



INNOMET II - Integrated human resources development and monitoring system for adding innovation capacity of labour force and entrepreneurs of the metal engineering, machinery and apparatus sector

Methodology for Qualitative and Quantitative Estimation of the Needed and Existing Levels of Competence of a Company's Staff

Work Package 2

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0. Introduction

In the 1990s, a new emphasis on strategy and the importance of HR systems emerged. Researchers and practitioners alike began to recognize the impact of aligning those systems with the company's larger strategy implementation effort – and assessing the quality of that fit. Indeed, although many kinds of HR models are in use today, we can think of them as representing the following evolution of human resources as a strategic asset:

The personnel perspective: The firm hires and pays people but doesn't focus on hiring the very best or developing exceptional employees.

The compensation perspective: The firm uses bonuses, incentive pay, and meaningful distinctions in pay to reward high and low performers.

This is a first step toward relying on people as a source of competitive advantage, but it doesn't fully exploit the benefits of HR as a strategic asset.

The alignment perspective: Senior managers see employees as strategic assets, but they don't invest in overhauling HR's capabilities. Therefore, the HR system can't leverage the management's perspective.

The high-performance perspective: HR and other executives view HR as a system embedded within the larger system of the firm's strategy implementation. The firm manages and measures the relationship between these two systems and firm performance.

We're living in a time when a new economic paradigm – characterized by speed, innovation, short cycle times, quality, and customer satisfaction – is highlighting the importance of intangible assets, such as brand recognition, knowledge, innovation, and particularly human capital. This new paradigm can mark the beginning of a golden age for HR. Yet even while human resource professionals and senior line managers grasp this potential, many of them don't know how to take the first steps toward realizing it.

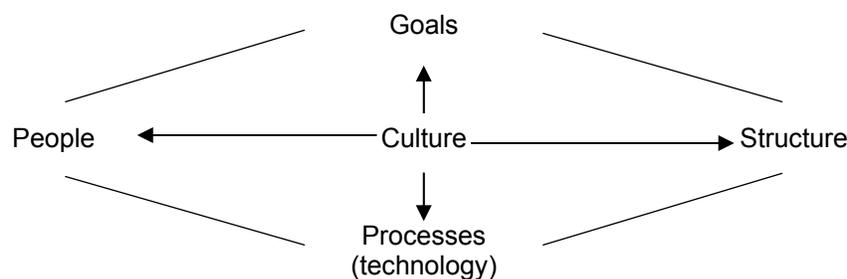
In our view, the most potent action HR managers can take to ensure their strategic contribution is to develop a measurement system that convincingly showcases HR's impact on business performance. To design such a measurement system, HR managers must adopt a dramatically different perspective, one that focuses on how human resources can play a central role in *implementing* the firm's strategy. With a properly developed strategic HR architecture, managers throughout the firm can understand exactly *how people create value* and *how to measure the value-creation process*.

1. Organization and Management

An organization is a group of people which works in the name of achieving common goals. Any institution or enterprise may be an organization. The organization model has been indicated in Figure 1.1. Below you will find a brief overview of the components of the model.

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 1.1. 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;

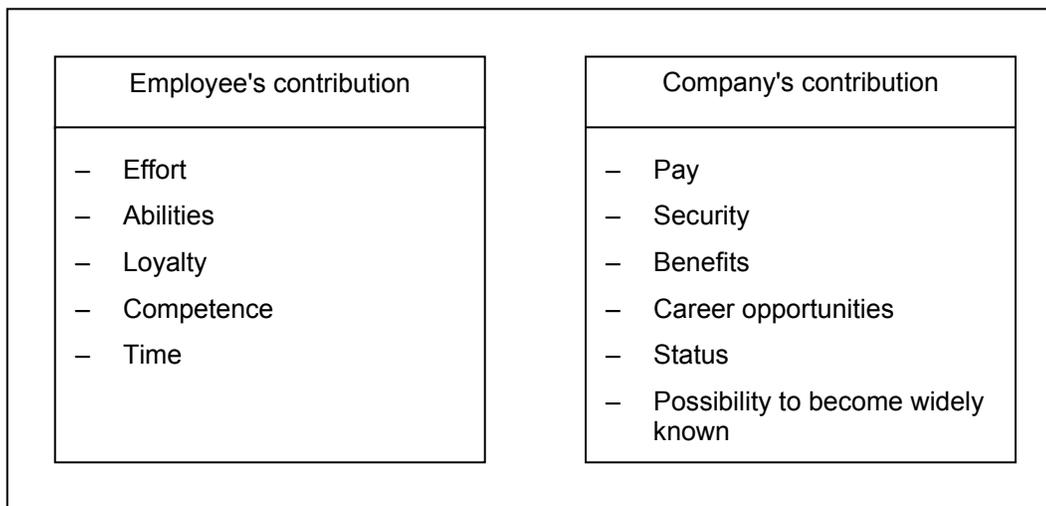
5. Accounting activities, e.g. providing financial information;
6. Managerial activities, e.g. planning and organizing.

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 Figure 1.2.

An organization expects primarily the following from an employee:

- high efficiency of work;
- creativeness and renewal proposals;
- loyalty.

Figure 1.2. Relationship between an Employee and an Organization



In industry competitiveness is achieved largely owing to technological development, qualified labor, existence of expertise and effective use of such possibilities.

The level of competence of an employee determines the productivity of work and thus the competitiveness of the entire organization. Labor-related productivity is affected directly by the employee's knowledge, skills, experience, motivation and the desire to apply them in a team. Hence the need to evaluate the competencies in order to determine the required and existing level of skills and knowledge.

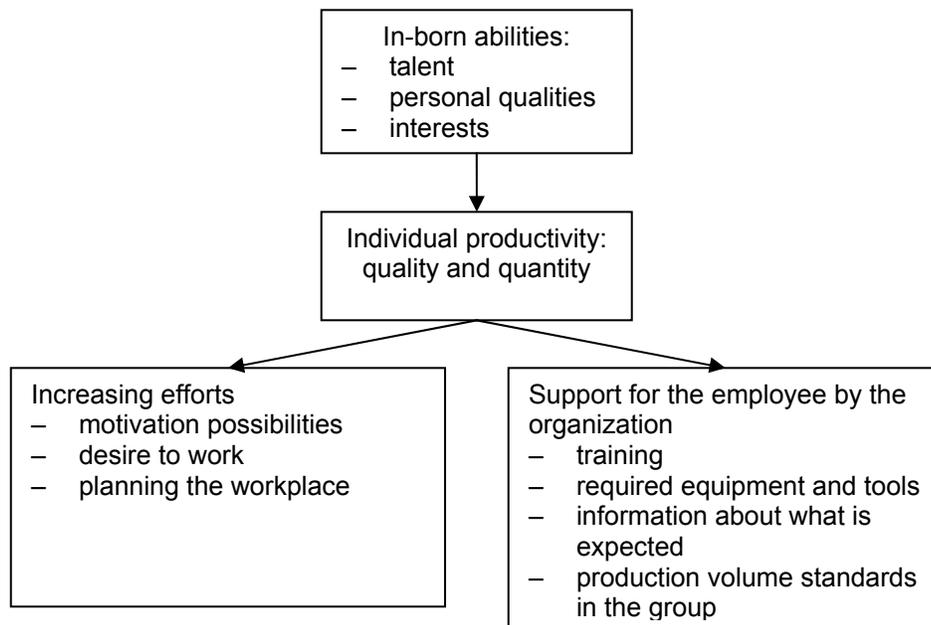
An effectively working organization must be well-organized and its employees must be qualified and motivated. It must be able to quickly adapt to the changing environment (flexible and self-learning) and be able to solve intra-organization conflicts (a smooth process of constant improvement).

The high efficiency of work achieved by each employee allows the organization to lower the cost price. The efficiency of the work of an employee depends on three factors:

1. The in-born ability of the employee to do the work;
2. The size of the efforts the employee is prepared to make;
3. Support given to the employee by the organization.

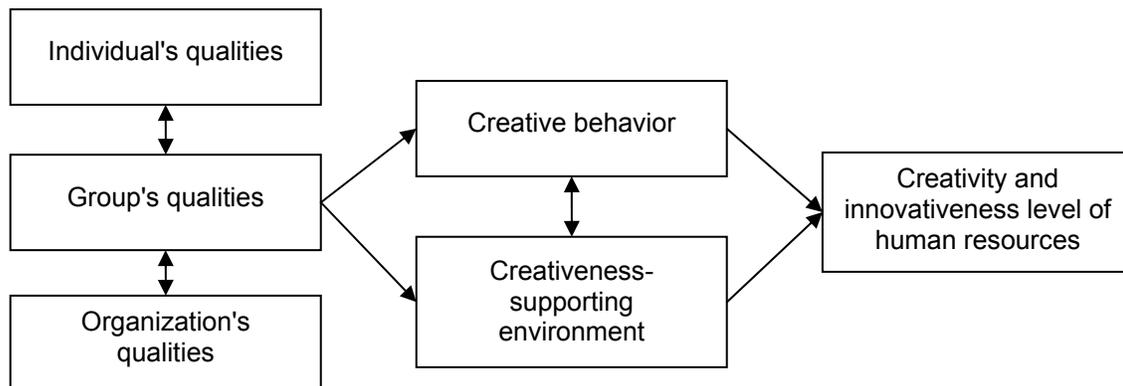
The connection between these factors is indicated in Figure 1.3.

Figure 1.3. Connections between Factors Affecting the Effectiveness of the Work of an Employee



Expectations regarding creativity and innovativeness are related to constantly changing environmental conditions, consumer expectations and ever-increasing competition. Proposals for better organization and direct performance of work should come not only from the management or the development department, but all employees of the company. However, this means that under the leadership of the management all employees of the company develop their creativity and competencies. Innovation in a company is primarily born in the cooperation between an individual and a group (see Figure 1.4).

Figure 1.4. Creativity and Innovativeness of Human Resources



We look at management as targeted guidance of the activities and behavior of people and melting it into a well-functioning whole in order to achieve the objectives of the organization and satisfy the needs of its members.

Four activities are indicated the most frequently as management functions: planning, organization, leadership and inspection. As depicted in Figure 1.5, these activities have to ensure such management of the organization's resources that the objectives are achieved in the most effective way. Resources are divided into human resources, funds, physical funds and information resources.

Planning is related to goal-setting, policymaking and establishment of procedures.

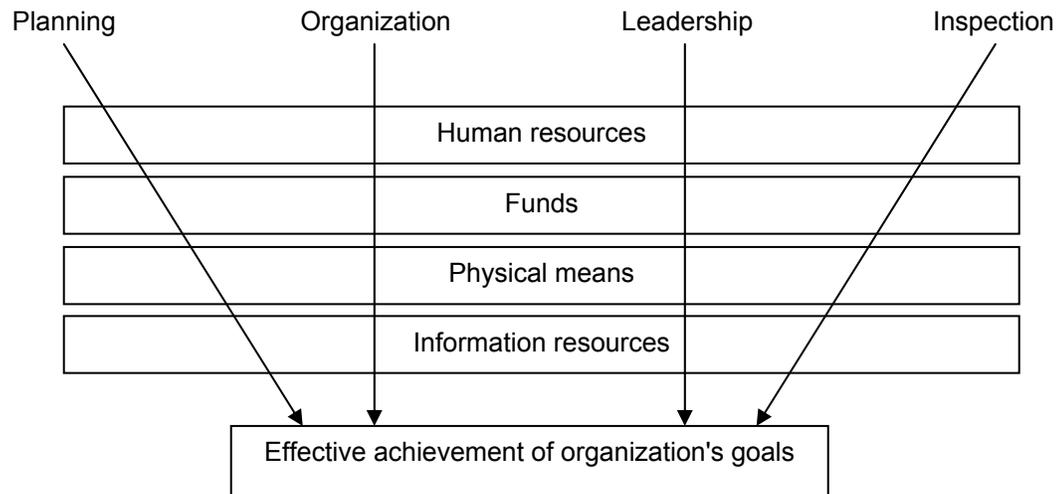
Organization means grouping tasks, planning workplaces and giving the right to make a decision. The result is the organization structure.

Leadership means motivation of employees so they make efforts in cooperation for the purpose of achieving the organization's goals.

Inspection means establishment of standards, evaluation of results pursuant to the established standards and correction of activities non-compliant with the organization's goals.

When production and marketing became more complicated, people with their knowledge and skills started playing a more important role and staffing, which had been viewed as a part of organization, was pointed out as a separate function.

Figure 1.5. Management Functions



2. Human Resources Development Environment

The surrounding environment has a direct effect on the successfulness of the organization and therefore changes outside the organization bring about the need to implement changes within the organization as well.

Only the organization that is at least a step ahead of the other will achieve a competitive advantage. Therefore, changes inside the organization anticipating changes in the environment pose one of the major challenges in the 21st century.

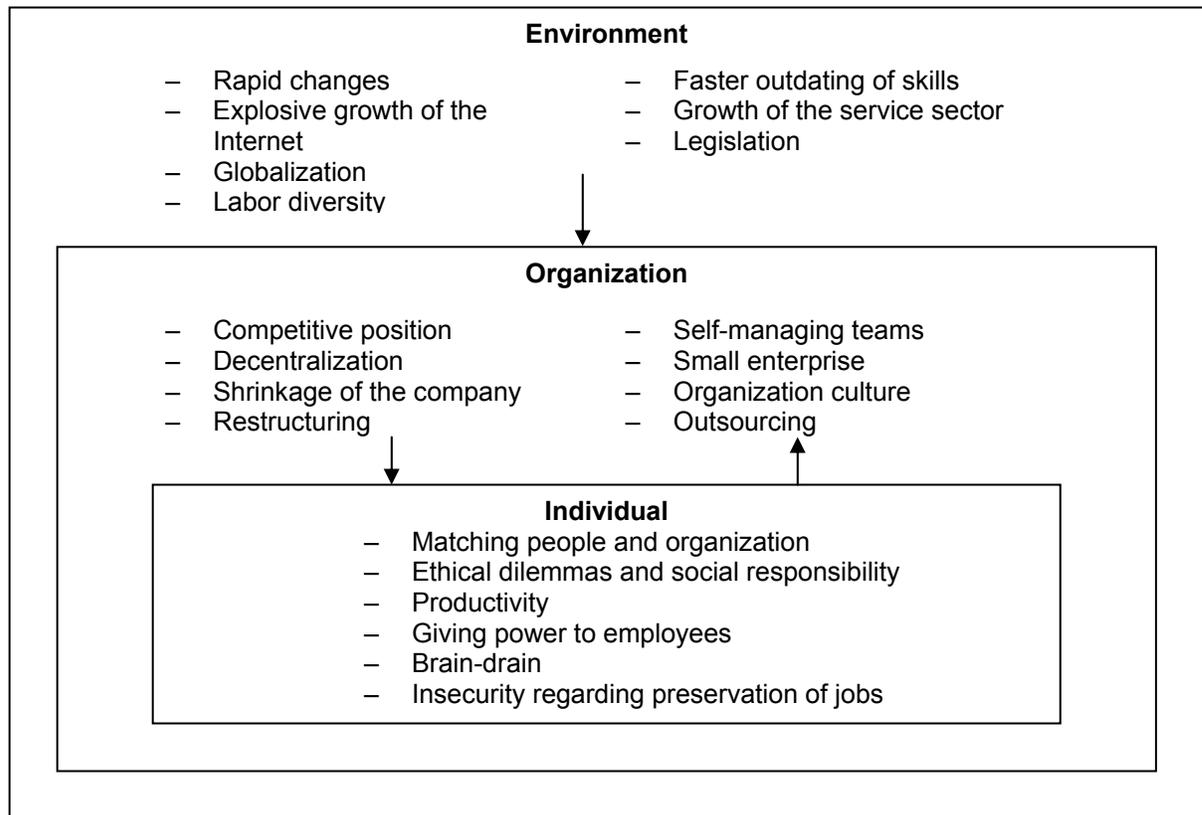
Since organizational changes can be successfully implemented only if all the people working in the organization actively support them, it is important that the executive be able to communicate the need for the changes to the employees and create an organization culture that supports changes.

Figure 2.1 shows organizations' main challenges arising from the environment.

Rapid changes in the environment surrounding the organization have made the saying "The only constant is change" a reality. In the 1950s Kurt Lewin introduced the three-stage model of implementing changes, which consisted of the following steps: unfreezing, changing and re-freezing. By the end of the century successful companies had abandoned re-freezing and reiterated to their employees that changes will never stop. There is only lifelong learning and consolidation of useful skills and manners of behavior through procedures and standards.

A sudden decrease of the product life cycle and the need to achieve results with smaller costs than before has brought about a growth in the intensity of the work for all employees. Due to rapid changes the skills acquired by employees *become useless faster than before*, which makes them acquire new skills while working.

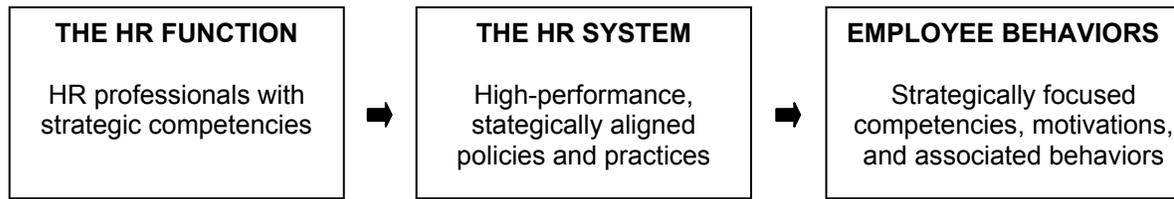
Figure 2.1. Main Challenges Arising from the Environment to Human Resources Development



2.1. Human Resources Management (HRM)

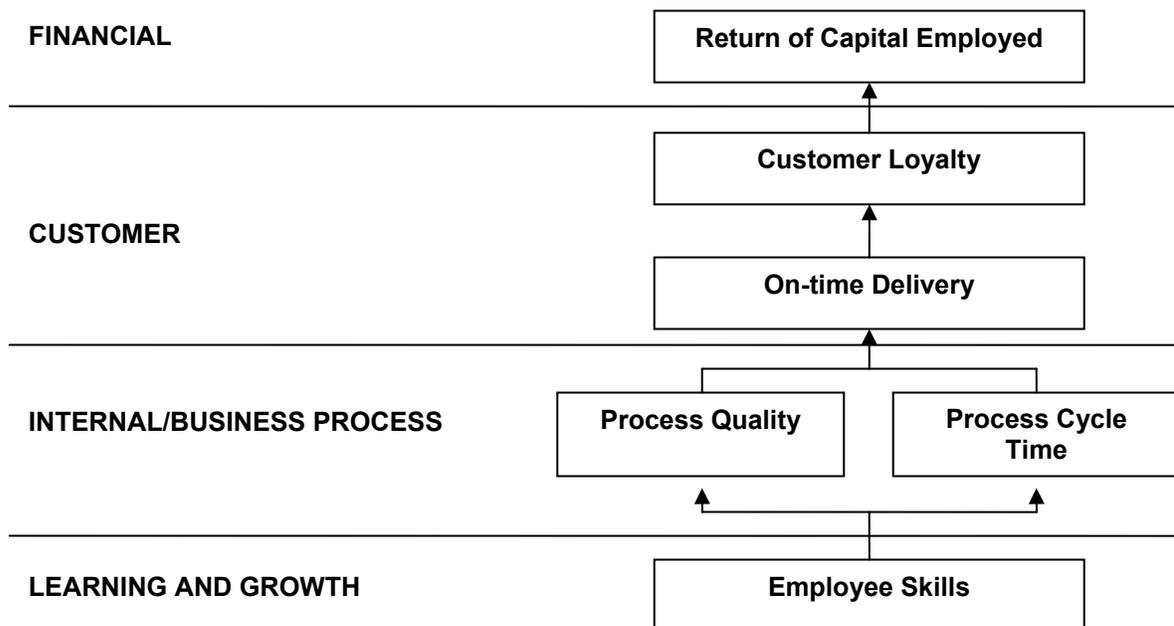
The foundation of a value-creating HR strategy is a management infrastructure that understands and can implement the firm's strategy. Normally the professionals in the HR function would be expected to lead this effort. This implies a departure from the traditional functional orientation of many HR managers and a wider understanding of the strategic role that HR might play in the firm. For example, Mark Huselid, Susan Jackson, and Randall Schuler point out that human resources management (HRM) effectiveness has two essential dimensions. The first, *technical HRM*, includes the delivery of HR basics such as recruiting, compensation, and benefits. The second, *strategic HRM*, involves delivering those services in a way that directly supports the implementation of the firm's strategy (see Figure 2.2.). Huselid and his colleagues found that most HR managers were very proficient in the delivery of traditional or technical HRM activities, but much less so in delivering strategic HRM capabilities (see Figure 2.2.).

Figure 2.2. HR’s Strategic Architecture



Every member of the organization must know how to support the firm’s success. Also, these questions help the organizations to decide how to allocate resources so as to breathe life into value-creation (see Figure 2.3.).

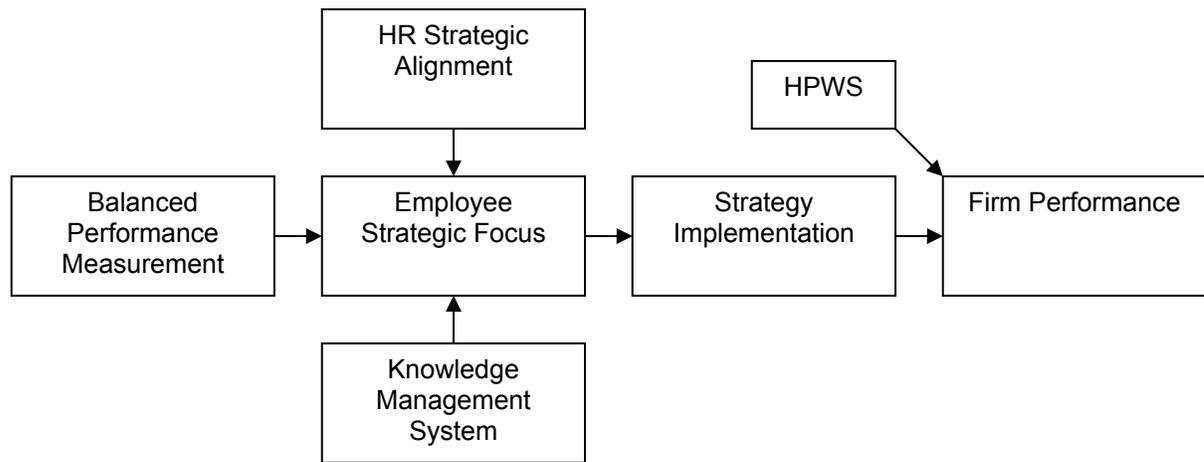
Figure 2.3. A Simple Illustration of Value Creation



Source: Robert S. Kaplan and David P. Norton, *The Balanced Scorecard* (Boston, MA: Harvard Business School Press, 1996), 31.

Once a firm clarifies its strategy, human resource professionals have to build a clear business case for why and how HR can support that strategy. The human resources and strategy implementation process is presented in Figure 2.4.

Figure 2.4. HR and Strategy Implementation



2.2. Ensuring Competence in the Organization

Key Definitions

- I** **Profession** means an area of activity based on similar duties and activities.
Vocation means a set of knowledge, skills, values and attitudes necessary for performance of duties, which is learned through studying and working in the respective profession.
Professional qualification means the level of competence required in the given profession, which is recognized based on regulated, historical or internationally evolved requirements. Having the professional qualification allows one to act in the given profession, unless otherwise provided by legislation.
Workplace is a part of a room where an employee performs his or her duties. The workplace contains equipment, jigs, tools, accessories and production inventory required for work and ensures the required work conditions.
- II** **Professional standard** is a document approved by a professional council, which describes the work and defines the competencies necessary for performing it at a specific professional level.
Competency is a set of knowledge, skills, experience, abilities, attitudes and rules of behavior, which has been described in the professional standard and the compliance of which is evaluated.
 Competence refers to an individual's knowledge, skills, abilities, or personality characteristics that directly influence his or her job performance.

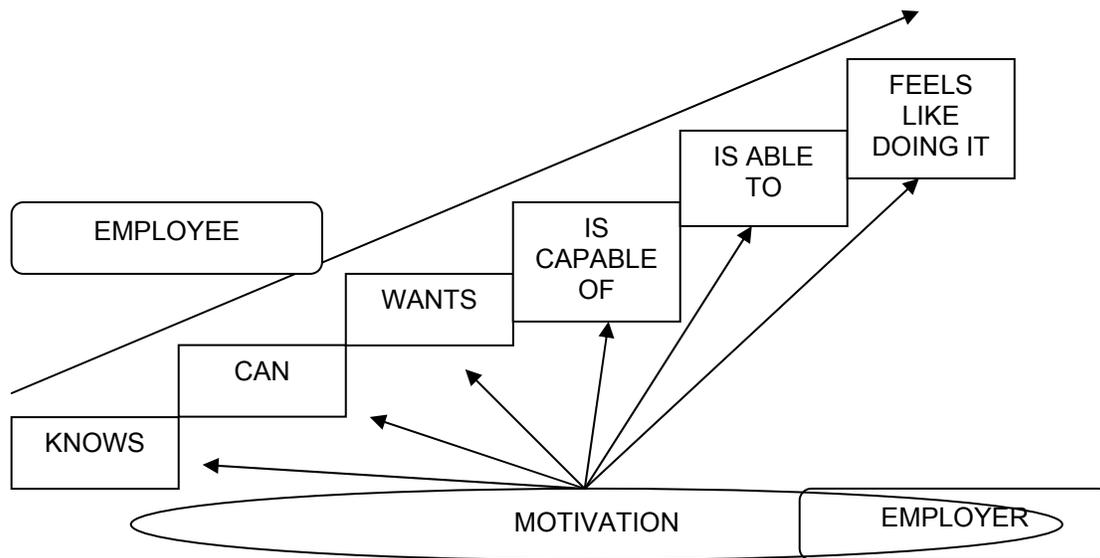
The application environment of human resources development is business. Business controls resources (energy, raw material, equipment, people, information, etc.). Through production activities resources are coupled with purposeful work, whereby after achieving the desired

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 labor quality (in the meaning of the resource) is evaluated based on the professional standard. Application of the social resource is indicated in Figure 2.5. The measure of the social (human) resource skills, knowledge and personal qualities is the professional standard.

Figure 2.5. Social Resource



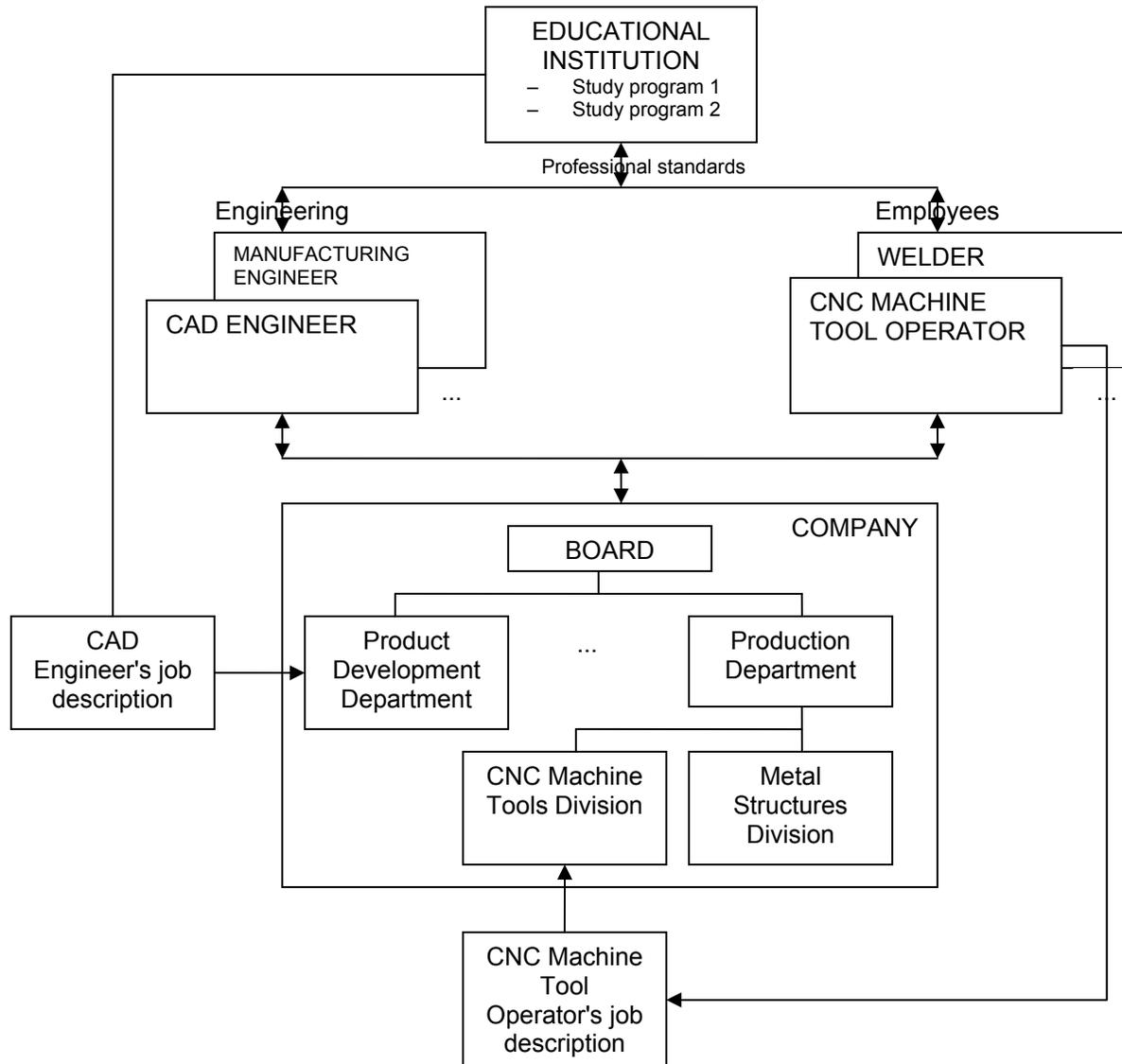
The professional standard is a document which sets out the requirements for knowledge, skills, experience, values and personal qualities.

The professional standard is:

- for establishing the qualification requirements for employees;
- 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.

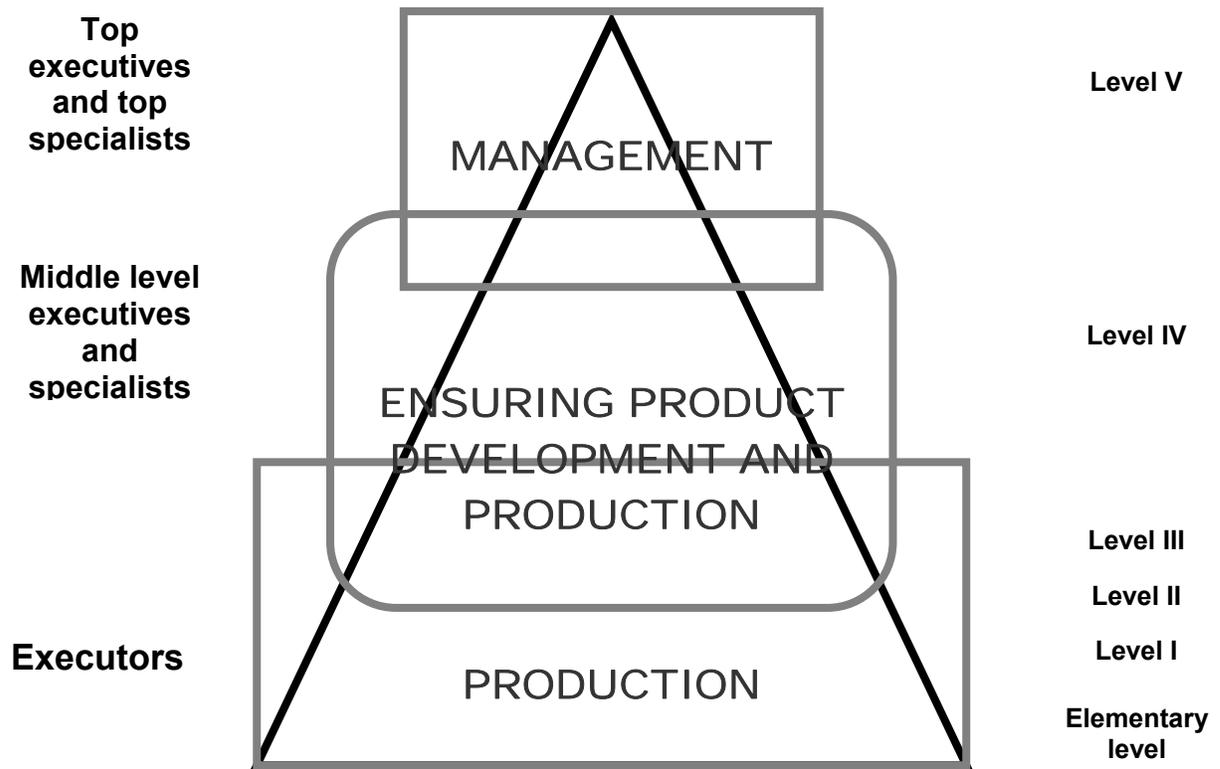
The professional standard is the central document which, on the one hand, is connected to the study program of education institutions and, on the other hand, the position of the company and requirements established thereto. The connection of the professional standard with the study and implementation process has been illustrated in Figure 2.6.

Figure 2.6. Connection of the Professional Standard with the Study and Implementation Process



The professional qualification system has five professional qualification levels, which correlate with the management and implementation levels of the company. The management and implementation levels of the company have been shown in Figure 2.7, which also indicates the professional qualification levels in the business environment.

Figure 2.7. Company Management Levels and Professional Qualification Levels



Professional qualification levels:

- Elementary level: No professional knowledge or skills requirement; routine, prescribed employment duties; the duty guides the employee; indirect responsibility;
- Level I: professional knowledge and skills have been obtained through training or working; work is guided by someone; able to manage with defined employment duties; responsibility within one's employment duties;
- Level II: professional knowledge and skills are accompanied by experience; able to manage with various employment duties; able to cooperate in a team; responsible for performance of employment duties;
- Level III: professional ability; teaching professional knowledge and skills; able to manage with complicated and changing employment duties; ready to take responsibility for division of resources and other people's work;
- Level IV: professional knowledge and skills are accompanied by management knowledge, skills and attitudes; able to manage with many complicated and changing employment duties in alternating situations; responsible for division of resources and other people's work;
- Level V: knowledge of the theoretical bases of economics; masters various manners of procedure in order to manage with employment duties in alternating and unexpected situations; high independence, responsible for analyzing, diagnosing and making and implementing decisions.

3. Company-Centered Skill/Knowledge Mapping and Analysis

The 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 goals.

Structural units comprise employees. Employees work on various positions established for the purpose of achievement of the aforementioned objectives.

The list of positions has been fixed during a certain period of time, but new positions may be added to it and it is possible to remove some positions from the list of the jobs during a longer period of time.

Figure 3.1 gives an overview of the current central relevant job titles in Estonia in the machine, metal and engineering industries. In various countries the essence of the machine, metal and engineering industries, the fields of activity of companies, the processes used therein and the structures of the positions are different and therefore it is not wise to unify the register of jobs.

An administrator must be able to enter data in and delete data from the register of job titles.

If there are any professional standards, the register of job titles uses job titles corresponding to the professional standard.

Figure 3.1. Register of Job Titles

1. Management	Member of the Board 1.2 Executive Director 1.3 Marketing Manager 1.4 Financial Director/Manager 1.5 Production Director 1.6 Development Manager 1.7 Sales Manager 1.8 Quality Manager 1.9 Purchasing Manager 1.10 Accounts Manager 1.11 Administrative Assistant
2. Engineering staff	2.1 Lead Mechanical Designer 2.2 Process Control Manager 2.3 Workshop Manager 2.4 Production Manager 2.5 Mechanical Designer 2.6 Manufacturing Engineer 2.7 Project Manager 2.8 Foreman

	2.9 Storekeeper 2.10 Mechanical Engineer 2.11 Power Engineer 2.12 Bookkeeper 2.13 Inspector in Occupational Health and Safety
3. Workers	3.1 Machine Tool Operator 3.2 CNC Machine Tool Operator 3.3 Milling Machine Operator 3.4 Grinding Machine Operator 3.5 Boring Machine Operator 3.6 Sheet Metal Machining Tool Operator 3.7 Mechatronic 3.8 Welder 3.9 Locksmith 3.10 EDM Operator 3.11 Tooling Specialist 3.12 Assembler 3.13 Painter 3.14 Metal Polisher 3.15 Heat Treatment Worker 3.16 Metal Casting Worker 3.17 Galvanizing Worker 3.18 Hot Galvanizing Worker 3.19 Slinging Worker 3.20 Crane & Hoisting Equipment Operator

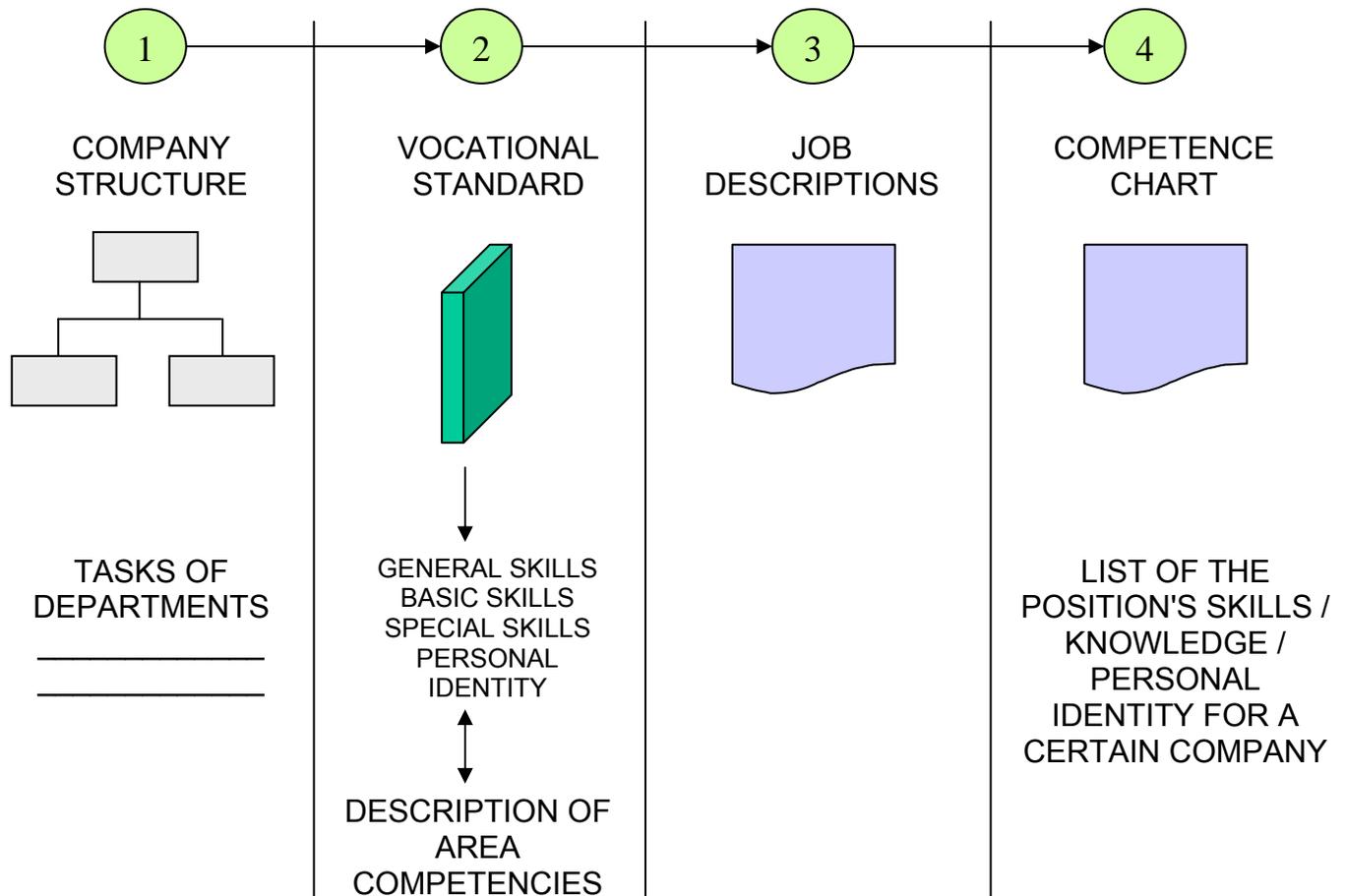
Jobs serve as the basis for sorting the entries of a database covering the employees.

The second key feature is the level of qualification:

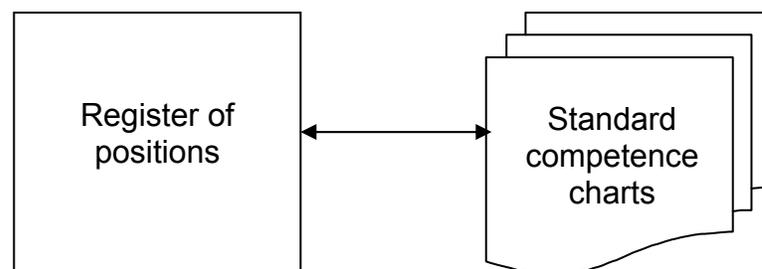
- 0 – the level has been fixed;
- 1, 2, 3 – the professional qualification levels of the employee;
- 4, 5 – the professional qualification levels of the engineers/executives.

The competence chart means a document describing the job-centered or person-centered required knowledge, skills and personal identity (competence). The process of developing competence charts has been indicated in Figure 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 specific company. Competence charts are drawn up based on the employees or jobs of the company. Standard competence charts have been developed so companies have it easier to draw up their competence charts.

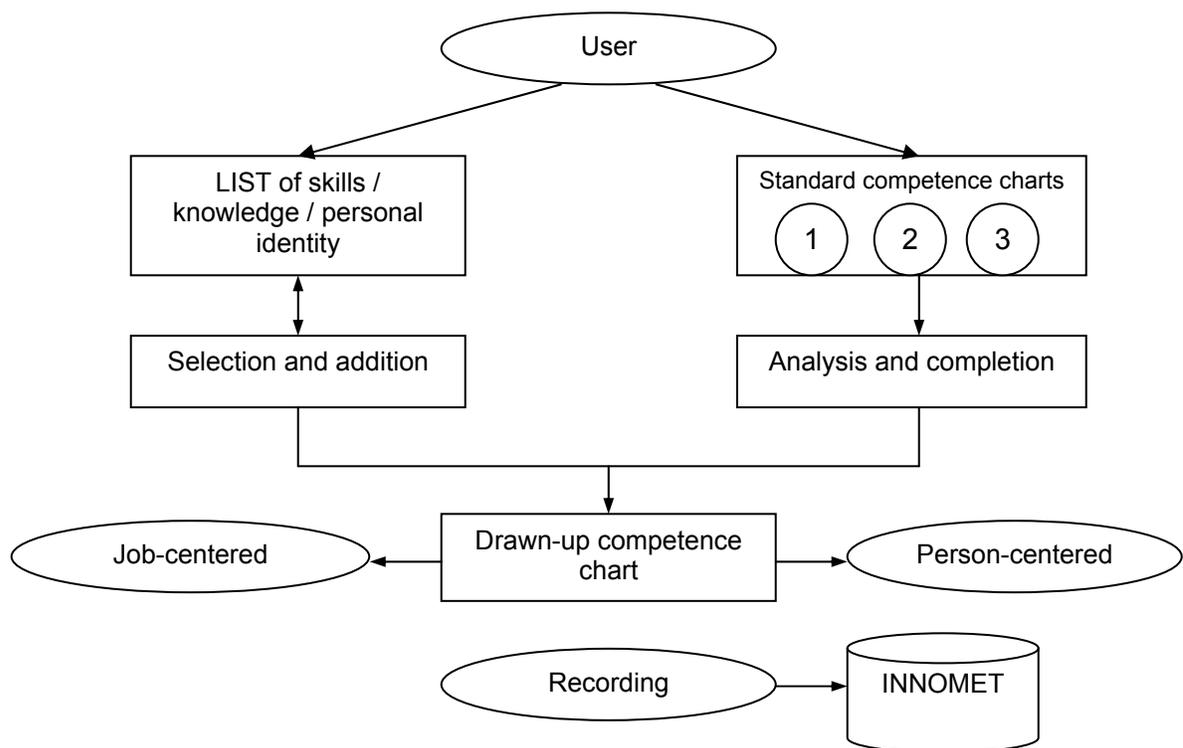


In the INNOMET system you can directly use the standard competence charts or draw up individual competence charts with regard to a specific job or person in the company (see Figure 3.3).

The standard competence charts have, like jobs, been divided into three groups:

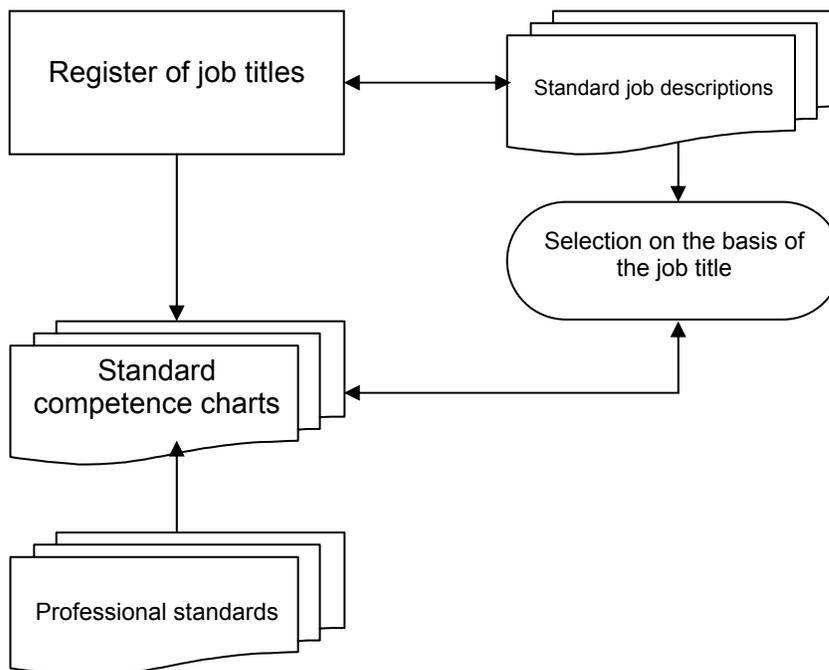
- 1 – management;
- 2 – engineers, middle level executives;
- 3 – workers.

Figure 3.3. Principles of Drawing Up Competence charts



The cohesion of job-centered documents has been given in Figure 3.4.

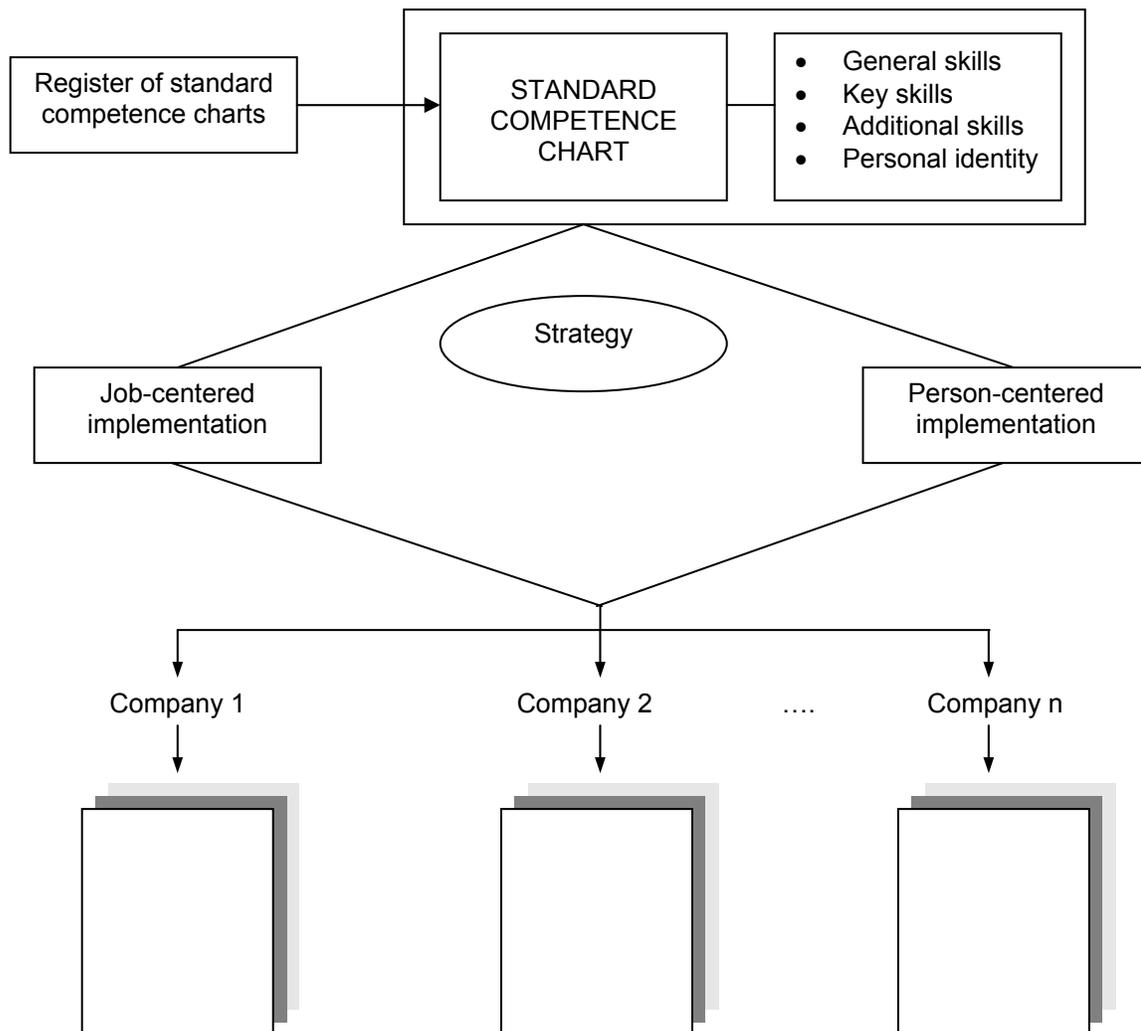
Figure 3.4. Cohesion of job-centered documents



The sample professional standard of the CNC Machine Tool Operator has been given in Appendix 1. The sample job description of the CNC Machine Tool Operator has been given in Appendix 2 and the competence chart of the CNC Machine Tool Operator has been given in Appendix 3.

The ideology of competence charts in the INNOMET system is indicated by Figure 3.5.

Figure 3.5. Ideology of competence charts in the INNOMET system



Filled competence charts of a specific company can be viewed by:

- 1) the system administrator;
- 2) an authorized employee of the company (authorization given within the company);
- 3) (an) employee(s) of (an)other company (companies), provided that the company has permitted it.

4. Compilation of Competence Charts

4.1. 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 Figure 4.1):

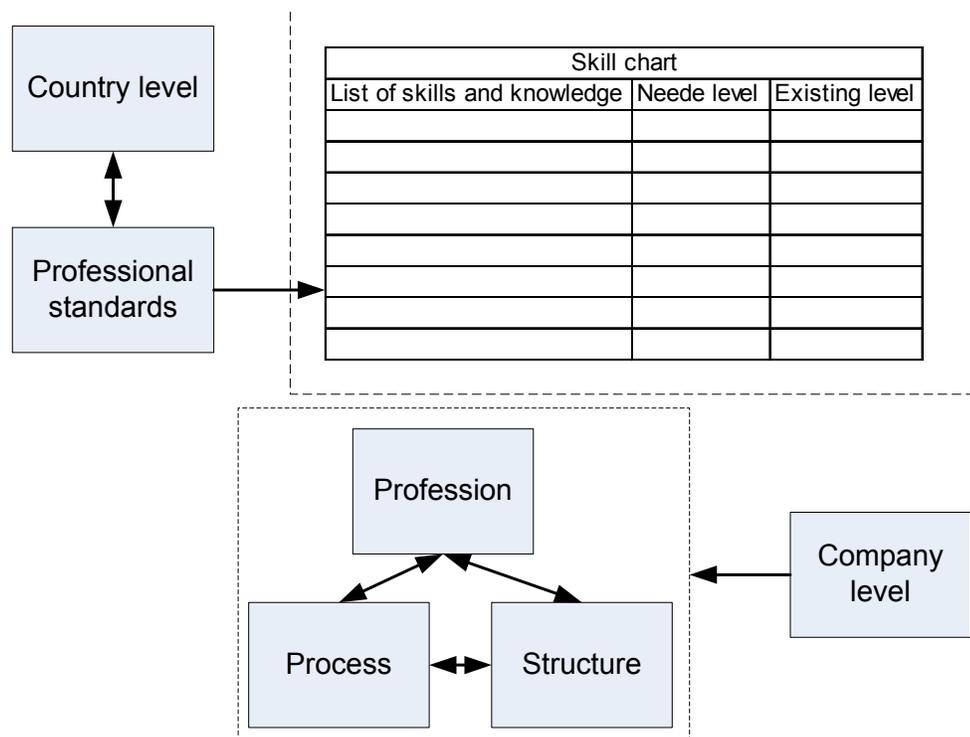
- a) list of competencies (description of skills and knowledge);
- b) results of estimation of needed levels of competencies;
- c) results of estimation of existing levels of competencies.

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

A sample job description and a sample professional standard of a CNC Machine Tool Operator have been set out in the Appendices 1 and 2.

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.

Figure 4.1. Compilation of Competence Chart: Description of the List of Skills and Knowledge



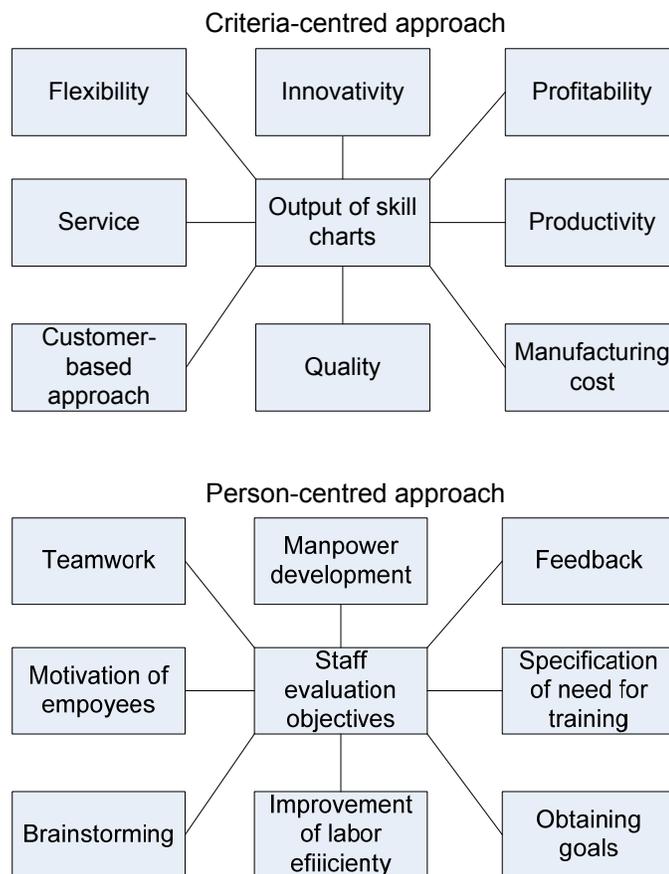
A list of competencies should, first and foremost, correspond to the tasks and duties of the respective job (e.g. CNC Machine Tool Operator) for the purpose of fulfilment of the strategic duties of the organisation as well as high-quality and timely execution of specific orders.

There are two main approaches to compilation of the list of skills and knowledge:

- 1) the competencies and personal qualities must ensure fulfilment of the company's strategic duties, which have different weight in different periods of time;
- 2) the personal qualities and competencies of the employees must comply with the preferences of personal criteria, which, in turn, should help the company upon achieving the established objectives and increasing the company's competitiveness.

The list of the criteria of both approaches has been given in Figure 4.2.

Figure 4.2. Two Approaches



Upon compilation of the list of competencies, different fields of competence (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. 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, which 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.

4.2. Estimation of Needed and Existing Levels of Competence

Estimation is the 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.

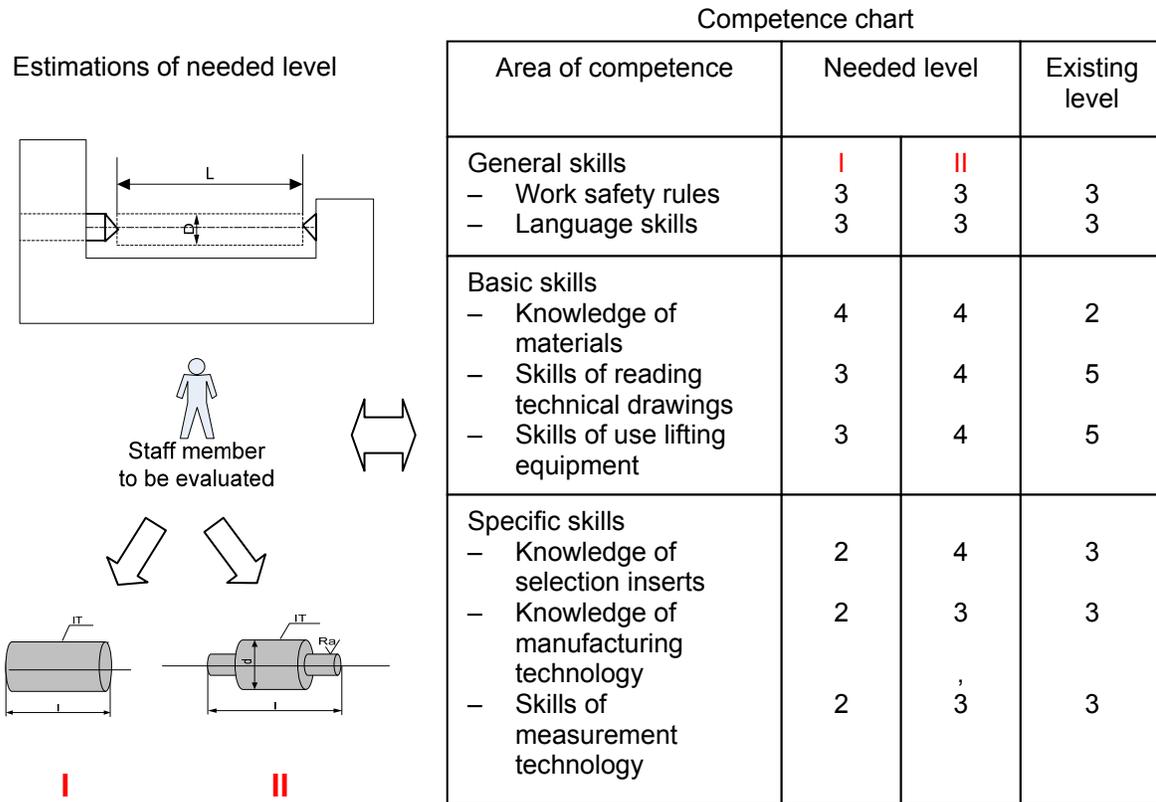
The basis for the evaluations is:

- 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.

Figure 4.3. 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.

Figure 4.4. Competence Chart Composition



Some expert assessments of the needed level regarding various jobs have been given in Appendix 4.

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, which have to be motivated.

From the point of view of clear limitation of the relationship between the employer and the employee it is 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 requirements for the needed level should ideally comply with the existing knowledge and skills of the employee (See Figure 4.4).

The main objectives of evaluation of the existing level of personnel are:

- to identify the specific level of each employee (or sometimes also the so-called average level of the given job in the company);
- to identify the 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 the existing resources into account and use them skilfully.

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.

Smart leaders try to prevent the following attitudes from emerging among employees:

- "I never know what my boss wants me to do!"
- "Why didn't they tell me before that they're not pleased with my work?"
- "My boss underestimates me, because he can't stand me!"

This can be avoided if the expectations are defined precisely, feedback is given throughout the year and all the estimated can be convinced of the correctness of the evaluation system.

Sub-types of personnel evaluation include the following:

- evaluation of candidates upon selection of the personnel;
- evaluation of the work performance of people;
- evaluation of the potential of employees.

It is wise to conduct the planned evaluation of the work of the personnel by way of correction of pay or promotion so that employees would perceive the connection between these events.

Methods of personnel evaluation

The methods of personnel evaluation have been indicated in Figure 4.5. Evaluation methods can be divided into behaviour-oriented and goal-oriented methods based on what is evaluated. Most of the methods described in Figure 4.5 are behaviour-oriented. The goal-oriented evaluation method is management through objectives.

Figure 4.5. Methods of Personnel Evaluation

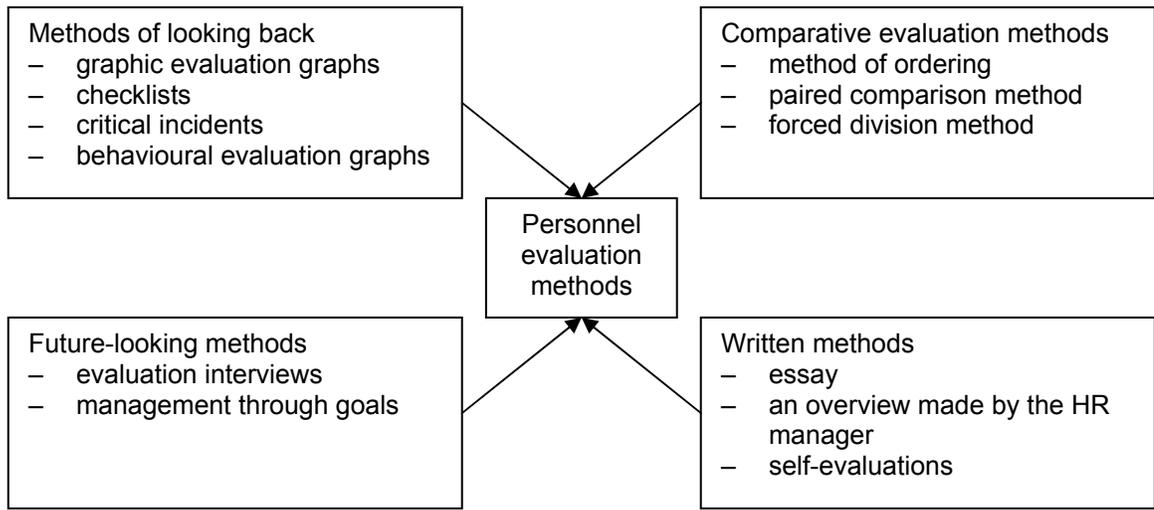


Figure 4.6. Assessment Chain (from target to appraisal)

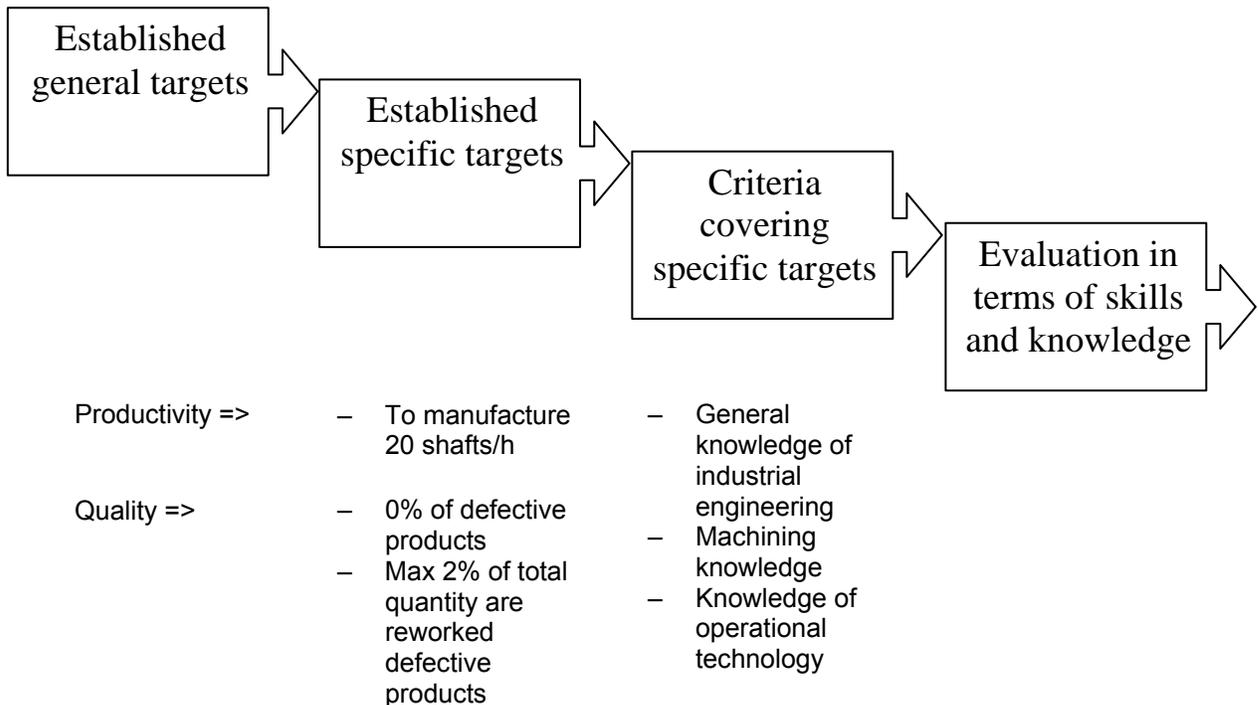


Figure 4.7

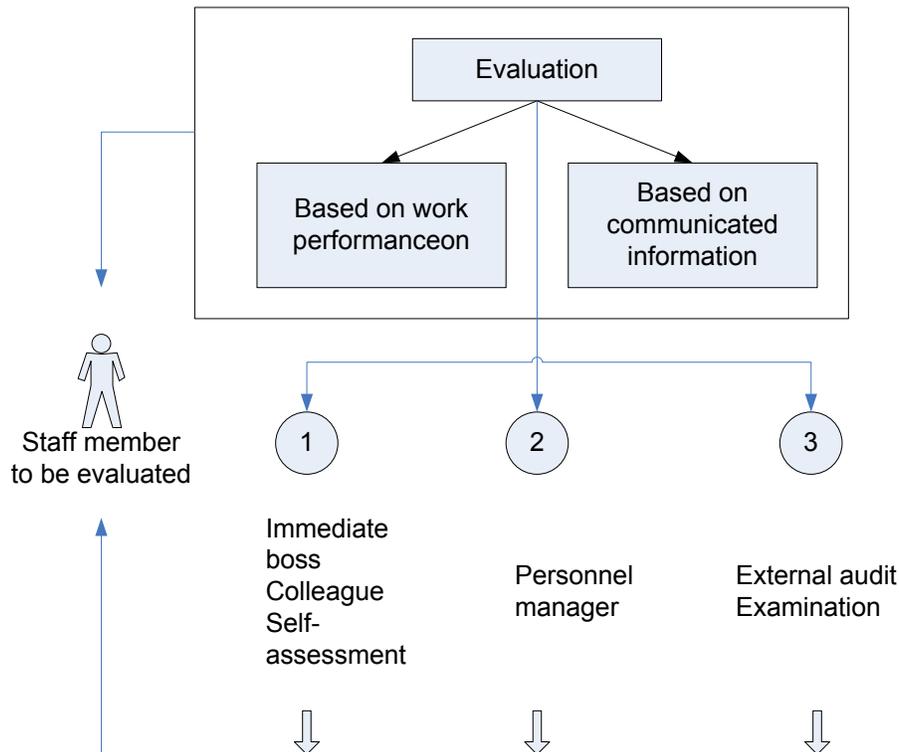


Figure 4.8. Evaluation of the Existing Level: Taxonomy / Expert Assessment

Evaluation	Description of taxonomy
0	I no nothing of the matter / I 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 (can surprise) – nothing can surprise

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 firm. 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. Kaplan and Norton have illustrated the value creation process in a very simple way (see Figure 2.3.).

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.

Appendix 1. Professional Standard of CNC Machine Tool Operator

PROFESSIONAL STANDARD

PROFESSIONAL TITLE: Computer Numerical Control (CNC) Machine Tool Operator

Professional level	Professional title	Specialisation	Title on the professional certificate
I	CNC Machine Tool Operator	None	CNC Machine Tool Operator Professional level I
II	CNC Machine Tool Operator-Setter	None	CNC Machine Tool Operator-Setter - Professional level II
III	CNC Machine Tool Operator-Foreman	None	CNC Machine Tool Operator-Setter – Professional level III
IV			
V			

In the Estonian professional system level I is the lowest and level V is the highest professional level. Not all professions have all levels. The definitions of the professional levels have been set out in section C.4 of the professional standard.

Part A. DESCRIPTION OF WORK

A.1 FIELDS OF WORK and JOB DESCRIPTIONS

CNC machine tools are used mainly for making products which have a complicated configuration and require great accuracy, by way of series as well as individual manufacture. CNC machine tool operators or manufacturing organisers are employed mainly in mechanical engineering and instrumentation industry. The most common job titles are as follows:

Professional level I	CNC Machine Tool Operator
Professional level II	CNC Machine Tool Operator-Setter
Professional level III	CNC Machine Tool Operator-Foreman

A.2 PURPOSE AND CONTENT OF WORK

CNC Machine Tool Operator makes products pursuant to working drawings with high quality and effectively.

Professional level I	The CNC Machine Tool Operator of professional level I makes products pursuant to prescribed working drawings. He performs simpler operations: turning; drilling; 2.5-coordinate milling. The employee of professional level I designs control programs for simpler details and forms or uses control programs which have been previously inserted in the control system of the machine tool. As a rule, the employee works on pre-set machine tools or sets the machine tool based on prior instructions and ensures the quality of the processed detail using inspection and measuring instruments.
Professional level II	The CNC Machine Tool Operator of professional level II makes technologically more complicated products (which involve geometric peculiarities and strict

	requirements regarding the accuracy of measures, the mutual position of the surfaces as well as the surface roughness). The employee operates various CNC machine tools (also service centres and flexi-modules which have 4 or more coordinates) and knows their control systems thoroughly. He sets machine tools and designs control programs for performing processing operations. He knows how to use jigs and is fluent in tool management.
Professional level III	As a rule, the CNC Machine Tool Operator-Foreman of professional level III is the head of the CNC machine tool division. He plans manufacturing in the division and ensures high quality and timely manufacturing of details with minimum resources. The duties of the foreman include organisation of tool management in the division, knowledge of using measuring and inspection instruments and maintenance thereof.

A.3 EMPLOYMENT DUTIES

Professional level I

- 1) Operating the machine tool
- 2) Setting the machine tool
- 3) Creation of the operation technology
- 4) Designing control programs (for simpler details)
- 5) Teamwork

Professional level II

- 1) Operating the machine tool
- 2) Setting the machine tool (selection and pre-setting of cutting instruments)
- 3) Creation of the operation technology
- 4) Designing control programs (CAD/CAM fluency)
- 5) Teamwork

Professional level III

- 1) Setting and operating machine tools
- 2) Knowledge and use of processing technologies, machine tools and their control systems
- 3) Planning and organisation of manufacturing
- 4) Organisation of tool management in the division
- 5) Organisation of teamwork

A.4 WORKING ENVIRONMENT AND SPECIFICS

The work schedule may be busy and tight at times. Working environment? Noise?

A.5 TOOLS

Machine tool, cutting instruments, auxiliary instruments, jigs, measuring instruments. The CNC system and software. The CAD/CAM system.

A.6 ABILITIES AND PREFERENCES

Ability to think logically. Geometrical imagination. Mathematical thinking. Ability to concentrate.

A.7 PROFESSIONAL EDUCATION

One can obtain the qualification of the CNC Machine Tool Operator of **professional level I** in a vocational education institution or in the workplace. The recommended level of education is secondary vocational education.

Acquisition of the qualification of the CNC Machine Tool Operator-Setter of **professional level II** requires at least two years of work experience. The recommended level of education is secondary vocational education.

The profession of the CNC Machine Tool Operator-Foreman of **professional level III** requires higher vocational education or at least 5 years of practical experience in the workplace.

PART B. PROFESSIONAL REQUIREMENTS

B.1 QUALIFICATIONS

Professional level I

Employment duties at professional level II

- 1) Operating the machine tool
- 2) Setting the machine tool
- 3) Creation of the operation technology
- 4) Designing control programs
- 5) Teamwork

Qualification 1. Operating the machine tool

Activities	Skills	Knowledge of
1. Processes and makes details using the machine tool	a) Skill of operating the CNC machine tool b) Workplace organisation skill c) Knowledge of the technical terminology in English	a) mechanical engineering materials b) mechanical engineering technology c) metal cutting and CNC machine tools d) control systems e) occupational health and safety
2. Maintains the machine tool		
3. Uses the control system of the machine tool		

Qualification 2. Setting the machine tool

Activities	Skills	Knowledge of
1. Places the processed detail in the machine tool	a) Skill of basing the processed detail and using jigs b) Skill of resolving dimension chains c) skill of choosing cutting and auxiliary instruments d) Skill of using the sub-programs (macros) of the machine tool	a) basing b) technological dimension chains c) coordination systems d) use of cutting and auxiliary instruments e) purpose and possibilities of the sub-programs
2. Places pre-set tools in the tool holder		
3. Sets zero points		

Qualification 3. Creation of the operation technology

Activities	Skills	Knowledge of
1. Accesses the working drawing	a) Skill of reading the working drawing b) Skill of designating the cutting modes c) Skill of achieving the required quality parameters d) Skill of trajectory designing of the cutting instruments (2-2.5-coordinate processing)	a) the coordination systems of the machine tool and processed detail b) designing the operation technology c) possibilities of ensuring quality
2. Requests or designs the processing technology		
3. Designates the moving trajectories of the cutting instruments		
4. Solves technological issues with the foreman or technician		

Qualification 4. Designing control programs		
Activities	Skills	Knowledge of
1. Designs simpler control programs	a) Computer skills b) Skill of manual programming of the control system of the machine tool c) Skill of manual programming for the purpose of designing control programs for making technologically simpler details d) Skill of automated designing of control programs	a) ISO 7-bit code b) position control system c) contour control system d) preparatory functions e) auxiliary functions f) control system and programming specifics g) CAD/CAM systems
2. Designs the control program simulation in the machine tool		
3. Is convinced of the correctness of the control program		
4. Makes the detail pursuant to the control program		

Qualification 5. Teamwork		
Activities	Skills	Knowledge of
1. Conscientious regarding employment duties	a) Performing employment duties by the prescribed time b) Foreign language skills	a) the production technique b) professional duties and liability c) the economy
2. Sense of duty regarding high quality performance of employment duties		

B.1 QUALIFICATIONS

Professional level II

Employment duties at professional level II

- 1) Operating machine tools
- 2) Setting the machine tool
- 3) Creation of the operation technology
- 4) Designing control programs
- 5) Teamwork

Qualification 1. Operating machine tools		
Activities	Skills	Knowledge of
1. Operates the machine tool and control system	a) Skill of operating CNC machine tools (incl. milling machines, service centres, etc.) b) Workplace organisation skill c) Machine tool defect identification skill d) Machine tool maintenance pursuant to the maintenance manual of the machine tool	a) mechanical engineering materials b) mechanical engineering technology b) metal cutting and CNC machine tools c) contour and position control systems d) occupational health and safety
2. Identifies defects of the machine tool, if necessary		
3. Maintains the machine tool and carries out minor repairs		

Qualification 2. Setting the machine tool		
Activities	Skills	Knowledge of
1. Places the processed detail in the machine tool	a) Skill of basing the processed detail and using jigs	a) basing b) working drawings

2. Pre-initialises cutting instruments	b) Skill of drawing up and resolving dimension chains	c) dimension chains d) use of jigs
3. Places cutting instruments in the tool holder	c) Skill of choosing and inspecting technological zero points	e) coordination systems f) use of cutting and auxiliary instruments
4. Sets technological zero points	d) Skill of choosing cutting and auxiliary instruments f) Skill of entering control programs g) Skill of adjusting control programs h) Skill of using the sub-programs of the machine tool	g) CNC machine tool programming

Qualification 3. Creation of the operation technology		
Activities	Skills	Knowledge of
1. Accesses the working drawing	a) Skill of designing the trajectories of the cutting instruments	a) the coordination systems of the machine tool and processed detail
2. Designates the moving trajectories of the cutting instruments	b) Skill of designating the cutting modes c) Skill of achieving the required quality parameters	b) designing the operation technology
3. Creates the operation technology (unless specified)	d) Skill of reading working drawings e) Skill of designating the spare processing capacity	c) the detail production technology d) metrology e) possibilities of ensuring quality
4. Creates the control program		

Qualification 4. Designing control programs		
Activities	Skills	Knowledge of
1. Enters the control program into the control system of the machine tool	a) Skill of designing control programs for making more complicated details	a) programming CNC machine tools b) working principles of the control systems
2. Inspects the control program using the simulation system	b) Skill of manual programming of the control systems of various machine tools	c) the essence and use of CAD/CAM systems
3. Inspects the operational readiness of the machine tool	c) Skill of using the CAD/CAM system for developing control programs	
4. Processes details on the machine tool and inspects the required parameters	d) Computer skills	

Qualification 5. Teamwork		
Activities	Skills	Knowledge of
1. Sense of duty regarding ensuring quality	a) Performing employment duties by the prescribed time	a) the production technique
2. Performs employment duties with high quality	b) Foreign language skills	b) professional duties and liability
		c) microeconomics and macroeconomics

B.1 QUALIFICATIONS

Professional level III

Employment duties at professional level III

- 1) Setting and operating machine tools
- 2) Knowledge and use of processing technologies, machine tools and their control systems
- 3) Planning and organisation of manufacturing
- 4) Organisation of tool management in the division
- 5) Organisation of teamwork

Qualification 1. Setting and operating machine tools

Activities	Skills	Knowledge of
1. Supervises the working order of machine tools	a) Skill of operating CNC machine tools	a) mechanical engineering materials
2. Looks for disturbances in the machine tools and guides their minor repairs	b) Workplace organisation skill	b) mechanical engineering technology
3. If necessary, assists upon setting machine tools	c) Skill of identifying defects of and maintaining machine tools	c) conventional and CNC machine tools
4. Sets machine tools and prepares them for work	d) Skill of reading working drawings	d) CNC systems
	e) Skill of using jigs	e) designing control programs
	f) Skill of choosing cutting and auxiliary instruments	f) jigs and tool management
	g) Skill of manual and automated programming	
	h) Skill of preparing machine tools for making products	

Qualification 2. Knowledge and use of processing technologies, machine tools and their control systems

Activities	Skills	Knowledge of
1. Verifies the correctness of working drawings	a) Skill of choosing the route technology of making details	a) route technology
2. Explains the working drawings to the employees of the division	b) Skill of designing the operation technology	b) operation technology
3. Designs operation technologies or assists other employees upon designing them	c) Skill of achieving the required quality parameters of products	c) quality assurance
4. Develops control programs	d) Skill of manual and automated programming of CNC machine tools	d) CNC systems
5. If necessary, checks the readiness of machine tools for processing details	e) Skill of adjusting control programs	e) designing control programs
		f) sub-programs of machine tools
		g) possibilities of adjusting control programs

Competence 3. Planning and organisation of production

Activities	Skills	Knowledge of
1. Plans work in the division	a) Skill of production planning	a) production planning
2. Divides employment duties in the division	b) Skill of giving work orders	b) productivity
3. Inspects performance of employment duties in the division	c) Skill of drawing up production reports	c) production organisation
	d) Skill of using resources rationally	e) goal-oriented management and
	e) Skill of identifying the production expenses	

<p>4. Reports to higher bodies 5. Solves problematic situations 6. Ensures quality in the division</p>		<p>reporting f) principles of drawing up the production documentation g) cost items and possibilities of cutting them</p>
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Qualification 4. Organisation of tool management in the division		
Activities	Skills	Knowledge of
1. Identifies the need for tools	a) Skill of identifying the need for jigs	a) jigs used in CNC machine tools
2. Identifies the need for auxiliary instruments	b) Skill of identifying the need for tools	f) cutting and auxiliary instruments
3. Keeps account of tools	c) Skill of identifying the need for auxiliary instruments	c) control and measuring instruments
4. Knows the useful life of tools and organises their usage cycle	d) Skill of identifying the need for inspection and measuring instruments	d) measuring technology
5. Pre-sets tools, if necessary	e) Skill of generating and maintaining databases	e) tool management

Qualification 5. Organisation of teamwork		
Activities	Skills	Knowledge of
1. Evaluates the personal abilities of the employees of the division	a) Skill of managing a small team	a) organisation of teamwork
2. Develops employees' knowledge and skills	b) Skill of organisation and mobilisation	b) production psychology
3. Encourages and motivates employees	c) Leadership skills	c) management theory and management methods
4. Evaluates results and carries out improvement activities	d) Analytical and decision-making skills	d) project management e) motivation

Knowledge and skills contained in all the qualifications
1. Material technology
2. Mechanical engineering technology
3. Position and contour control systems
4. Manual and automated programming of CNC machine tools
5. Production organisation
6. Conventional and CNC machine tools
7. Tool management
8. The skill of reading working drawings and making products on CNC machine tools with high quality and effectively

B.2 ELIGIBILITY REQUIREMENTS – here you should indicate the minimum education and work experience requirement based on which the eligibility to the professional examination is decided			
Professional level	Work experience	Education	Other
Professional level I	Training pursuant to the CNC machine tool operator training programme or 1 year of work experience in a company	Preferably secondary vocational education	Knowledge and skills of an employee operating metal cutting tools
Professional level II	Training pursuant to the CNC machine tool operator training programme or 2 years of CNC machine tool work experience in a company	Secondary vocational education	Knowledge and skills of an employee operating CNC machine tools
Professional level III	Training pursuant to the CNC machine tool operator training programme and in-service training (approx. 40 hours a year). 5 years of work experience on CNC machine tools in a company	Secondary vocation education or preferably higher vocational education	Knowledge and skills of an employee operating CNC machine tools, foremanship experience and knowledge

PART C. GENERAL INFORMATION AND ANNEXES

C.1 INFORMATION ABOUT THE PROFESSIONAL STANDARD

1. Professional standard number in the register of professions	
2. Authors of the professional standard	1)Jüri Riives, AS Eesti Talleks, Chairman of the Supervisory Board; 2)Juhan Anvelt, NORCAR BSB Eesti AS, Executive; 3)Matti Timmermann, AS TARKON, Human Resources Manager; 4)Allan Märk, AS Tööriistavabrik, Head of Division; 5)Edgar Hansen, Tallinn Industrial Education Centre, Head of Department; 6)Veiko Põldmaa, Tallinn Industrial Education Centre, Instructor.
3. Introduction of the draft professional standard	a) AS TARKON; b) AS FERREKS TT; c) Estonian Tool Manufacturers' Association (ESTA); d) VERTEX Estonia AS; e) Tallinn Industrial Education Centre; f) Tallinn College of Engineering.
4. Professional standard approved by	Professional Council of Machine, Metal and Instrumentation Industry
5. Number and date of the decision of the professional council	
6. Time of validity of the professional standard	3 years (if necessary, revised based on previous matter-of-fact proposals)

7. Version of the professional standard	V1 (the first version)
8. Classification of economic activities in Estonia (NACE)	
9. Classification of jobs (ISCO)	
10. European Qualifications Framework (EQF)	Professional level I - 3 Professional level II - 4, 5 Professional level III - 6
11. Body attributing the profession	EML / KOO-MET
12. Professional chamber	
13. Area	Machine engineering / usage of CNC machine tools
14. References to training programmes in the Estonian education information system	None

C.2 PROFESSIONAL TITLE IN FOREIGN LANGUAGES

ESTONIAN

TASE

AMETINIMETUS

I	Arvjuhtimisega metallilõikepinkide operaator
II	Arvjuhtimisega metallilõikepinkide operaator
III	Arvjuhtimisega metallilõikepinkide operaator
IV	
V	

RUSSIAN

УРОВЕНЬ

НАЗВАНИЕ

I	Оператор станков с ЧПУ
II	Оператор станков с ЧПУ
III	Оператор станков с ЧПУ
IV	
V	
V	

C.3 REFERENCES

- J. Riives, „Programmeerimine APJ tööpinkidele”. TTÜ kirjastus, Tallinn 1988, 75 p.
A. Kimmel, „Metallilõikepinkide automatiseeritud programmeerimine”. TTÜ kirjastus, Tallinn 1991, 70 p.
A. Kimmel, „Arvjuhtimisega metallilõikepinkide programmeerimine”. TTÜ kirjastus, Tallinn 1992, 117 p.

C.4 DEFINITIONS AND DESCRIPTIONS OF SYSTEM OF PROFESSIONS

Professional standard – a document approved by the Professional Council, which describes the work and specifies the specific competencies necessary for performing the work.

Professional levels – a set of qualifications necessary for working in the field of activity, which has been described in the professional standard and the compliance of which is certified at the respective professional level.

Specialisation – an essential part of the profession, which has a practical output in the labour market.
Employment duty – a set of integral activities for the performance of which respective knowledge and skills are necessary. A respective qualification is established for performance of each main employment duty.
Qualification – a set of knowledge, skills, experience, abilities, attitudes and manners of behaviour, which allows the employee to perform the respective employment duty and is manifested as a set of activities.

C.5 ANNEXES

Appendix 2. Job Description of CNC Machine Tool Operator

COMPANY		JOB DESCRIPTION OF CNC MACHINE TOOL OPERATOR			KD xxx-xx
					Version 1
Document	Prepared by		Approved by		Page(s) 39/43
					Date:

Job: **CNC Machine Tool Operator**
 Structural unit: Production
 Direct supervisor: Production Manager
 Reports to: Executive, Production Manager
 Subordinates: None

1. GENERAL PROVISIONS

- 1.1. The Executive enters into and terminates the contract of employment with the CNC Machine Tool Operator.
- 1.2. The CNC Machine Tool Operator is supervised by and reports to the Production Manager.
- 1.3. In his activities the CNC Machine Tool Operator shall act pursuant to:
 - 1.3.1. the legislation of the Republic of Estonia;
 - 1.3.2. this job description;
 - 1.3.3. directives of the Executive, lawful orders of the Executive and Production Manager;
 - 1.3.4. internal work procedure rules, occupational health and safety rules and fire and electrical safety rules of the company;
 - 1.3.5. other rules of procedure and guidelines established in the company.

2. MAIN OBJECTIVES

The main objectives of the work of the CNC Machine Tool operator are:

- 2.1. making products of high quality and in a timely fashion pursuant to working drawings;
- 2.2. constant quality inspection in order to ensure the quality of products;
- 2.3. optimal and purposeful use of the mechanisms, machines and equipment that are at the disposal of the company;
- 2.4. regular maintenance of the production equipment.

3. REQUIRED SKILLS

An employee who possesses the following knowledge and skills may hold the position of CNC Machine Tools Operator:

- 3.1. Education: CNC machine tool employee training;
- 3.2. Language skills: Estonian; professional English;
- 3.3. Work experience: preferably prior work experience as a machine tool operator;
- 3.4. General and special skills: skill of reading working drawings; general knowledge of mechanical processing technology; knowledge of CNC machine tools and their control devices; knowledge of tools and their usage skills; knowledge of processing technologies and materials to the required extent; skill of creation of control programs for CNC machine tools;
- 3.5. Qualities: ability to manage stress, sense of duty, precision, honesty, correctness;
- 3.6. Computer skills: quite important from the point of view of performance of the employment duties;

3.7. Driver's licence: not important from the point of view of performance of the employment duties.

4. RIGHTS

The CNC Machine Tool operator has the right to:

- 4.1. make proposals to the Executive and Production Manager for improving the work organisation;
- 4.2. make proposals for modifying the production technology;
- 4.3. receive information necessary for performance of working duties;
- 4.4. demand the provision of special clothing, personal protective equipment and tools required for work;
- 4.5. refuse work with regard to which no training has been received or which is against the law;
- 4.6. receive as much in-service training as required.

5. EMPLOYMENT DUTIES

- 5.1. Making products pursuant to the technical documentation (working drawings, routing technology, operation technology, etc.) with high quality and by the prescribed time;
- 5.2. Creating control programs and entering them into the control system of the machine tool;
- 5.3. Selecting tools and placing them in the instrument holder of the machine tool;
- 5.4. Following the rules of procedure and quality requirements of production;
- 5.5. Exercising quality supervision over products;
- 5.6. Setting the machine tool;
- 5.7. Following the user manuals of equipment;
- 5.8. Carrying out current and planned maintenance of equipment;
- 5.9. Sharpening and adjusting tools and measuring parameters;
- 5.10. Following occupational safety instructions, using personal protective equipment;
- 5.11. Operative notification of the Production Manager about problems;
- 5.12. Keeping one's tools and workplace in order;
- 5.13. following the lawful orders of the Executive, Production Manager or an employee replacing him;
- 5.14. In the event of unforeseen hindrances, addressing the Executive or Production Manager for elimination of the hindrances.

6. LIABILITY

The CNC Machine Tool Operator shall be liable for:

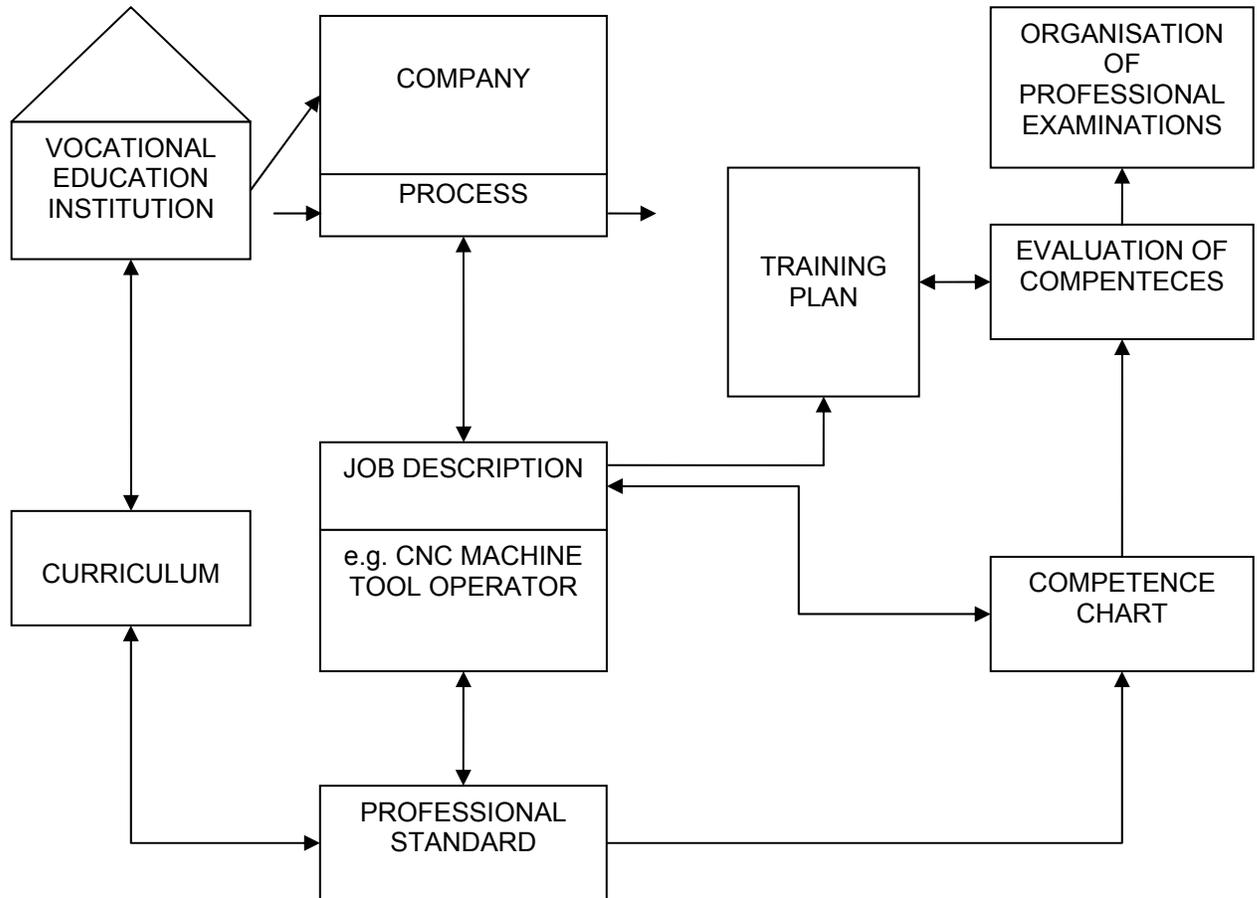
- 6.1. fulfilment of the requirements set out in this job description;
- 6.2. following the internal work procedure rules, effective rules and regulations, legislation of the Republic of Estonia, directives and orders of the Executive and orders of the Production Manager;
- 6.3. adherence to the occupational health and safety rules, fire and electrical safety rules and sanitation rules;
- 6.4. making products in a timely fashion and complying with the quality requirements;
- 6.5. prudent use of tools.

Employee	Employer
..... /Signature/ /Signature/
..... /Name/ /Name/
 Date	 Date

Appendix 3. Competence Chart of CNC Machine Tool Operator

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. Primary 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		
1.2.7. Machine tool operation skill		
1.2.8. Knowledge of cutting and auxiliary instruments		
1.2.9. Knowledge of measurement and control instruments		
1.2.10. Skill of measurement and inspection of processed details		
1.3. Additional 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		
1.3.6.		
1.4. Personal skills		
1.4.1. Sense of duty		
1.4.2. Precision and correctness		
1.4.3. Able to work independently		
1.4.4. Sense of liability		
1.4.5. Able to concentrate		
1.4.6. Able to cooperate		
1.4.7. Ready to learn		

Appendix 4. Human Resources Development Process



Appendix 5.

