coordinated and supervised by the test leader (in the Innomet project: BME, Hungarian project partner). The performed tasks are summarized in every week and the progress report appears in the public Innomet Test Web Site. The updated report contains all needed and executed activities have been done by team members so far. The continuous control of testing process increases the efficiency and knowledge about the testing progress and state of testing database of Innomet.

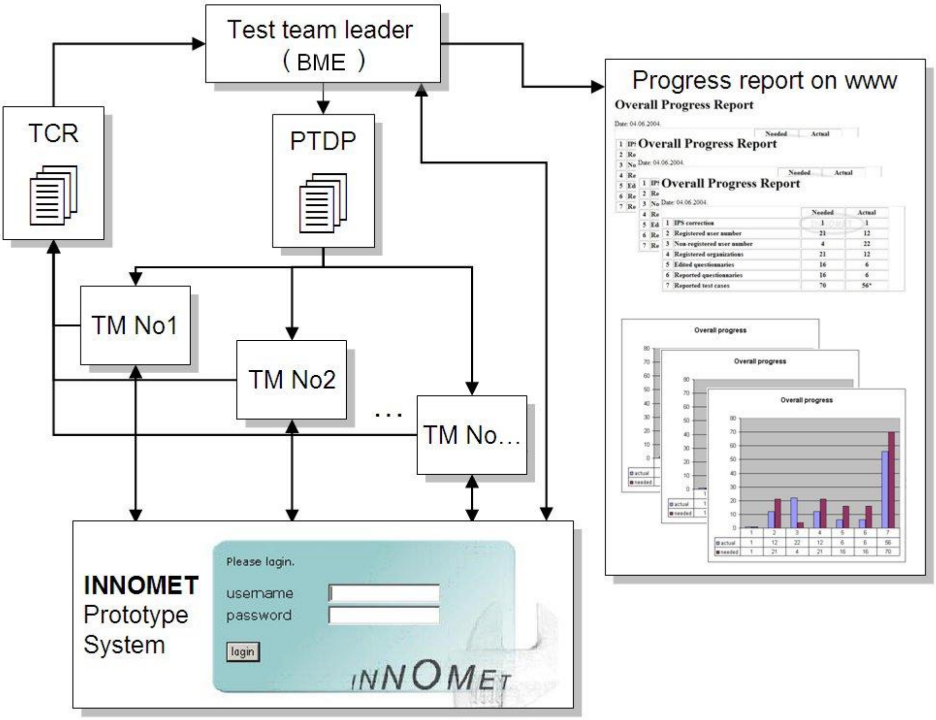

Figure 6 Supervise model of Testing Innomet

The IPS as a very common combination of open source program is available on the international web sites of Innomet project and working on the same database established on TUT's server and after Sysware implementation in the partner countries, regions. The IPS had been tested in advance by the developers on the predefined software environment. IPS user names and passwords are distributed to the partners and following by testers in the same form as the future users can reach and enter the system via the user interfaces in the partners native languages and in English and simultaneously with filling up the Innomet database with realistic labour force requirements of the network companies and relevant education activities of network institutions

Test Schedule

Testing activities schedule must be included in the Test Plan. The activities shall include items (procedures) to be tested, test deliverables, and other major milestone activities. This paragraph defines any additional test milestones needed and based on estimation of time required to each testing task states the schedule for each testing task and test milestone.

Duration	Activity	Method & Subject	Responsibility
by December 9th	proposals for modification of Preliminary Test Development Plan	via Innomet free list: modification requests	All partner
	Identifying testing team members;	via Innomet free list: Name, Organisation E-mail address of responsible person	
December 10th	**Finalising and delivering to the Innomet partners**	**Preliminary Test Development Plan**	**TQ**
by December 15th	List of test network companies and institutes, user profile requirements to TQ	via Innomet free list: name of test organisations, users name proposals	All Tester
from December 8th to December 18th	IPS modification; clarification of test environment, clearing non-relevant users and data	via Innomet free list: Remarks on modification	PL, EML
December 15th	**Finalising and delivering to the Innomet partners**	**The user names of the testers**	**TQ**
from December 18th to January 24th	Input TQRs belonging to Network Organisations to TQ	via internet	All Tester
	Sending TQRs, Comments and Test Case Reports dealing with Questionnaires to TQ	via internet: Test Questionnaires, Test Case Reports No: TC1-8; TC11;	
from December 18th – February 28th	Appearing and developing Innomet Test Site on the Innomet Hungarian Web Page	All information, documents and template forms belonging to Innomet Testware are available; Current actions and state of test development, temporary results can be followed,	TQ, BUTE
January 31st	Summary of partial Test Case Reports	via Innomet free list: Overall Preliminary Test Reports (Draft)	TQ
by February 14th	Sending proposals to the deliverable document and remained Test Case Reports to TQ	via Internet: Test Case Reports No: TC9-10; TC12-;	All Tester
by February 15th	All Test Case Reports is available;	via Internet	BUTE
February 28th	**Summary of Test Case Reports and Updated D2.1 (version 3)**	**via Innomet free list: Overall Preliminary Test Reports (Complete)**	**TQ**

Figure 7 Test schedule of Innomet I

The testers of IPS are to work with this Preliminary ***Test Development Plan*** in order to select and validate the ***Test Questionnaires*** (of Network Partners) to fill up ***IPS database*** with realistic labour force requirements and educational courses. They follow Test Cases prescribed to report the testing results in the ***Test Case Report***

Form to Test Quality manager who is to summarise their remarks and results in the document of ***Overall Report of Test Results***.

TEST CASE REPORT			
Test case number:	TC 10	**Test case name:**	Search certificate exams
Used user role:	Administrator ☐ Educational Inst. ☒ Firm ☐ Certification Auth. ☒		
Date:	January-April 2004	**Tester name:**	M. Szántai; M. Larsson;, E. Browne, Mr. Rao; J. Riives, M. Koik, J. Papstel
Tester organisation:	BUTE; KTH; IALP; EML, TTU	**Tester location:**	Hungary; Sweden; Italy; Estonia
Test procedure description: Prescribed at section 3.2 and 4.2 in the Preliminary Test Development Plan of INNOMET <http//:www.manuf.bme.hu/innomet/test.htm>			
Identify the requirement that this procedure satisfy:			R[19] +

No.	**Action**	**Pass/Fail**		**Remarks**
1.	Add			
2.	Edit			
3.	Change			
4.	Copy			
5.	Display search result, course details and help	X		Date interpretation isn't correct when period end is in next year; Details by clicking on the name of exam
6.	Continue			
7.	Cancel			
8.	Confirm			
9.	Save			
10.	Close			
11.	Delete			
12.	Remove			
13.	Delete skill and type			
14.	Delete profession			
15.	Delete level			
16.	Delete row			
17.	Assign skills			
18.	Assign periods			
19.	Assign programs			
20.	Select	X		*Links to further descriptions*
21.	Select firm			
22.	Select skill			
23.	Select profession	X		
24.	Select location	X		Insert
25.	Select date	X		American format
26.	Select level			
27.	Select inquiry			
28.	Search		X	Sometimes it runs on error
29.	Mark profession or skill type			
30.	Back to search results	X		
31.	Back to Main		X	There is no separate button with description "Back"
32.	Print results	X		Standard printing function

Figure 8 Example Test Case Report form of Innomet I

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COMPARATIVE ANALYSIS OF THE COMPETENCE MODELS IN ITALY, FRANCE, SPAIN

Eileen Browne, Filippo Laurenti

1. INTRODUCTION

In order to facilitate the mobility of people, students and workers within the European borders, European Union started since last eighties to face the problem of competences' certification related to the mutual recognition between EU members.
To this purpose European Union proposed different sets of guidelines insisting on certification transparency, on the quality both of teaching and training, and to the recognition of qualification and competences. European Union invites Member States to develop models of certification as transparent and clearly understood as possible. To make easier this task to Member States, EU developed tools as "European Qualifications Framework – EQF", "European format for the CV", "Europass" and "European Credit Transfer and Accumulation System – ECTS".
Have Southern European countries responded to European recommendations? Have they all adopted the competence model? This survey, whose specific aim is to answer these two questions, contains as a case study the competence model concerning the CAD/CAM area in Region Piemonte.

2. THE COMPETENCE MODEL IN ITALY - NATIONAL STANDARDS (ISFOL)

In Italy, the birth of a certification system according to competences, in line with Lisbon objectives and with the Bruges - Copenhagen process has gained concrete dimensions progressively, through the realization of training channels as IFTS courses or courses for adult education, and through the introduction of the Citizens Training Booklet prepared by a technical work group from the Ministry of Labour and Social Policies. The booklet provides a meaningful instrument above all to attest acquired competences and in order to certify training credits gained in traditional contexts of learning (formal) or obtained through training experiences (non-formal) and everyday experience (informal).
In Italy "competence" is defined as the group of knowledge, skills and behaviour.
Competences are distinguished in:

- basic competences: these are considered as pre-requirement for access to training and considered absolutely necessary in order to find employment and in order to face change positively (ICT, foreign languages, safety and accident prevention, economy, organization, legislative rights).

- technical-professional competences: made up of knowledge and skill connected to operating activities required by tasks and production processes. (specific or technical knowledge in a given field of work)
- cross-sectional competences (behaviour): include the ability to diagnose, relate, problem solving, decision making, etc and, those personal characteristics that come to be when a worker faces an organizational atmosphere and that are thought essential for transformation of professional knowledge into concrete working behaviour.

In Italy, competencies are certified by the Regions. The minimum level of competence for each profession is defined at national level. At local level the regions, upon the basis of analysis of professional requirements, programme training offer based on national standards. Competences are registered in an individual training booklet.

3. THE COMPETENCE MODEL IN REGION PIEMONTE

As previously stated, defining and developing standards for competence is the responsibility of the Regions.

The Piemonte Region has begun a phase of elaboration and testing of on-line flexible operating instruments that allow both description and certification of competences through common methods, and diversification between varying target groups.

The Region Piemonte model is called *Collegamenti* (www.collegamenti.org) and is based on the following elements:

- Professional profile
- Areas of activities and actions
- Competence and ability

The professional profile is a description of the characteristics that make the profession unique. In *Collegamenti* these characteristics are 8: who - does what – how - where and when – why - with what limits - with what resources.

Within the Areas of Activities (AoA) the characteristics of each professional outline are identified.

The areas of activities allow for precise descriptions of operating procedures: they highlight which and how many activities belong to each professional outline.

To describe the areas of activities, it is necessary to break them down into a number of actions.

This is an example of the standard profile for CAD/CAM technician:

Area of Activities 1: Configure the CAD/CAM system

Action 1: Install the CAD/CAM software to be used

Action 2: Install peripherals (graphic printers, plotters etc)

Action 3: Use peripherals (graphic printers, plotters etc)

Area of Activities 2: Produce mechanic parts using CNC tool machine

Action 1: Transmit data to CNC tool machine

Action 2: Prepare necessary tools

Action 3: Fix the piece to be worked

Action 4: Use the CNC tool machine
Area of Activities 3: Make drawings for mechanical elements
Action1: Prepare bi-dimensional and tri-dimensional models using CAD and CAD/CAM systems.
Action 2: Modify bi-dimensional and tri-dimensional drawings
Action 3: Produce supporting documents for drawings
Area of Activities 4: Carry out tools for elaborating mechanical pieces
Action1: Read the production plan for each piece
Action 2: Set the working parameters for mathematical model
Action 3: Prepare tools suitable for production
Action 4: Apply the norms for manufacturing product
Action 5: Prepare the CAM path tool
Action 6: Produce supporting documents for drawings

Through using competences the operative sequences that allow for good management of the AoA of each professional profile.
So competence means ‘how a worker organises and manages his/her skills in relation to the areas of activities to be carried out’
To describe in detail this is ‘how he/she organises’, each competence is broken down into a variable number of abilities.
This is an example of the standard profile for CAD/CAM indicating the following areas of competences broken down into related abilities.
Competence 1: Analyse projects for minutiae or mechanical groups
Skill 1: Identify the distinctiveness of the project
Skill 2: Relaborate a project
Skill 3: Specify the task of the design and of the project
Competence 2: Contextualise projects for mechanical parts
Skill 1: Specify variations/evolution of the original project
Skill 2: Optimize the program for CNC according to the variations made to the project
Skill 3: Prepare the documentation supporting variations
Competence 3: Organise computerised systems for the production of mechanical parts
Skill 1: Prepare the production system
Skill 2: Compare the appropriateness of the computer system with the production study
Skill 3: Optimise the system configuration for simulating the production process
Skill 4: Define the operating systems for supporting production

To make further clearer the relationship between AoA and competences:
The Areas of Activity are the tasks to be carried out
The competences are ‘how’ these tasks are carried out.

4. THE COMPETENCE MODEL IN FRANCE

During the ‘80s, a new model developed inside the organizational structures in France: the competence model.
This model distanced itself from an idea of a company that had made its way in the ‘70s and which was characterized by rigid hierarchic structures, in which the workers occupied limited and well defined professional roles, therefore characterised by limited flexibility in human resources management.
The new organizational model, defined as “organisation apprenante” is characterized by far less limited professional roles, which allow a greater flexibility of organization, as compared to the past.
In such an organization, the competence-based approach may be useful for:

1. Evaluating the needs of training and specialization of the personnel (improvement)
2. Spreading and strengthening an organizational culture
3. Establishing recruiting criteria
4. Evaluating personnel
5. Planning promotion

The use of competence profiles would furthermore prove useful in order to:

- Promote the adoption of a vocabulary common to companies, ministries and training institutions
- Define the needs of competence and the corresponding activities for employee development, with an aim to integrate such competence into the labour market
- Help to orient policies connected to the labour development, such as programmes, services as well as any subsequent measures
- Help establish new roles corresponding to the professions
- Promote the development of work tools
- Provide the training organizations with the necessary elements for adjusting training programmes or developing new ones

Under such circumstances, a professions classification with required skills has been developed.
There are many databases that list trades and their respective competences, and among them, the most reliable are: ONISEP (Office International d’Information sur les Enseignements et les Professions), CIDJ (Centre d’Information et Documentation Jeunesse) and ANPE (Agence Nationale pour l’Emploi).
ANPE, in particular, has elaborated the Répertoire Opérationnel des Métiers et des Emplois (ROME) http://www.anpe.fr/ , in order to identify as accurately as possible all job offers and requests, so as to compare them and to promote professional mobility by means of defining which professional positions are related.
ROME presents a treelike structure: on the first level the professional categories are outlined, singled out by crossing the dominant social status and professional environment one belongs to.
One or more professional domains correspond to each professional category.

The professional domains indicate a set of knowledge and technical competences to put to use when carrying out an activity and they can be identified by their function, by the work organization type or by the techniques carried out, by the field involved etc.
Each professional domain corresponds to one or more jobs – trades, which consist of clusters of work situations and which are the basic unit of the ROME classification.
This situations combination is given by the likeness or similarity of various jobs – trades activity contents, by the presence of basic skills common to these jobs – trades and by the closeness of the required profiles in order to perform the job – trade.

In the process of this grouping, ROME takes into consideration the fact that, although the classification for a certain trade is identical, the job itself and the real work contexts vary considerably from one organization to another in the same activity field.
Finally, the trades – jobs are characterized by a certain number of specific matters, which take into account the variations of work contexts that a trade – job may undergo on the labour market.
The combination of the above mentioned factors allows for creating job offer and demand profiles, which take into account the type of company organization and the workers' skills.
In this regard, it is important to underline the introduction of the concept of competence, as the combination of savoir (knowledge), of savoir-faire (know-how) and of savoir-être (know-how-to-be), which result in behaviour.
This behaviour allows individuals to carry out the tasks to accomplish in a given organization, according to the work situations.
The skills are classified into:

- Basic technical skills, skills considered essential to carry out the trade – job
- Associated skills, in other words, the skills which are not essential for carrying out the trade – job, yet crucial for the functioning of an organization and which the worker has acquired during previous work experience.

These skills are common to all workers in a company and are usually grouped in relation to related savoir-faire (e.g.: communication, group work ability to cooperate) and savoir-faire related to the organization (e.g.: being independent, having initiative, contributing to progress).

- Job related skills, these are the savoir-être required for the practice of the trade – job and are generally given by the use of computer, by knowledge of foreign language or by cognitive and social skills that distinguish the new work contexts.

It is quite important to underline how, in the skill/competence definition, there are both an individual aspect, related to workers' knowledge, abilities and aptitudes, as well as an organizational one, related to the inner structure of the organizations.
The integration of these two aspects is defined as "ability to act".

5. THE COMPETENCE MODEL IN SPAIN

During the Nineties there have been many profound changes in the Spanish qualifications system. The main ideas concerning the reform processes in VET have been:

- The creation of a National Qualifications & Vocational Training System.
- The development of a VET Qualifications Framework (National Catalogue of Vocational Qualifications).

Many initiatives have been set up with several tools:

- National Catalogue of Vocational Qualifications. It is organised depending on the appropriate competences for vocational exercise. It includes associated vocational training, with module structure.
- A procedure of assessment, accreditation and catalogue of vocational qualifications.
- Information and guidance in vocational training and employment.
- Assessment and quality improvement of Qualifications and National System of Vocational Training.

The key terms of this process are:

- Vocational Qualification: set of vocational competences with meaning for employment which can be acquired through module training or other types of training, and also through labour experience.
- Competence Unit: minimum part of vocational competences, for recognition and accreditation.
- Vocational Competence: set of knowledge and abilities which make possible the delivery of vocational training according to the requirements of production and employment.

Incual (Instituto Nacional de las Cualificaciones - National Institute for Qualifications) is the official body delegated to the regulation and coordination of the National System of Qualifications and Vocational Training.

"The National Institute for Qualifications, is the technical support organism for General VET Council, responsible for defining, creating and updating the:

- National Catalogue of Vocational Qualifications
- and the respective Module VET Catalogue"

Spain is now designing its National Catalogue of Vocational Qualifications, according to a guideline in two dimensions: qualification and sectoral level. In this Catalogue 26 professional families divided in 5 levels have been defined.

Level 1: competence in a narrow group of relatively simple work activities corresponding to normal processes, since theoretical knowledge and practical abilities to be applied are limited.

Level 2: competence in a group of well defined work activities, including the ability to use appropriate techniques and tools, above all in practical work which can be autonomous within the limits of those techniques. This needs knowledge of the

activity technical and scientific basis and ability to understand and apply the process.
Level 3: competence in a group of well defined professional activities, which need a complete knowledge of different techniques and can be autonomously carried out. It involves responsibility in coordinating and supervising technical and specialised work. This requires the understanding of the activity technical and scientific basis and the assessment of both the process components and its economical consequences.
Level 4: competence in a large group of complex professional activities, carried out in a wide range of contexts, requesting the combination of technical, scientific, economic or organizational elements to plan actions, to define or develop projects, processes, products or services.
Level 5: competence in a large group of extremely complex professional activities carried out in different, often unpredictable contexts: this involves planning actions or conceiving products, processes or services. Great personal autonomy. Frequent responsibility resources allocation, in analysis, in making diagnosis planning, carrying out and assessing activities.

6. CONCLUSIONS

How Southern European countries responded to European recommendations? And do they all adopt the competence model?
France was already adopting this model before the EU recommendations, in fact the French system probably inspired EU levels.
ANPE (Agence Nationale Pour l'Emploi) has elaborated the Répertoire Opérationnel des Métiers et des Emplois (ROME), in order to identify as accurately as possible all job offers and requests, so as to compare them and to promote professional mobility by means of defining which professional positions are related. In this context, the skills are classified into:

- *Basic technical skills*
- *Associated skills*
- *Job related skills*

Italy and Spain are aligned to UE indication.
In **Italy**, ISFOL (the National Standard) defined the competence as the group of knowledge, skills and behaviour. Competences are distinguished in:

- *basic competences*
- *technical-professional competences*
- *cross-sectional competences*

In **Spain**, INCUAL (*Instituto Nacional de las Cualificaciones* - National Institute for Qualifications) is the official body delegated to the regulation and coordination of the National System of Qualifications and Vocational Training.
The National Institute for Qualifications, is the technical support organism for General VET Council, responsible for defining, creating and updating the:

- National Catalogue of Vocational Qualifications

- and the respective Module VET Catalogue"

In this Catalogue 26 professional families divided in 5 levels have been defined.
What emerge clearly is that each country adopts a national standard to describe and evaluate competences which are all relatively similar.
Even if these national standard adopted by Southern European countries are rather aligned to EU recommendations, still it is important to keep a control, on a local level, regarding how education and training systems – and the connected competences evaluation and certification methodologies – result satisfactory in terms of transparency.

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THE EXPERIENCE OF APPLICATION OF THE INNOMET INFORMATION SYSTEM IN ESTONIA BY THE EXAMPLE OF THE ENGINEERING, METAL AND APPARATUS INDUSTRIES

Kirke Maar, Riina Tallo

1. BACKGROUND

The idea of the INNOMET cooperation model was sparked during the Leonardo da Vinci INNOMET project (2003-2004, see http://www.emliit.ee/innomet1/index.html) in the framework of which the conceptual bases of human resources development were developed (descriptions of specialties, principles of determining skills, knowledge and personal qualities according to jobs and the company specifics; development of the principles of the evaluation system) and the prototype of the INNOMET database in the Internet environment was realised. The goal of the project was to improve practical cooperation between educational institutions (in-service training providers) and companies (demand for in-service training) in the engineering, metal and apparatus industries through evaluating and mapping human resources.

In 2004 when the application of the INNOMET information system was launched in the engineering, metal and apparatus industries in Estonia, the cooperation between training providers and employers in the engineering, metal and apparatus sectors was non-existent or insufficient. The qualification and skills of workers who graduated from a vocational education institution and/or offered training courses did not fully comply with the expectations of companies. The study programmes did not meet the labour and qualification needs/skills of the private sector.

According to the “Employment Forecast for 2004-2010” survey commissioned by the Estonian Ministry of Economic Affairs and Communications the growth of productivity in the Estonian engineering, metal and apparatus sectors was weaker than that of sales, which means that there is a need for additional labour force and in-service training.

According to the given data, the importance of managers, unskilled workers, skilled workers and manual workers had decreased, while the importance of machine and device operators, middle-level specialists and technicians had decreased. According to forecasts of the survey due to export growth and growth of sales on the internal market the added value generated in the sector by 2010 will double in comparison with 2002 (in constant prices).

Internal demand and export will continue increasing according to the survey. Owing to the growth in labour productivity it will not bring about a rise of employment proportional to sales growth, but by 2010 approx. 4 thousand additional jobs will be created in the sector.

Against the aforementioned background the Estonian engineering, metal and apparatus industries were fertile soil for application and testing of the INNOMET information system as to whether the ideas of the INNOMET system can offer real solutions for the employment problems of the business sector.

2. INNOMET II – APPLICATION OF THE INNOVATIVE HUMAN RESOURCES DEVELOPMENT SYSTEM IN ESTONIA

A project application was submitted to the European Social Fund in order to apply the INNOMET information system in the engineering, metal and apparatus industries in Estonia. The project was launched in March 2005 and it lasted until the end of 2006. The project applicant was the Federation of Estonian Engineering Industry non-profit association and the partners involved were 10 educational institutions and 6 local authorities from three Estonian regions where engineering, metal and apparatus industry enterprises mainly operate (see Fig. 1).

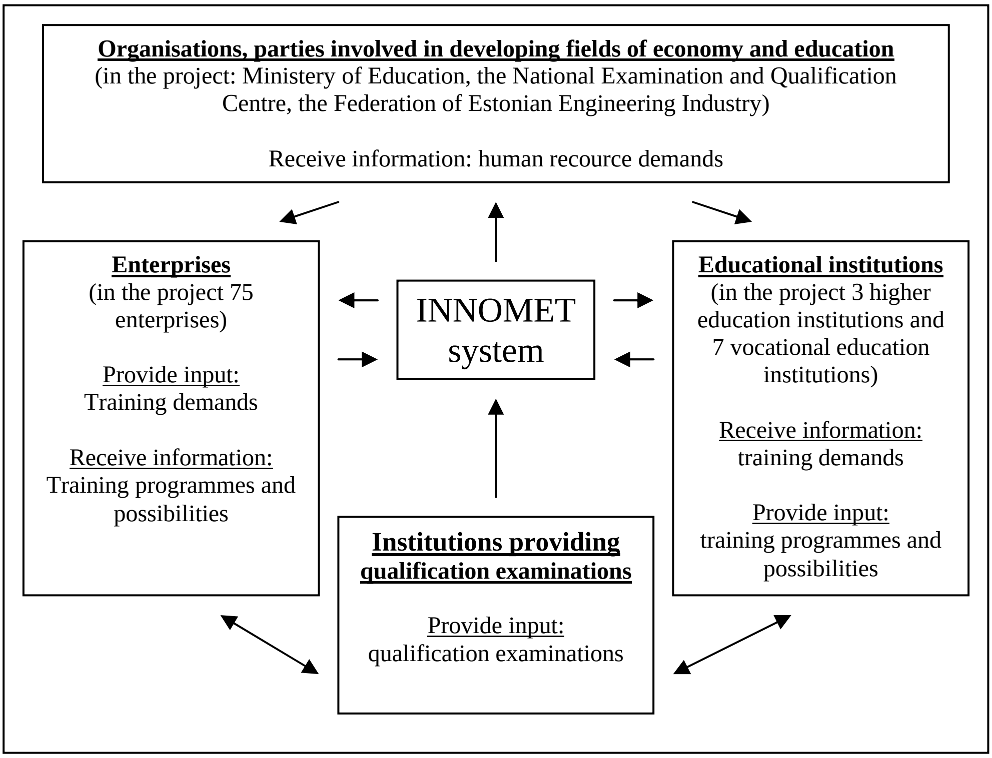

Figure 1 The circle of partners involved in the project

The total cost of the project was EUR 48,800 of which EUR 36,500 was covered by the European Social Fund.

Main objectives of the project:

- Application of the INNOMET international development project, financed in the framework of the Leonardo da Vinci II programme in 2003-2004, in Estonia;
- Improvement of training provided in the area by higher and vocational schools, bringing it into conformity with the requirements of the branch of industry;
- Human resource development and improvement of competitiveness in the labour market by raising the efficiency of in-service training in the engineering, apparatus and metal industry sectors and developing it;
- Elaboration and development of possibilities for practical life-long learning in the sector.

As a result of the project, the capability of educational institutions (those providing academic and professional higher and vocational education) to provide in-service training was to be increased, and so was the competitiveness of enterprises, and the shortage of skilled workers in the area of engineering to be decreased.

In order to achieve the objectives of the project, the Internet-based information system INNOMET II was applied in Estonia. This connected, on common bases, the in-service training possibilities of schools as well as the labour needs of enterprises in the area of engineering.

Main activities of the project:

1. The levels of the labour needs and skills of the existing personnel of enterprises operating in the area of engineering were mapped (on the basis of 75 selected enterprises throughout Estonia).
2. In-service training possibilities of schools and levels of training were mapped.
3. Information obtained from enterprises and schools were analysed and entered into the INNOMET II information system; an interactive database was created.
4. Based on the information obtained, schools were able to adjust their study programmes and in-service training programmes to make them meet the requirements of the branch of industry.

Target group

Apparatus and engineering enterprises

The main project activities regarding enterprises were mapping human resources in the sector and identification of training needs. 75 companies were selected as the target group of the survey: 40 from the Tallinn region, 20 from Ida-Viru County and 15 from Tartu and Tartu County.

Employees of the enterprises (preferably employees participating in the survey sample) were the target group of the pilot training courses organised during the project, which included training 415 employees of “low competitiveness” due to technological or vocational education reasons.

Pilot training courses were organised in the so-called bottleneck areas and involved a target group (employees of the enterprises) whose level of skills and qualification did not meet the required level according to the survey (due to modernisation of technology and equipment, vocational education reasons, etc.).

150 employees of the enterprises who had undergone training were allowed to take a professional qualification examination in the framework of the project, see an exemplary course calendar in Fig. 2.

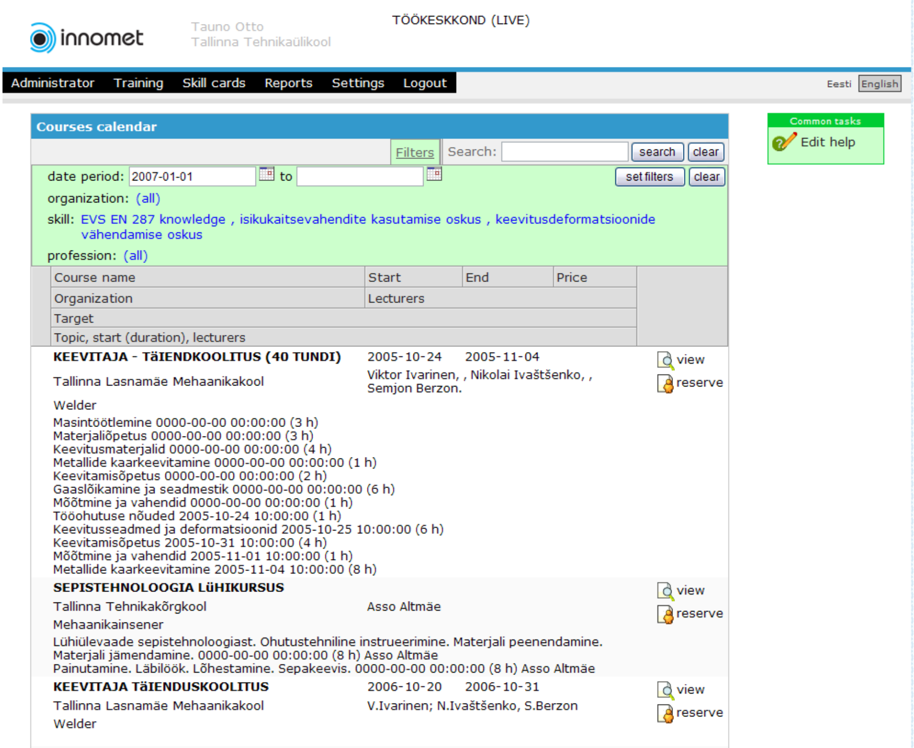

Figure 2 Course calendar in the system [1]

Regional roundtables, seminars and forums were organised in order to introduce the INNOMET II information system and to facilitate the spread thereof to other sectors. In the final phase of the project the system were prepared for spreading to other sectors and tests in the building sector were conducted.

Educational institutions

Educational institutions mean vocational schools and higher education institutions involved in the project as partner schools, their employees and students who directly contribute to identification of the needs, development and practical application of the INNOMET system. All bigger schools teaching engineering specialties at the vocational and higher education levels were involved as partners.

In addition to application of the INNOMET II information system a lot of attention was paid to drawing up and developing the in-service training systems of educational institutions. The partner schools brought in-service training offers in compliance with business requirements during the project. The competency systems arising from professional standards and jobs were used as the basis for descriptions of in-service offers (see Fig. 3).

415 employees of the enterprises were trained in the course of the project on the basis of the adjusted in-service training offers. The goal of the pilot training was to test on the one hand, the principles of operation of the information system and on the other hand, the development of the cooperation between enterprises.

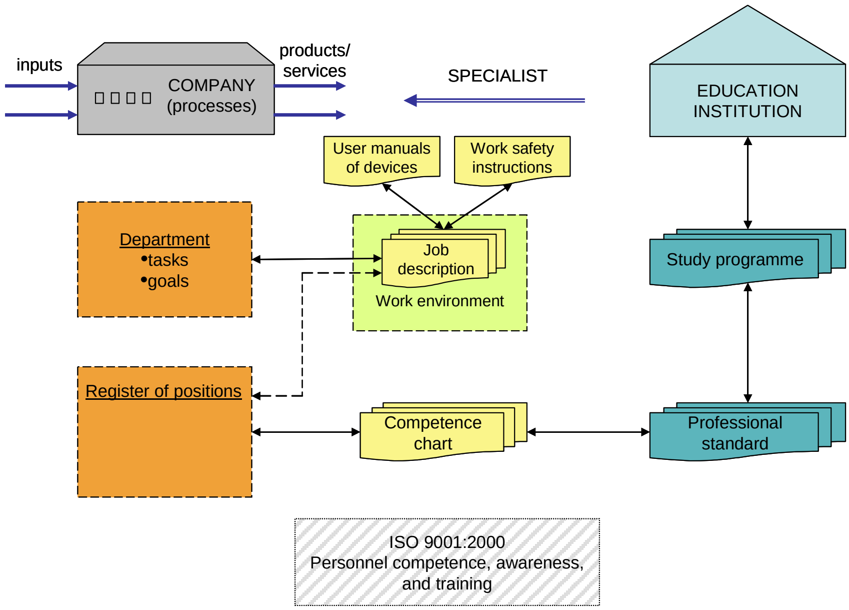

Figure 3 Competence chart model

Additionally, training aimed at training providers and training managers were organised for educational institutions.

The training of training providers – training professional specialists – was conducted with the aim of increasing the level of skills and qualification of the training providers of vocational and higher education institutions upon provision of in-service training. Upon selection of the target group it was proceeded, on the one hand, from the content of the training programme and, on the other hand, the request of the partner schools. From each school 2-3 instructors were able to participate in each training course. There were five training courses in the framework of the project.

The training of training managers – a training course on how to organise in-service training (project management, preparation of training and involvement of the target group) was carried out with the aim of improving the capacity of educational institutions for provision of in-service training.

Estonian education sector on a broader scale

The education sector will benefit from the project owing to survey results – the results of the project will be spread in the education sector more broadly. Both in the project's preparation as well as application phase the Ministry of Education and Science was consulted in order to ensure the suitability of the developments with the Estonian in-service training landscape and development of the existing areas.

Basic school and secondary school students

Among other things, the project focused on raising awareness among students. A reputation campaign introducing engineering specialties among basic school and secondary school students was carried out, in the framework of which company visits were made and information days introducing the activities of the companies were held.

It is also important to indicate the value of the reputation campaign carried out in the framework of the project in the longer run. The problem of schools lays in relatively low-standard admission competitions, which can be partially attributed to the low reputation of engineering among young people. Various jobs and specialties were introduced in the framework of the project (indicating, for instance, the wages of specialists, which, contrary to prejudice, amount to several times the average wage).

3. EXPERIENCE UPON APPLICATION OF THE INNOMET II PROJECT

By today the principles of operation of the INNOMET cooperation model and information system have been carefully tested and the suitability and effectiveness of the cooperation model has been confirmed.

The human resource needs of the enterprises have been mapped and based on the analysis in-service training for 415 employees has been carried out exceeding the initial plan by 45 persons.

On the basis of experience in organising pilot training it was confirmed that companies and educational institutions were interested in continuous cooperation in development of human resources and saw mutual benefits in it. However, based on the experiences of the project it can be admitted that upon development of in-service systems in educational institutions separate attention must be paid to the specifics of adult training and the issues of drawing up and marketing training offers aimed at enterprises, whereby an educational institution may need additional training and counselling upon the absence of previous experience.

Training conducted for training managers of educational institutions was very justified in this context and also provided an opportunity for exchanging experiences and developing cooperation between educational institutions. In the case of several pilot training courses cooperation ideas were realised in practice and training courses were carried out in cooperation with various educational institutions.

A positive example is in-service training where the possibilities of the educational institutions in a region did not meet the needs of the enterprises of the region and the experience and lectors of educational institutions of other regions were involved in organising training.

One of the positive results of the project is certainly the development of a competency-based professional standard for CNC machine tool operators. Starting from 2007 the professional examination can be taken by the first employees of the enterprises and obtain professional qualification based on the developed professional standards. The total number of persons who have passed a professional examination during the INNOMET II [2] project exceeded the planned 100 fast and before completion of the project this number was, similarly to the number of persons who have undergone the pilot training, exceeded as well and the final number of those who passed the professional education was 150. Professional examinations were carried out for skilled workers of Levels I and II.

The competency-based structure of professional standards and the respective system of mapping human resources and drawing up in-service training offers has received very positive feedback from all parties. Defining jobs based on competencies allows for increasing the mobility and flexibility of in-service training and attribution of a profession. This, in turn, allows companies to develop human resources more effectively and from the point of view of the needs of a specific company as well as for more flexible possibilities upon increasing one's competitiveness.

4. FURTHER DEVELOPMENT PERSPECTIVES OF THE INNOMET INFORMATION SYSTEM AND COOPERATION MODEL

Based on the positive experiences of application of the INNOMET information system in the engineering, metal and apparatus industries the information system will be expanded to 5 additional sectors as of the beginning of 2007 (construction, information technology, electronics, timber industry and car service).

The system will be adjusted to the needs of five additional sectors by the summer of 2008. Considering that by the aforementioned sectors there may be considerable overlapping between jobs and competencies within jobs the expansion of the

INNOMET information system is preceded by a detailed comparative analysis of jobs in the sector. The conducted analysis will be used as a basis for harmonisation and further development of the professional standards of sectors as well as upon adjustment of the INNOMET information system to the needs of five additional sectors of business.

A comparative analysis of jobs and competencies will allow for the creation of five additional separate information system environments, but to join the additional sectors to the existing database in such a manner that there will be one integrated environment as a result thereof. Integration of professional standard systems and principles of in-service training in industrial sectors will also increase the flexibility and mobility of human resources development.

Professional associations and representatives of enterprises will be involved in the process of joining sectors in order to ensure the suitability of the established integrated information system with the specifics and needs of various sectors. Similarly to the INNOMET II project the main vocational and higher education institutions providing in-service training in specialties are closely connected with the process.

Another important objective for 2007 is to analyse the resources of in-service training offers in cooperation with the existing and potential partners and compliance thereof with the needs of enterprises, to map the main problem areas and to analyse the possibilities of application of the output of employment needs arising from the INNOMET cooperation environment in different development and planning processes, focussing mainly on the mapped problem areas.

Possible additional areas where the labour force training needs output of the INNOMET information system could be applied:

- forecasting the need for labour;
- planning support measures aimed at companies;
- planning the in-service training of pedagogical personnel and planning in-service training resources of educational institutions;
- vocational counselling.

The INNOMET Foundation has been established in order to ensure the INNOMET information system and sustainable development of the cooperation model. The main goals of the Foundation are as follows:

- administration and development of the INNOMET information system;
- coordination of the INNOMET information system and cooperation between the parties of the cooperation model;
- development of further application possibilities of the INNOMET information system and initiation/application of cooperation projects.

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THE IMPORTANCE OF THE MECHANICAL ENGINEERING AND METALWORKING INDUSTRY AND THE ROLE OF THE INNOMET SYSTEM TO DEVELOP THE INDUSTRY

Maris Balodis

1. STRATEGIC IMPORTANCE OF THE EUROPEAN MECHANICAL ENGINEERING INDUSTRY

The mechanical engineering sector plays a crucial role in the European economy for a number of reasons:

- Mechanical engineering is not only a sector in its own right but, as a supplier of capital goods and common technologies used by different industries, it acts as a cross-fertiliser causing a knock-on effect to a much greater number of European sectors.
- The mechanical engineering sector, as provider of enabling technology to all other sectors of the economy, provides the ***fundamental industrial infrastructure*** underpinning the European economy.
- Moreover, ***mechanical engineering is one of the major exporting sectors*** accounting for about 15% of exports of EU manufactured goods [1].
- ***Mechanical engineering is a strategic industry***: it is a high added-value, knowledge-intensive sector which supplies all other sectors of the economy with the machines, production systems, components and associated services, as well as technology and knowledge they need.
- ***Mechanical engineering provides*** not only the equipment, but also the ***skills and knowledge*** for improving existing processes and products and for developing new products in all sub-sectors. This is of particular importance when viewed in the context of the economic development of an enlarged Europe and beyond.
- European mechanical engineering is a world leader with 41% of global output, Europe is the world's largest producer and exporter of machinery (EU 261,707 million in 2002), including complete plant exports [1]. ***It is vital to maintain such a leadership position***, ***if Europe is to become the most competitive knowledge-driven economy in the world***.
- Mechanical engineering is a driver of innovation and a pioneer, applying and integrating innovations into its own products and processes. It should be borne in mind that ***mechanical engineering is a link – very often the first – in a value-creating chain***: should one part of this chain fail, the whole would suffer.

2. CURRENT SITUATION IN THE LATVIAN MECHANICAL ENGINEERING INDUSTRY REGARDING THE HUMAN RECOURSES AND ITS DEVELOPMENT NEEDS

Association of Mechanical Engineering and Metalworking Industries of Latvia is a voluntary public non-profit organization founded at 1994 as informative and consultative center for specified industrial sector joining more then 140 companies today [3]. The goal of Association's activities is to promote the development of the metalworking sector, mutual cooperation and professional growth of the specialists in the sector. Members of the association account for more than 75% of the total output produced by Mechanical Engineering and Metalworking sector in Latvia (Figs 1-3).

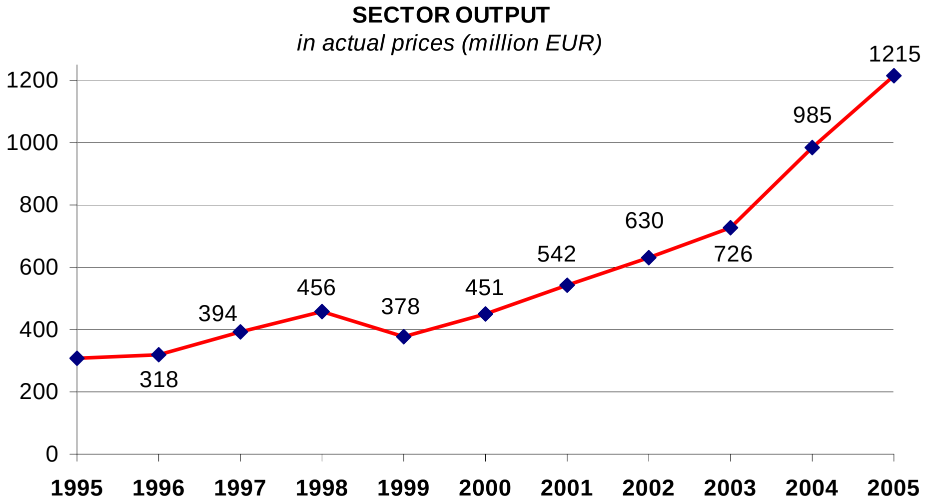

Figure 1 Sector output in actual prices (EUR)

The Latvian mechanical engineering industry is continuously facing the problem concerning highly educated specialists towards nowadays' market needs. Such problem has arisen due to the fact that educational sector can not prepare the engineering specialists according to the nowadays' market needs, because the industry is continuously applying the latest technologies and innovations in their production where higher educated and skilled workers are needed in order to profit from the investments made in the new technologies.

The mechanical engineering companies will not be able in the long term to achieve and maintain their competitiveness if there will be a lack of skilled specialists that industry is demanding. Due to this fact closer collaboration between industry and educational sector is vital in order to prepare the vocational school and University graduates according to industry needs as well as retraining of existing human resources in cooperation with training centres is of high importance to maximize the productivity by adapting new technologies and inventions in production processes.

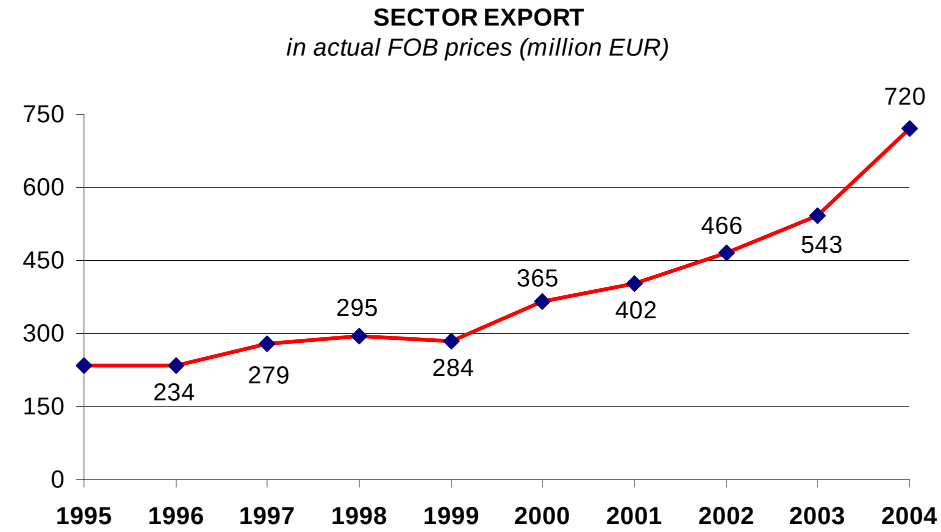

Figure 2 Sector export in actual prices (EUR)

Figure 3 Sector employment in Latvia

In the fact basically the same conclusion has been made in the European Economic and Social Committee's OPINION of the Industrial Change in the Mechanical Engineering Sector in 2005 as written hereinafter:

> *"All improvements begin with innovative and challenging educational systems. Up-to-date modules have to be devised, also in companies themselves. Industry must be encouraged to cooperate closely with*

educational institutes, higher education establishments, and vocational training centres. Direct participation of managers in relevant educational programs must be encouraged and, in return, teachers must be offered the opportunity of interaction with industry. Due to rapidly developing product and service cycles, life-long learning and, consequently, employee flexibility towards change, must become common practice in companies."

As a second arising problem we should underline the following – the small number of young people have chosen the engineering professions as their carrier profession, therefore task to promote engineering becomes day by day more important, because current situation in long-term will lead to dramatic lack of engineering staff. One of the biggest problems I see in attracting students into engineering is the image, or more correctly the lack of image, of the engineering profession. Unlike other professions, engineering is not visible to the general public. Engineering works behind-the-scenes and yet has a direct impact on every aspect of daily life. Engineers ensure we have heat, light, shelter, transportation, entertainment, appliances, communication systems, medical technology, clean water, waste disposal and millions of other solutions. In this particular point I would like to quote the following:

> *"A career as an engineer provides a way to make real and often dramatic improvements in life - not just for one client at a time, like many other professions - but for groups of people and all of society"* [2].

At the same time additionally I would like to refer at the European Economic and Social Committee's ***OPINION*** concerning the image of industry:

> *"Nowadays young people are less inclined to study and to work in the technical industries, a phenomenon that has partly to do with an outdated image of industry. This calls for action focusing on new technologies by industry itself, supported by a cultural drive on the part of national and Community media, with a view to altering public perception. Good communication between companies and the public, particularly with youngsters, is crucial. A change of mentality and approach is needed to reverse current trends. Increased awareness of the reality of mechanical engineering is needed. This concerns the overall process of technology, business services, the chains of inter-related technologies, processing, marketing, internationalisation, etc. The better these inter-relations and exciting processes are presented, the more it will foster interest amongst the general public and young people in particular.*

Due to the small number of mechanical engineering graduates companies are pushed more and more to find their internal human recourses and use them more and more efficiently where non-stop investments in the new technologies and production automation has to be made by industry to increase the productivity per worker. Production modernization creates the need for retraining of existing specialists in order to gain new skills and knowledge. Industry can not wait for three, four or five years until new specialist will graduate vocational schools or Universities therefore retraining facilities for companies have to be offered.

To establish a successful collaboration between the industry and educational sector, to offer retraining facilities and motivate youngsters to be involved in engineering the INNOMET tool has been developed and created.

3. THE BENEFITS OF IMPLEMENTING THE INNOMET SYSTEM IN LATVIAN MECHANICAL ENGINEERING COMPANIES

After carrying out several test of the INNOMET system implementation in the Latvian metalworking companies the following benefits could be divided in two parts:

1. Short-term benefits (within 1 - 2 years)
2. Long-term benefits (within 3 – 8 years)

Table. Benefits of implementing the INNOMET system in Latvia

Short-term benefits (within 1 - 2 years)	**Long-term benefits (within 3 – 8 years)**
Information availability of retraining courses presented by INNOMET system. More and more training centres and educational institutions will be involved in the joint INNOMET system where companies will be able to search for courses they need. **Increased knowledge and skills of human resources are gained through courses offered by INNOMET system**.	**Increased understanding about engineering professions amongst young people**, because INNOMET system presents the list of engineering professions and description of each profession. This will benefit in **higher number of students who study engineering** professions and who later after 5, 6, 7 or 8 years will get involved in the industry.
Overview about strong and weak sides of the employees' competences gained through INNOMET system competence charts. Based on gathered information company can plan what training courses are needed and/or in what competences employees should be employed in order to receive maximum benefit from worker.	Revision of study programs in educational institutions what will lead to **more industry oriented study programs**. This will give enormous benefit in long-term, because the youngsters will be prepared and ready to work in industry. In this particular case will be **solved the cause of the problem** avoiding of investments in solving the problem's result when unprepared students graduate schools without any understanding of real situation in companies and are not ready for practical work in the industry.
Comparison of the company's **competence level with average results of the whole country**, the region or certain group of companies. General overview on where we are today.	
Depending on the results of competence evaluation of the employees in the INNOMET system, to find courses and register employees to the courses that	Through analysis of competence level in the company, the company is able to evaluate its **ability to fulfil its strategic objectives and to plan further**

would help to **improve competence level in needed fields**.	**activities** depending on existing competences and its level.
Flexible **evaluation of competences periodically** through INNOMET system and assessment of the training effectiveness.	
Evaluation of the company's personnel competences in order to find out the skills which have to be improved for workers by applying for retraining courses offered by INNOMET system. Competence evaluation though INNOMET system gives real **feedback to educational sector which courses should be developed in order to reach needed level for particular competence therefore having focus more on industry needs**.	

Successful implementation of the INNOMET system in Latvia and other partner countries, as an intermediary "tool" between industry and educational sector, will contribute partly in solving almost all of the problems described above and play an important role to link all players involved in the development of the mechanical engineering sector, as a result direct input in the Lisbon objectives realisation will be reached.

4. REFERENCES

1. OPINION of the European Economic and Social Committee on Industrial Change in the Mechanical Engineering Sector - [WWW] http://www.orgalime.org/about/EESC_MELC_en.doc (30.01.2007)
2. Linda Lefler, Atlantic Region Forum, Halifax, Nova Scotia, March 26,1991 - [WWW] http://www.carleton.ca/cwse-on/webmtjnen/chap19.html (30.01.2007)
3. Database of Latvian Metal Industry Enterprises - [WWW] http://www.masoc.lv/index.php?id=27&lang=2 (02.02.2007)

VALORISATION OF THE RESULTS AND PRODUCTS OF INNOMET

Jaanus Vahesalu

1. BACKGROUND

21st century can be characterised by globalisation, borderless information spreading via Internet and creation of new economic consortiums. Traditional management scheme "manufacturer – trade mark owner – wholesaler – reseller" has changed to "subcontractor – contractual manufacturer – trademark owner – wholesaler and distributor" multi-way realisation. In manufacturing it causes also changes in qualification structure and characteristic skills of labour force.

Enterprises and trade unions are interested in certain vocational standards and specifying skills level of employees. Academic world and vocational education providers cannot react to these changes correspondingly without knowing the real needs of industry world. Hence the gap between the needs and reality of labour force structure and quality exists. By stimulating contacts and cooperation between the different factors both in business and educational systems, synergies can be successfully achieved to realised the abovementioned main criteria.

INNOMET is an acronym for the projects which aims are to develop an innovative database model for adding innovation capacity of labour force and entrepreneurs of the metal engineering, machinery and apparatus sector. Project is funded by the European Commission Leonardo da Vinci II programme during the period of 2003-2004 and 2005-2007, focusing on a new monitoring tool ensuring qualified labour force for enterprises in the machinery, metal engineering and apparatus sector in terms of local and European needs.

The primary objective of INNOMET projects and the INNOMET tool as such is to increase the responsiveness of education institutions to business demands and to improve the access of vocational and higher educated specialists into labour market. For that purpose it is proposed to introduce an integrated virtual database system for educational and industrial needs in the sector, which includes links to existing educational opportunities, e.g. different levels of study programmes, as well as private sector qualified labour force and mapping of the industrial needs for human resources.

Many countries in Europe are facing similar problems in the metal, machinery and apparatus sector – lack of highly qualified and skilled labour force, low cooperation between companies, absence of local and international cooperation networks, low productivity (based also on lack of knowledge of human competence systems). The INNOMET system has a valuable trans-national value, as none of the project partner countries – Estonia, Latvia, Sweden, Hungary, Italy and Finland - have developed an integrated sectoral model for cooperation and improvement of capacity of educational system and labour force demand. Therefore it is crucial to disseminate the INNOMET tool (database system) as an example how to approach to possible solutions in order to develop human resources and competitiveness of enterprises. Elaborated model is usable with minor changes also in any other industry field.

INNOMET database could also serve as a dynamic and constantly up-dated study on human resources in the sector if a relevant pool or so called critical mass of companies is included in the system. Companies will be motivated to renew information in certain periods, as INNOMET tool can be effectively used for companies` own human resources evaluation and development. The system can also be used in the development of trans-national skills` passports in Europe.

2. WHAT IS „VALORISATION"?

Originally a French term, the concept of valorisation is now widely accepted by the European vocational training community. "Valorisation" can be described as the process of disseminating and exploiting projects outcomes, with a view to optimising their value, enhancing their impact and integrating them into training systems and practices at local/national as well as European level.
Dissemination can be characterized as a key to valorisation. Information on how a project is developing and dissemination of the results to target groups are the essential tools for project valorisation. Dissemination involves ongoing production of clear, targeted information on a project's achievements via appropriate means. Dissemination is a strategic tool of valorisation but it needs to be supplemented by specific measures for exploiting, using and assuring the sustainability of the project results. This is achieved through constant interaction between the project partners and a sample of potential users of the project results right from the start of the project when the proposal is drawn up and throughout its entire lifecycle. Exploitation of results means that the project results meet needs clearly identified at the outset so that they can be used in vocational training systems and practices. Projects outcomes can be tangible like training products, course materials etc. as well as intangible like training methodologies, processes or experiences.

3. VALORISATION ACTIVITIES DURING INNOMET PROJECTS

During the INNOMET I project a pilot version of a new innovative INNOMET system was created and tested on more than 15 companies and several different educational institutions. The system merged also a link to study packages and to a harmonised qualification system, including all related information form the partner countries. The main version system was translated also into national language of partner countries. There were 2 levels in terms of access to functionalities: public area and protected area. In addition to promised activities in the application – INNOMET marketing report has been produced to promote the project to local and international partners.

The core objective of the INNOMET II project is the realisation of the system – from test version to the dynamic working system – among the network partners in all partner areas by 2007 – Estonia, Sweden (Stockholm area), Hungary (Budapest area) and Italy (Piemonte area) and to test and valorise the system in new partner areas, such as Portugal and Latvia (see Fig. 1). The old version of the database has been updated, new innovative modules have been added, which make the system more user-friendly and flexible.

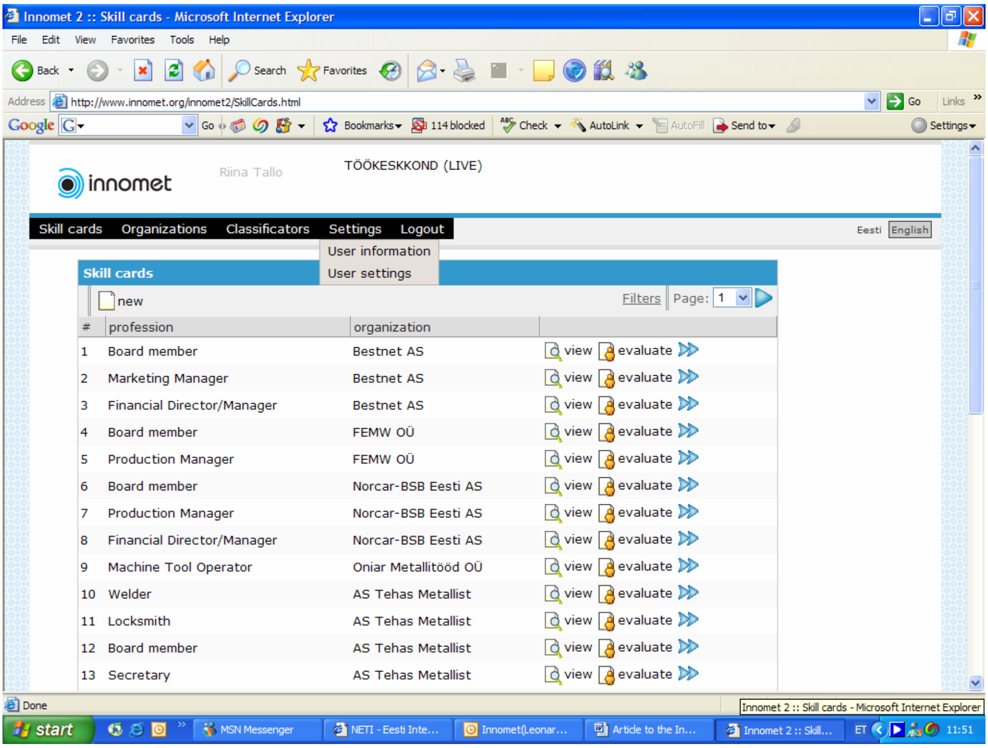

Figure 1 INNOMET system

The focus of the valorisation has been put to all different levels – organisational, regional, educational, sectoral, national and trans-national level. Several activities have bee carried out in order to introduce INNOMET projects, its objectives and results (the INNOMET system) to the wider audience and to emphasize the possibilities of the system by human resources development:

- INNOMET brochure (see Fig. 2) was published in the beginning of the project with the aim to give a better understanding about the objectives, content and expected outputs of the project. The brochure was launched in English, including also the possibility to translate it into other national languages of partner countries by using electronic version. The brochure has been distributed in several seminars, international conferences throughout

Europe (e.g. 5th International DAAAM Baltic Conference in Tallinn, General Assembly of the Council of European Employers of the Metal, Engineering and Technology-based Industries in Oslo)

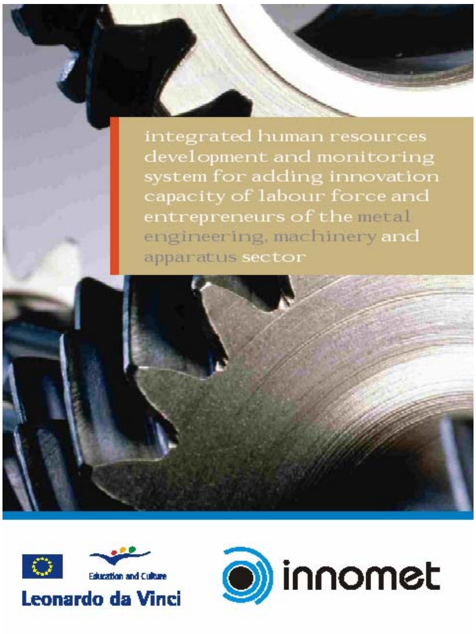

Figure 2 INNOMET brochure

- INNOMET system has been introduced also in written media (including local newspapers, sectoral magazines) and in publications (e.g. *Otto, T. Models for Monitoring Technological Processes and Production Systems. Tallinn University of Technology Press, Tallinn, 2006*, including chapter of INNOMET). Main ideas of the system have been presented and discussed in several industrial exhibitions or technology fairs in Europe.

- As the main target groups of INNOMET projects are educational institutions and the industrial sector (engineering, metal working, machine building, tool making etc), the core focus of dissemination activities will be put for the enhancement of cooperation through interaction, networking and better social dialogue. Therefore many forums, seminars, round-tables etc have been organised in all project partner countries throughout the project, in order to develop common understanding of industrial needs and capabilities of academic world (see Fig. 3). In every partner country national seminars have been carried out in spring 2007 (February-March), which have gathered all the responsible and interested parts and where the INNOMET system and main outputs of the project have been presented.

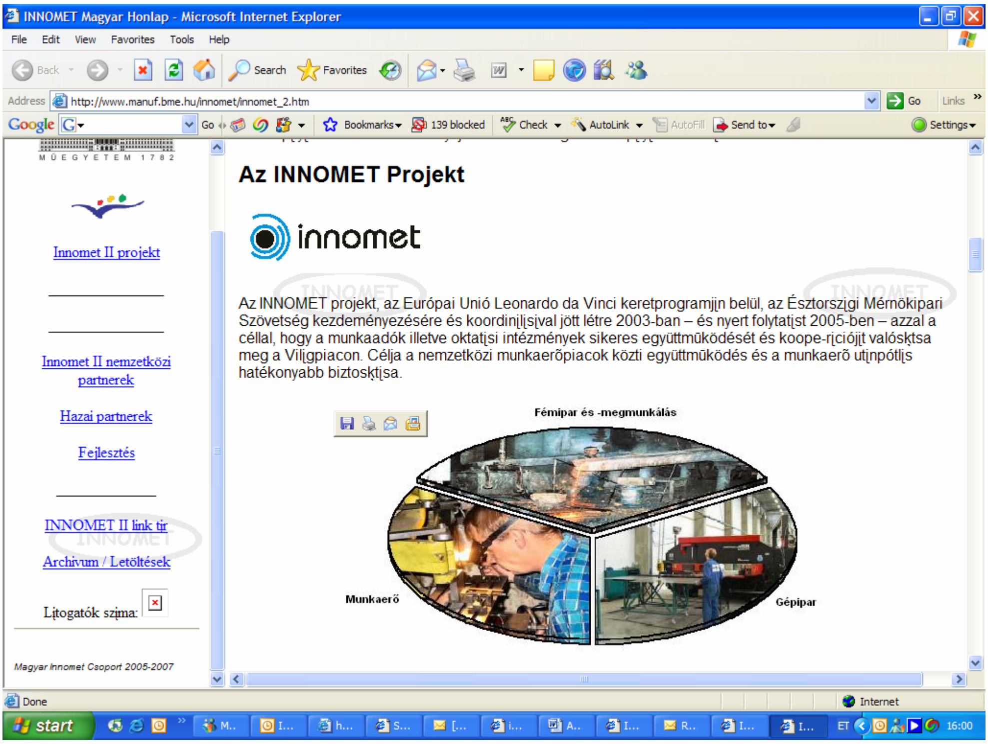

Figure 3 Information about the project on the Hungarian INNOMET II website

The full list of valorisation activities can be found on the project website: www.innomet.ee/innomet.

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