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Tallinna Ettevõtlusamet

EMÜ EESTI MASINATÖÖSTUSE LIIT
FEDERATION OF ESTONIAN ENGINEERING INDUSTRY

Tartu
heade mõtete linn

INNOVATIVE CLUSTER DEVELOPMENT IN COMPANIES OF METAL-, MACHINERY- AND APPARATUS INDUSTRY – INNOCLUS II

Main goal of INNOCLUS II project is to strengthen competitiveness and successfulness of companies in metal-, machinery- and apparatus sector and to stimulate economic development through networks/clusters in industrial branches, but also through implementation of innovative measures in European economic environment.

Cluster is a system of marketing-based and non-marketing-based relations between geographically concentrated (usually in regions) enterprises and other institutions. The nature of a cluster is based on daily relations (both business and personal), which mostly require geographical proximity, durability, formal and non-formal contact channels (Abramson, 1998).

Components of an industry cluster are following:

- Research & development (R&D) of public and private sector
- Skilled work-force;
- Training centres and institutions for further education;
- Support structures of innovation (agencies for technology transfer; patent bureaus, chambers of industry, business unions and associations etc);
- Local governments; physical and social infrastructure;
- Financial institutions;
- Intermediate- and end-consumers.

Cluster is the expression for open business model. Through cluster development one can achieve the efficiency and competitiveness of institutions belonging to the cluster. Despite of many positive aspects of cluster development, it is also important to take into consideration some weaknesses and dangers, which may occur by unfavourable conditions. Cluster SWOT analysis has been brought up in Table 1.

Table 1 Analysis of cluster expediency (SWOT)

STRENGHTS	WEAKNESSES
• Spatial co-existence • Economical interaction • Higher productivity and efficiency • Faster distribution of innovations • Faster launch of new products • Easier establishment of new companies • Rational division of resources	• Weakening of competitive advantages • Sensitiveness to external influences • Possibility for over-consolidation • Possibility for mutual misunderstandings • Barriers to competition
OPPORTUNITIES	**TRENDS**
• Rapid development of know-how • Constant development of human resources • Systematization of R&D activities • Integration with local authorities • Access to specific services • Intensification of networks • Adaptability of venture capital • Development of social infrastructure	• Trend to passiveness • Formation of cartel agreements • Excessive centralization • Internal unhealthy competition

1. Business environment of an enterprise (enterprise and its surrounding)

Enterprise is an undivided system, which needs to be managed competently, fast and effectively, in order to guarantee its rational functioning. This means first of all, that all the functional sub-units belonging to the company (departments, offices, plants, divisions etc) have to know their official purposes and tasks, they have to obtain in time the information needed for fulfilling their official tasks, and their activity (passivity) can not hinder other sub-units to fulfil their concrete tasks on time.

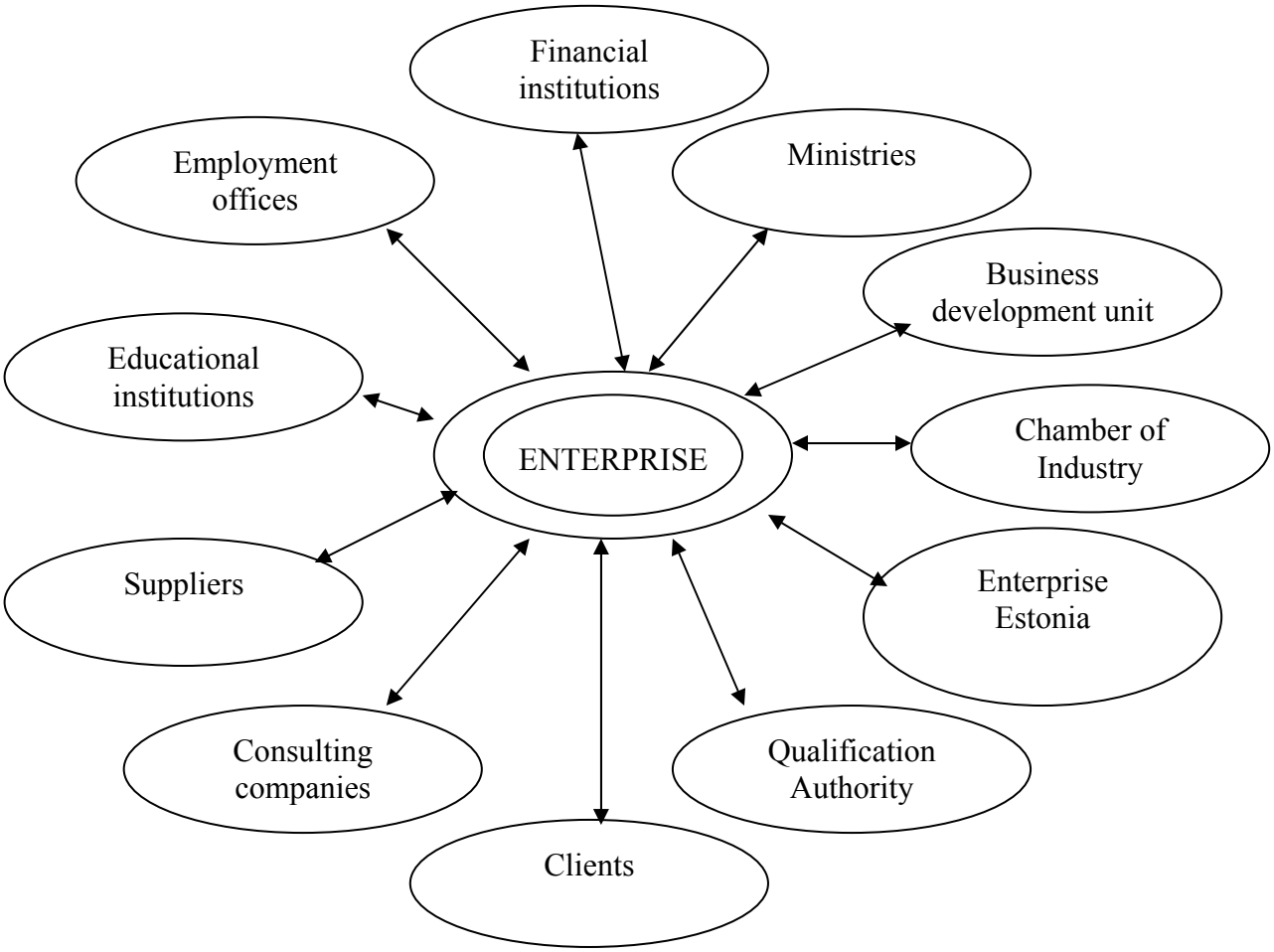
An enterprise can be described through its organisational management structure.

An enterprise is functioning in a business environment and is directly related to it. Business environment can supported or even hinder business development. Business environment will be formed by institutions, which more or less are involved with enterprises. Enterprise and its surrounding have been described on Figure 1.
Institutions, which have most common communication or information exchange with enterprises, have been switched to the model of business environment.

The aim of the research was to get an overview about the intensity and cooperation potential of enterprises with different institutions. Participating companies have been divided into three groups:
- Large enterprises (300 and more employees);
- Medium-sized enterprises (50 – 300 employees);

- Small enterprises (less than 50 employees).

Figure 1 Enterprise and its surrounding



For the overview about the nature of cooperation of an enterprise with each of partner group following parameters were analysed:
- number of contacts per year;
- manner of information exchange;
- nature of cooperation;
- importance of cooperation/communication timely;
- evaluation of cooperation;
- initiator of contact;
- opinion about how to develop cooperation;
- main hindrances for cooperation development;
- opinion about the development of special-purposed cooperation networks.

The results of the research can be found on figures 2 and 3. The analysis of results showed, that the highest intensity of cooperation and potential of enterprises is with clients, after that with suppliers. The situation was almost the same by Finnish enterprises.

Figure 2 Intensity of cooperation

V – low, K – medium, S – high

Nr	Institution	Description 0 / 25 % / 50 % / 75 % / 100 %
1	Banks	1. 16 K; 33 V; 50 S
2	Ministries	17 K; 83 V
3	Business development units	33 K; 67 V
4	Chamber of Industry	50 V; 50 K
5	Enterprise Estonia	33 K; 67 V
6	Qualification Authority	33 K; 67 V
7	Clients	S
8	Consulting companies	50 V; 50 K
9	Educational institutions	17 S; 33 K; 50 V
10	Employment offices	17 K; 16 S; 67 V
11	Suppliers	33 K; 67 S

Figure 3 Potential for cooperation

V – low, K – medium, S – high

Nr	Institution	Description 0	25 %	50 %	75 %	100 %
1	Banks			58 K 42 S		
2	Ministries			42 V 58 K		
3	Business development units	17 V	25 S	58 K		
4	Chamber of Industry	8 S		67 K		
5	Enterprise Estonia		27 V 33 S	50 K		
6	Qualification Authority	17 V 8 S			75 K	
7	Clients			42 K 58S		
8	Consulting companies	17 V 8 S			75 K	
9	Educational institutions	8 V	33 S	59 K		
10	Employment offices		25 V 33 K	42 S		
11	Suppliers	8 V	42S	50 K		

Promising is the situation also with educational institutions and with Enterprise Estonia, which shows the bigger orientation of enterprises to trainings and development activities.
Quite well informed were enterprises about the activities of business development unit (Tallinn City Enterprise Board) and employment offices and they believed, that the cooperation with these organisations should be intensified.
Enterprises have very low direct contacts with ministries. In this field hopes of companies rely on the business association (Federation of Estonian Engineering Industry - EML). Federation of Estonian Engineering Industry has long-term and good contacts with many of Estonian ministries, most of all with:

- Ministry of Economic Affairs and Communications,
- Ministry of Education and Research,
- Ministry of Foreign Affairs,
- Ministry of Social Affairs.

Nowadays, in the world of rapid development cooperation plays an important role. Relatively low intensity of cooperation with the surrounded organisations proceeds mainly from two aspects:

1. The knowledge about the possibilities offered by the enterprise-surrounded organisations is quite low. Positive impact has been poorly generalised and informed to others, even the websites of corresponding organisations are quite informative.
2. Companies have mostly small-numbered management board and engineer-technical personnel, whose work-load is heavy. Everyday business routine does not give possibilities to deal with "untypical" problems and therefore searching for new solutions or possibilities will be left behind.

2. Regional cooperation

The most important areas in the field of metal-, machinery- and apparatus industry in Estonia are:

1) Tallinn-Harjumaa;
2) South-Estonia;
3) East-Estonia (Lääne- and Ida-Virumaa).

The areas above have the biggest concentration of metal-, machinery- and apparatus companies and their share of total industrial production makes more than 80%. At the same time one can say, that the contacts between these areas are relatively low. Activity-based and informative axis between areas is almost totally missing and enterprises in these areas are operating quite isolated.

Activity-based and informative cooperation between areas could have following objectives:

1. Compilation and implementation of joint training programmes, especially in the fields, where there basis of local knowledge and skills is missing;
2. Exchange of information about customers and markets. Solid and impersonal information about problematic customers should reach all companies. Also, joint

access to new markets of discovering of potential opportunities would be more fruitful acting together.

3. Organisation of cooperation in the field of R&D (purchase of new equipment or technology). Presentation and learning of technologies, if possible writing a development project, applying financing from Enterprise Estonia.
4. Integrated cooperation between educational institutions and enterprises. One possibility could be to identify the needs and possibilities of work-force in schools and to offer places for apprenticeship. Different companies could concentrate on apprenticeship places in different field, with the aim to cover all the main fields for the industry branch by acting together.
5. Generating synergy between enterprises in Tallinn-Harjumaa and South-Estonia, by dividing better resources both local and global. Not all companies should purchase all the unique equipment or technology. They could cooperate and use the resources more rationally.

Development of cooperation has been happened so far quite spontaneously without clear visions and cooperation. There are two principal possibilities, how to organise cooperation:

1. Cooperation between functional groups (see Figure 4).
2. Cooperation between geographical communities (see Figure 5).

Both schemas have their own advantages and disadvantages.

It is definitely easier to organise cooperation between geographical communities, as the number of global connections is smaller. But, the cooperation between geographical communities is limited to general exchange of information, not much to raising and solving essential issues. The cooperation motor proceeded by principle of location should be Federation of Estonian Engineering Industry, but who does not have enough resources for that. For the innovative progress it would be rational to exploit cooperation between functional groups. Here the engines and initiators should be the functional groups themselves. Every functional group should define its goals and tasks to achieve them in a joint environment. General forums could have coordinating and analytical character.

Figure 4 Structure of regional cooperation network, based on functionality

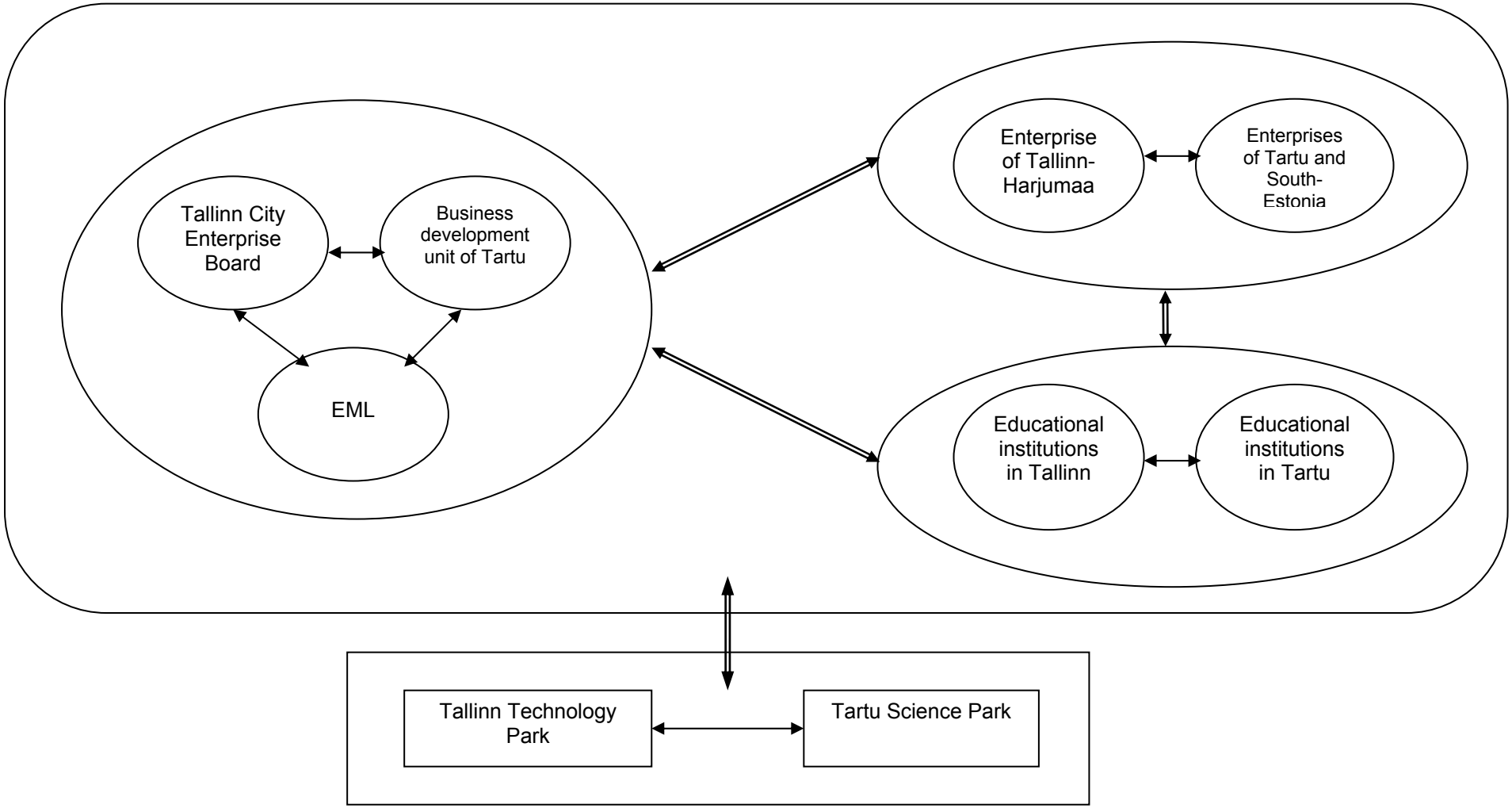
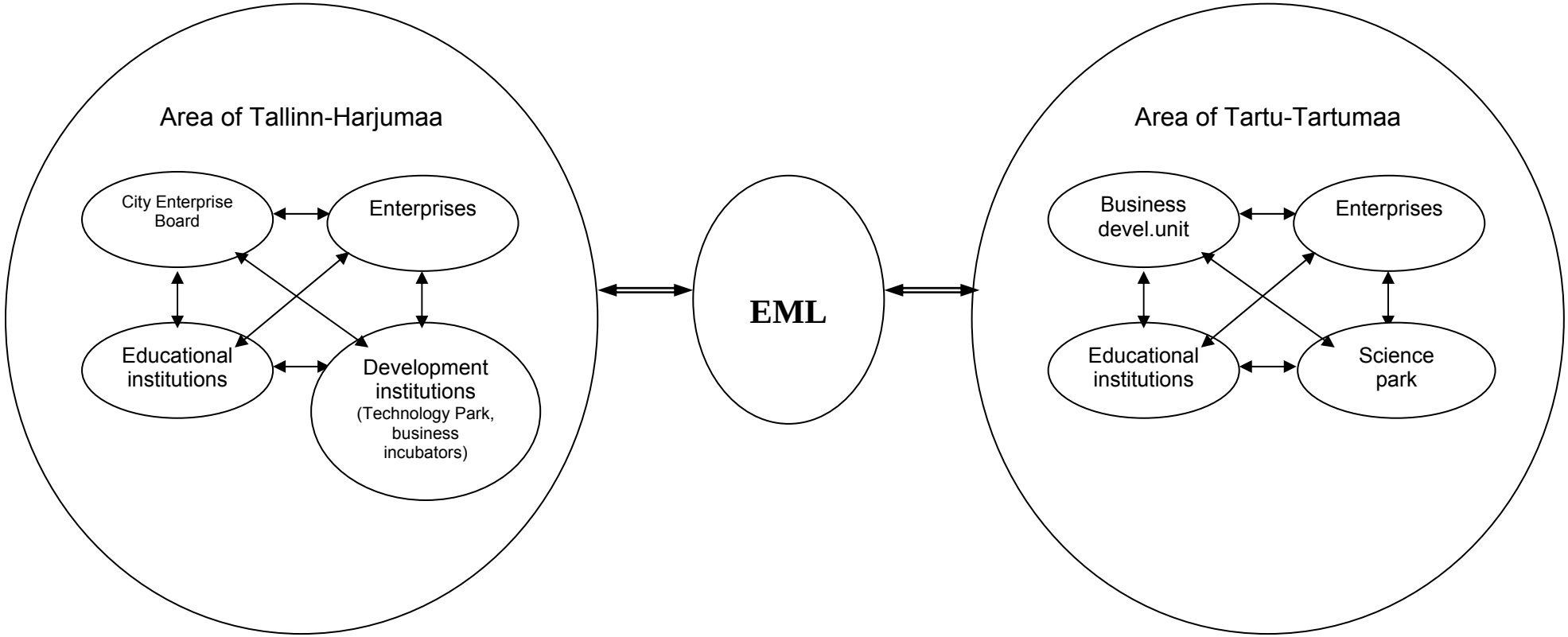


Figure 5 Structure of regional cooperation network, based on location



3. Integration cluster

Besides business environment, where the company functions, he has to be in cooperation with many elements of business chain. Business chain is a connection, which, resulted from the strategy and goals of the company, will be implemented through the organisational structure.

Following activities will create a business chain of a typical machine building enterprise:

- marketing;
- R&D;
- purchasing activities;
- preparation for production;
- production;
- sales;
- delivery;
- after-sales customer support.

If junctions and connections between them are defined and they are located on a specific area, a structure is formed. A structure is a closed, fixed system, a network an open system.

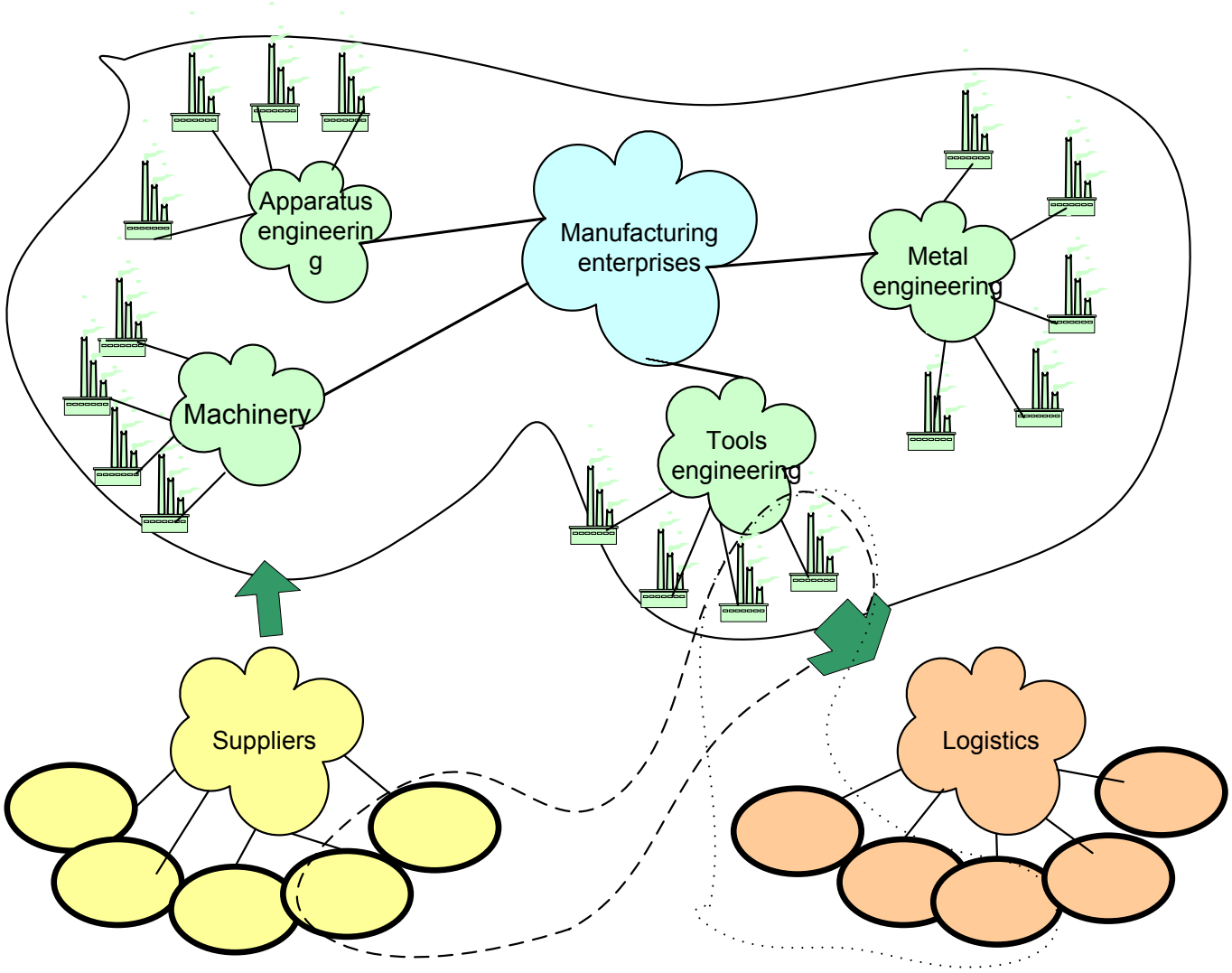
To enhance competitiveness and productiveness it important to have integrated production and cooperation networks. The vision of a cooperation network has been described on Figure 6.
Integration means cooperation and co-effect between different structural (internal) or network (external) elements.

General objectives of networks are following:

- to divide actions or activities – cooperation for better achievements;
- to divide knowledge and/or information – cooperation to strengthen competitiveness;
- by dividing goals, tasks, actions – achievement of higher professionalism with shorter time and less costs.

Returning to realisation of business chain in the company, it is extremely important for manufacturing company to organise procurement and supply. Both procurement of goods for manufacturing and delivery of products to consumers are the components of logistics.

Figure 6 Vision of cooperation network



Conclusions:

1. There are cooperative relations between manufacturing companies and supplying companies, which have arisen thanks to personal contacts and "good coincidences" and which do not base on optimization of supply chains or on other systematic factors.

2. Manufacturing companies have their own criteria by selection of supplier, from which more important are:
   - price of goods (material);
   - duration of supply;
   - punctuality of delivery;
   - abidance by agreements;
   - payment criteria and –deadlines;
   - quality of goods;
   - presence of quality certificates of material (goods);
   - order comfort;
   - personal relations;
   - long-term positive working experience.

3. Companies, which have ISO quality certificates, have worked out criteria for endorsement of suppliers and they run a register of approved suppliers (mostly electronically).

4. Material suppliers are relatively often in the same markets with the same products.

5. Majority could practice internet-based handling of orders, which would avoid unnecessary amount of time spent for registering orders, but presuming also accuracy both in forming an order and fulfilling the order. Many supplying companies have practised internet-based ordering system through their website.

6. Not very much focus will be put on optimization of supplying chains. The reason for that could also be small volumes of supply.

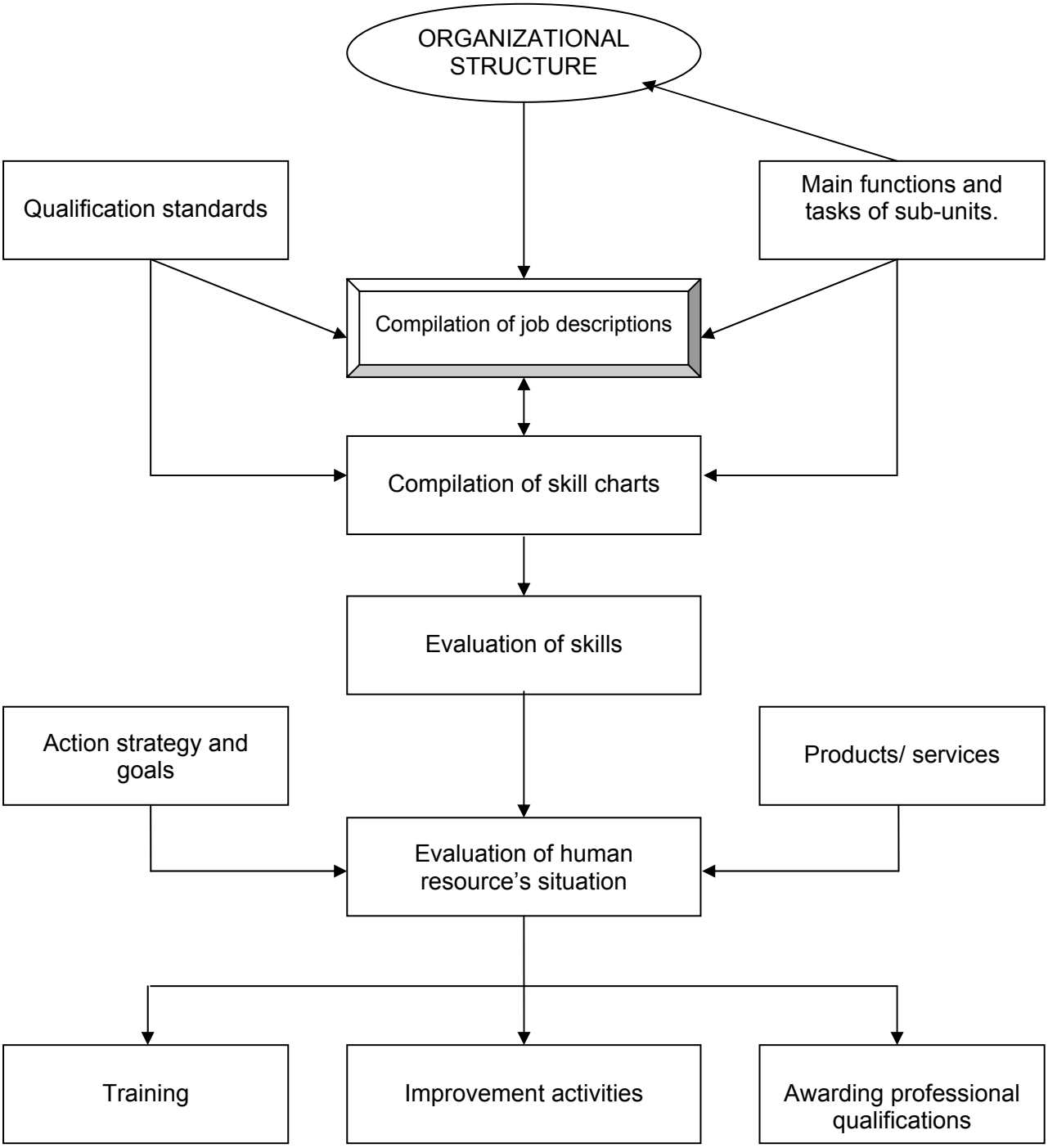
7. Metal- and machinery industry uses relatively poorly supplying system, which is based on timing. The reason is:
   - lack of stressed manufacturing;
   - not enough attention will be put on diminishing of duration of production cycle.

4. Integration between industrial enterprises and educational institutions

Production-related expenditures in company can be divided into three main categories:
- regular costs of the plant (costs of production premises, equipment, communications etc);
- expenditures for materials;
- salaries.

Current production can be characterized by the pressure on all these articles. This requires putting more focus on higher productivity, where qualified workforce plays an important role.
Training of personnel plays an important role by development of human resources in the company (see Figure 7). For organising a training cooperation with training institutions is needed. It is also important to fixate and to inform schools about the main training fields. Regionally fixed fields of training and potential training institutions are listed in figures 8, 9 and 10.
Development of human resources has been described on Figure 11.

Figure 7 Development of human resources in the company



Abbreviations in use:

- TTÜ – Tallinn University of Technology;
- TTKK – Tallinn College of Engineering;
- TLMK – Lasnamäe School of Mechanics;
- TTHK – Tallinn Industrial Education Centre;
- NKK – Narva Vocational Training Centre;
- TTÜ VK – Virumaa College of Tallinn University of Technology;
- KJP – Kohtla-Järve Polytechnics;
- SKK – Sillamäe Vocational School;
- TKHK – Tartu Vocational Education Centre
- VKHK – Võrumaa Vocational Education Centre.

The aim of development network of human resources (Figure 11) is to identify dynamically essential needs of further training and to contribute to the organisation of trainings and qualification examinations with the aim to provide enterprises with qualified workforce.

Figure 8 Complementary training of enterprises in South-Estonia

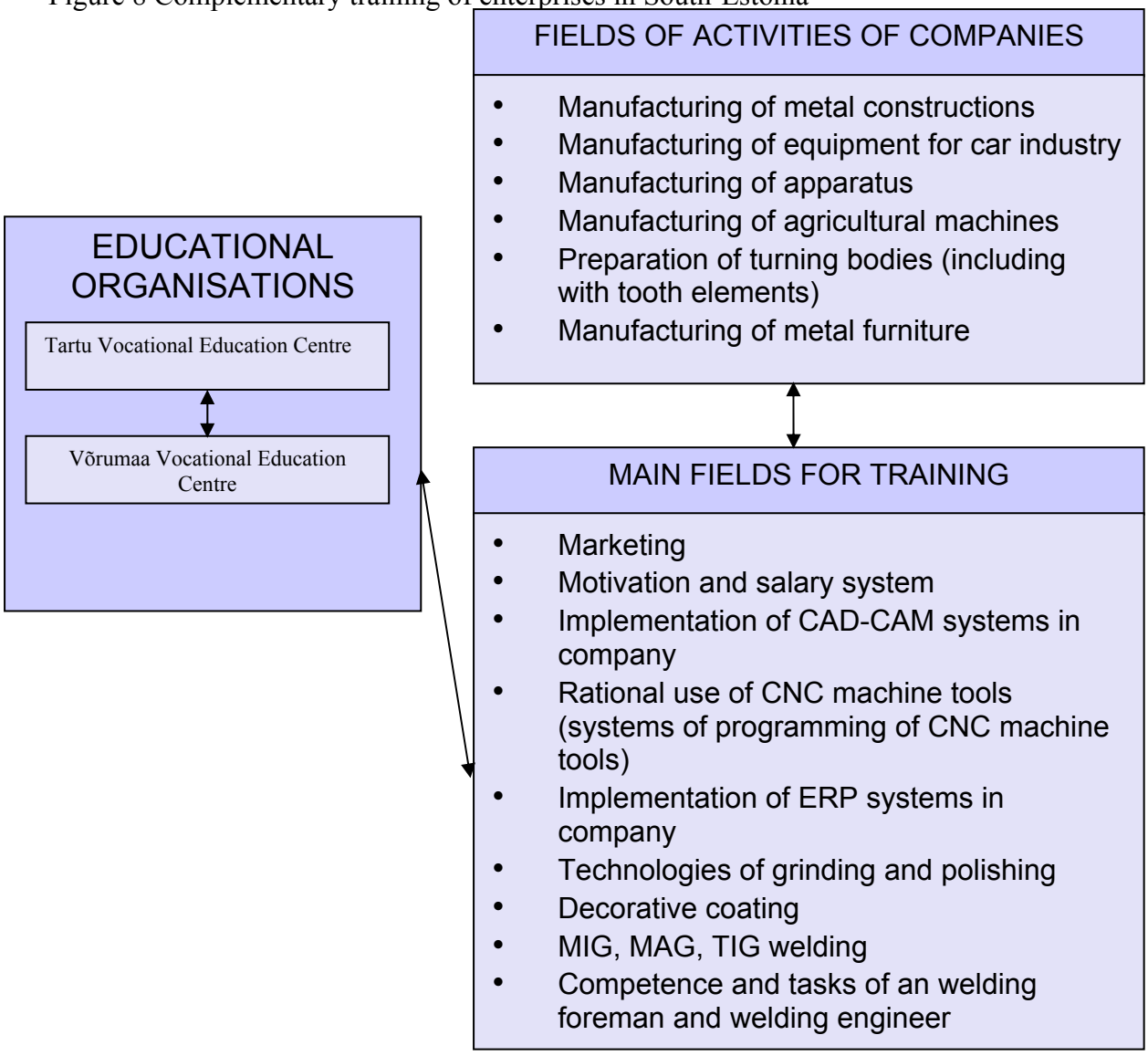


Figure 9 Complementary training of enterprises in Tallinn-Harjumaa

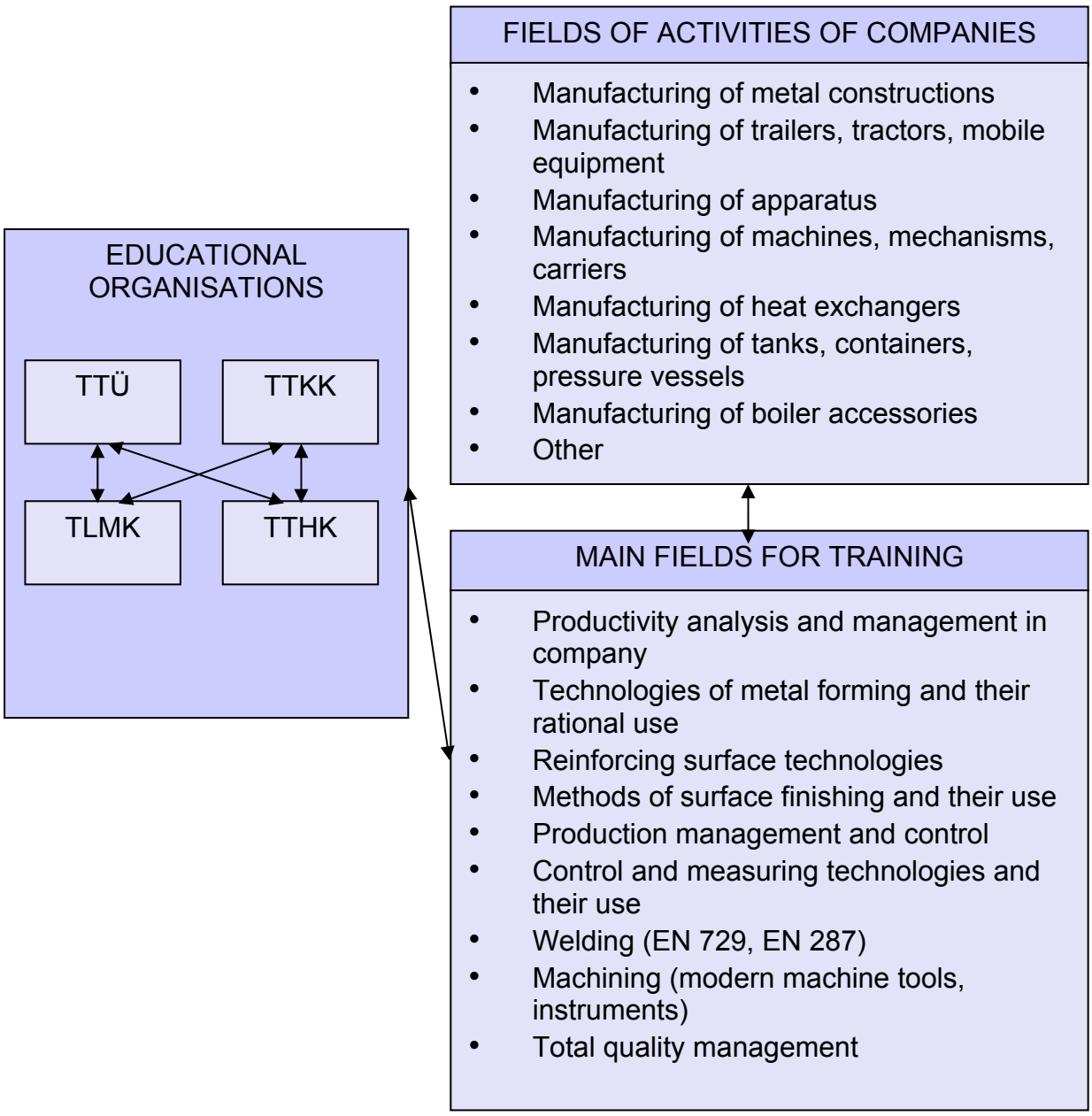


Figure 10 Complementary training of enterprises in East-Estonia

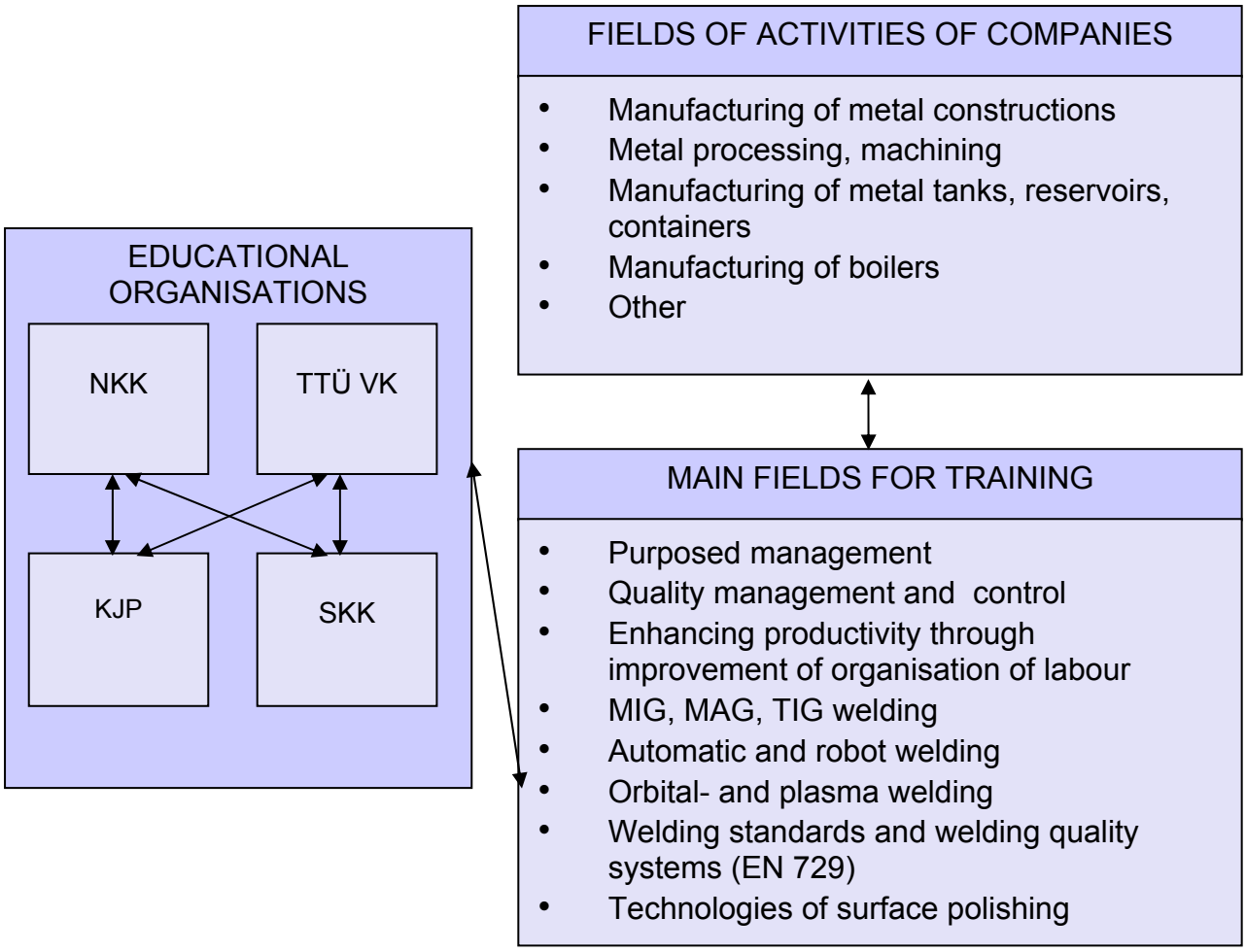
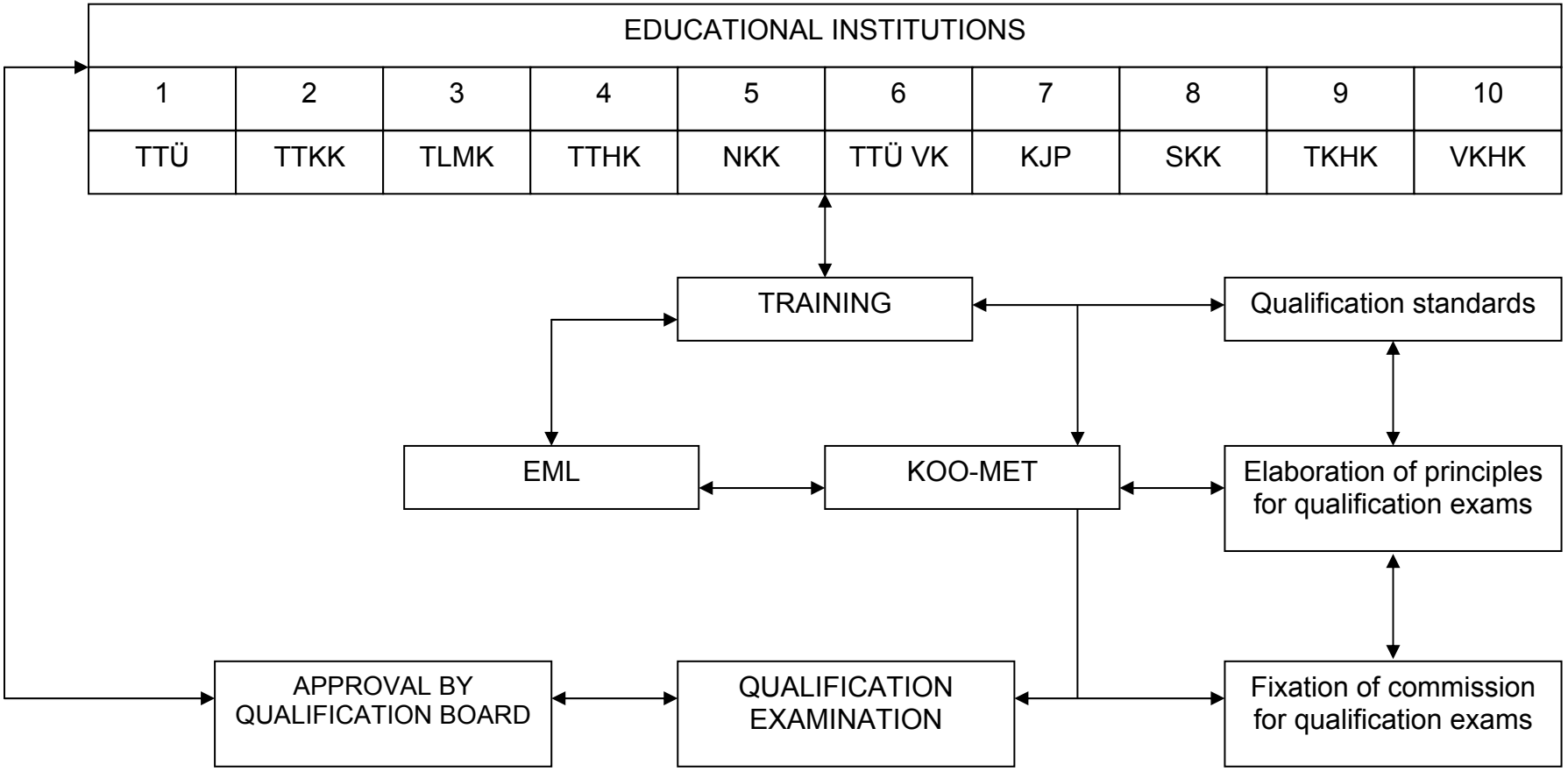


Figure 11 Development networks of human resources



5. Analysis of cluster development in automobile industry

Automobile industry is one of the most innovative and fast developing industrial branches in the world. There is a hard competition between car manufacturers. Main levels of the competition are:

- Number of car models;
- Duration of the launch of a new model;
- Innovativeness of a new model:
  - User-friendly;
  - Functionality;
  - Safety;
- Price for consumers;
- Quality.

From the point of view of manufactures competitive advantages are:

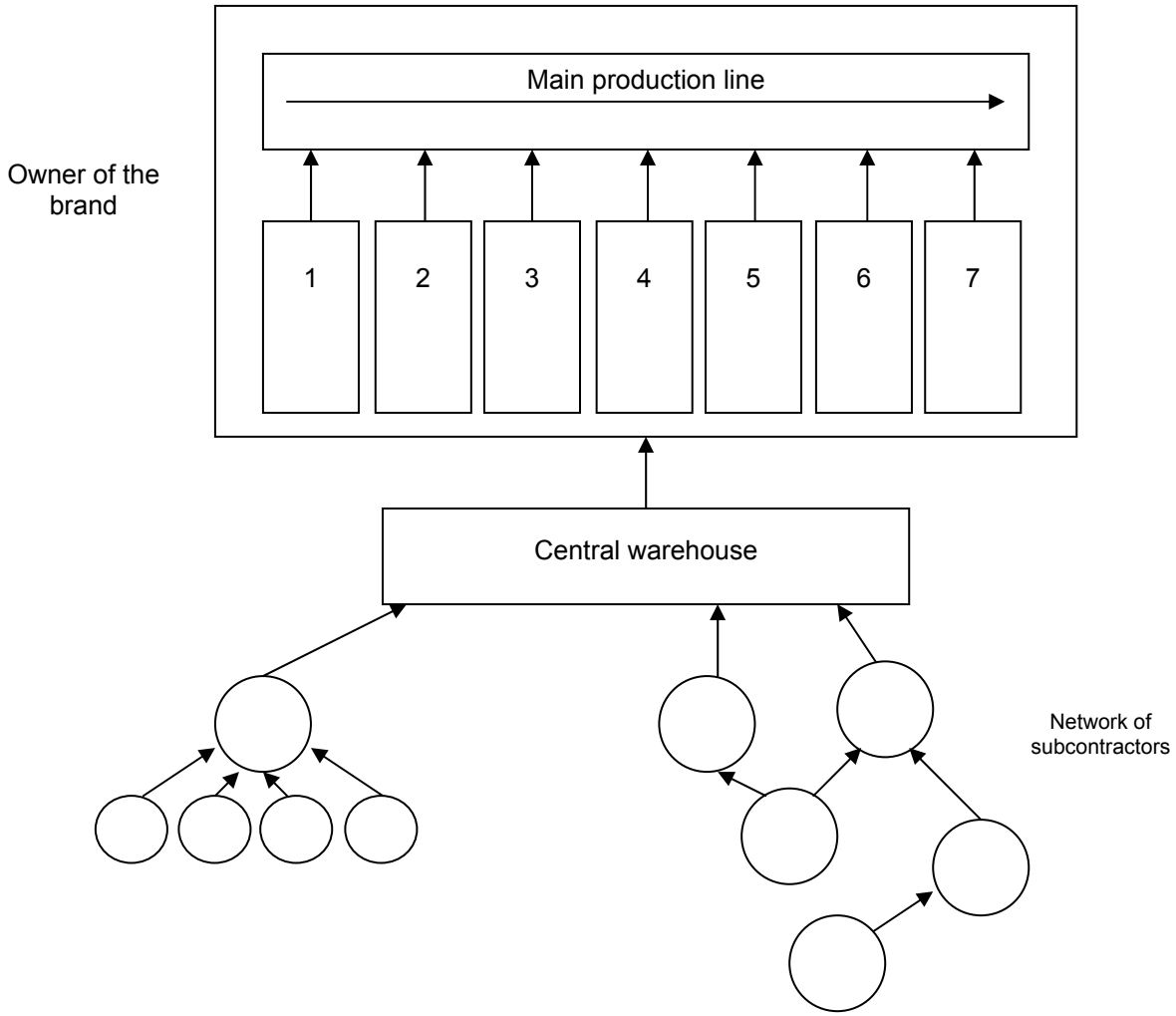
- High quality;
- Low manufacturing cost;
- Short production cycle;
- High flexibility.

To profit from these competitive advantages all car manufacturers have to solve constantly following strategic issues:

- Level of automation (i.e. balance between human capital and machines);
- Level of labour professionalism (development of human resources);
- Level of flexibility (how many car models can be produced together on the main production line and how fast could the equipment be readjusted from the production of one model to another one);
- Length of stroke (time unit, after which new car will be completed on the production line);
- Use range of new (expensive) materials (how long is the planned life cycle of one car part);
- Level of quality insurance (quality lies on car safety, smoothly running, comfort, aesthetic look and its persistence);
- Level of product development and range (what is the difference between old and new model and how long is the life cycle of one product);
- Optimization of supply chains (what is the relative importance of the products manufactured by base company and how the subcontracting system is organised).

Typical organizational scheme in automobile industry has been described on Figure 12.

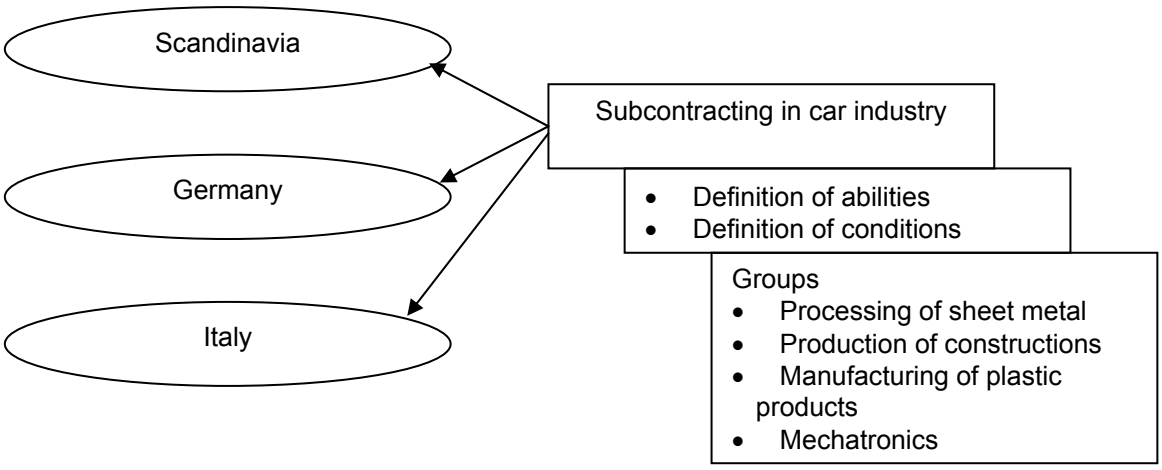
Figure 12 Typical organizational schemes in automobile industry



1 – body stamp and assembly
2 – body painting
3 – assembly of front and rear axle
4 – assembly of engine and power transmission
5 – assembly of dashboard and electronics
6 – assembly of seats and seat padding
7 – completion of extras

General cluster development scheme can be found on Figure 13.

Figure 13 Cluster development



To be part of car industry subcontracting network, certain ability requirements should be fulfilled by applicant. Most important among them are:

- infrastructure;
- production volumes (to produce details or products in bigger volumes, 100 000 per month or more);
- qualified personnel (qualification certificates or other documents proving competence);
- company-based certificate (ISO 9001:2000, QS 9000, ISO/TS 16949:2002, etc);
- guaranteed punctuality by fulfilling orders;
- required quality of products and mechanisms for its verification;
- flexibility.

Proof for ensuring corresponding criteria are usually so called „other party" audits, which will be carried out by representatives of manufacturers. Company, who wants to participate in subcontracting network, has to prove his ability to fulfil those criteria mentioned above. From the point of view of ensuring quality of products, it is important for manufacturers to have quality management certificate ISO 9001:2000 or other certificates for standards. Conceptual model of ISO 9001:2000 can be found on Figure 14.

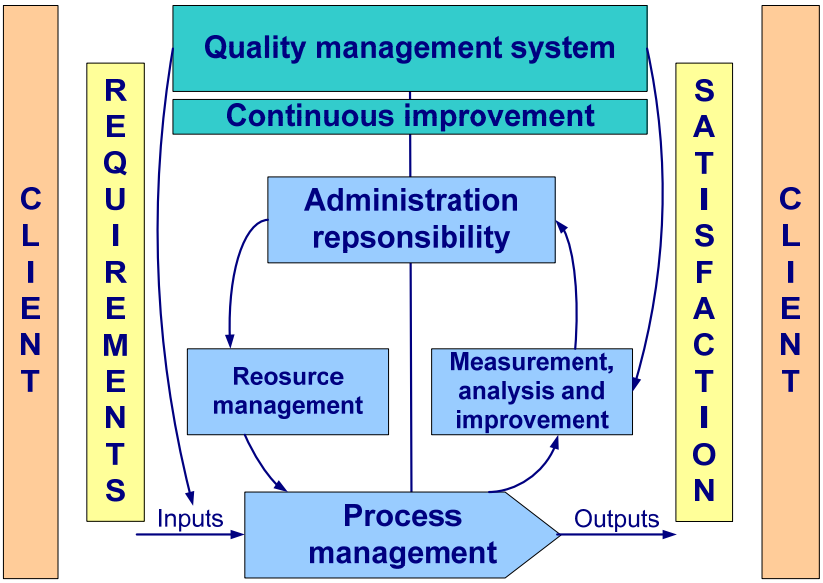


Figure 14 Conceptual model quality management ISO 9001:2000

The model is targeted to demands of clients, their wishes and their fulfilment (taking into account quality functions). Activities from the client requests until their realization should be covered by quality management system, which will be realized on the basis of corresponding model.

There are three main components by quality management system:
1) Structure of quality management system (harmony between organizational structure and quality management system` s structure);
2) Management of resources with activities to evaluate, measure, analyse and improve the results);
3) Process supervision.

All listed components have quite complicated nature, whereby each of them has its own structure, based on tasks.

6. Design of a structure for the database about technological capabilities and sources for research

For mapping technological resources of an enterprise and using these on purpose of developing future co-operation network as well as for capability analysis of subparts of enterprise or single enterprises is necessary to systematise and arrange all the technological capabilities depending on their nature. Those activities will be the basis for design of a structure for the database about technological capabilities (TECHNOL).
Technological capabilities are considered as hierarchic associations, whereas definition of technological capability acts as basis for classifying. In classification four levels can be distinguished.

Figure 15 Classification of technological capabilities (TV)

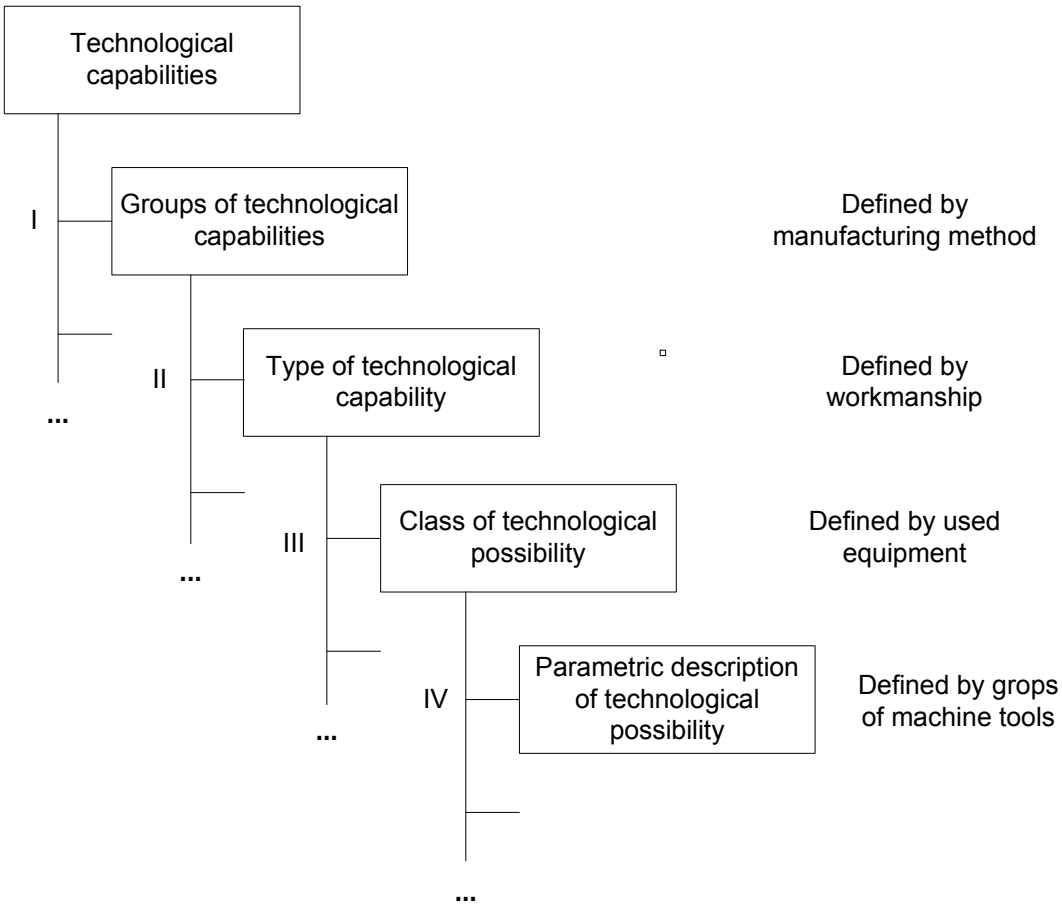


Table 2 Groups of technological capabilities (I: A)

Nr.	Name of the group
1.	Machining
2.	Machining of sheet material
3.	Electro-chemical methods
4.	Electric discharge machining
5.	Welding
6.	Moulding
7.	Heat treatment
8.	Finishing methods
9.	Powder metallurgy
10.	Engineering methods

Table 3 Description of technological capabilities within the group (types of technological capabilities in a certain field (II: B)

Nr.	Types of machining
11.	Turning
12.	Milling
13.	Drilling
14.	Grinding
15.	Threading
16.	Planing
17.	Broaching
18.	Hobbing
19.	Shapering

Nr.	Welding types
51.	Gas welding
52.	Spot welding
53.	Electrode wire welding
54.	MIG / MAG welding
55.	TIG welding
56.	Laser welding

57.	Automatic welding
58.	Friction welding
59.	Plasma welding

Table 4 Examples of machining type` explanation (III: C)

Nr.	**Type: Milling (12)**
121.	Vertical milling
122.	Radial milling
123.	Horizontal milling
124.	Portal milling
125.	CNC milling

Nr.	**Group of technological capability: 4 Electric discharge machining**
41.	Wire-cut EDM
42.	Ram EDM
411.	–
412.	–
421.	–
	…

Example: there are no types of electric discharge machining.

Table 5 Structure of the database of technological capabilities (TECHNOL)

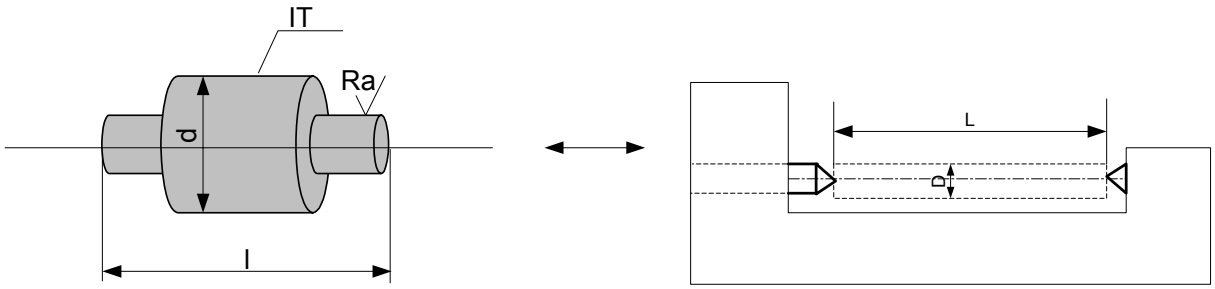
TV group	**TV type**	**TV class**	**Parametrical description**
MACHINING	MILLING	Vertical	L_{max} = B_{max} = H_{max} = $IT_{possible}$ =
		Radial	L_{max} = B_{max} = H_{max} = $IT_{possible}$ =
		Horizontal	L_{max} = B_{max} = H_{max} = $IT_{possible}$=
		Portal	L_{max} = B_{max} = H_{max} = $IT_{possible}$ =
		CNC	L_{max} = B_{max} = H_{max} = $IT_{possible}$ =
	DRILLING	Vertical	D_{max} = L_{max} = B_{max} = H_{max} =
		Radial	D_{max} = L_{max} = B_{max} = H_{max} =
		CNC	D_{max} = L_{max} = B_{max} = H_{max} =
		Coordinate	D_{max} = L_{max} = B_{max} = H_{max} =
		…	
…	…	…	…

Exercises by exploitation of technological capabilities

Knowledge of technological capabilities is important regarding from three aspects:

- What kind of products the enterprise is able to manufacture (product – machine tool)
- What are technological capabilities of different enterprises (similarities, differences) to enable organising co-operation as rationally as possible
- When technological capabilities of enterprise are fixed in some field, then how is possible to manufacture a product or group of products as rationally as possible?

Figure 16 Description of product and corresponding machine tool



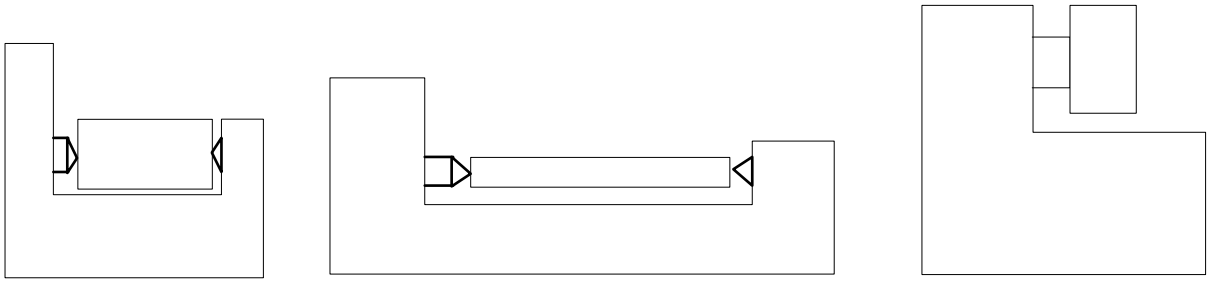
PRODUCT

- d – max diameter of machining
- l – max length of machining
- IT – quality class of machining
- Ra –surface roughness parameter

WORK-BENCH

- L – max distance between centres
- D – max diameter above support
- T – internal diameter of spindle
- TK –quality class of the machine tool
- PK –surface quality parameter derived from manufacturing method

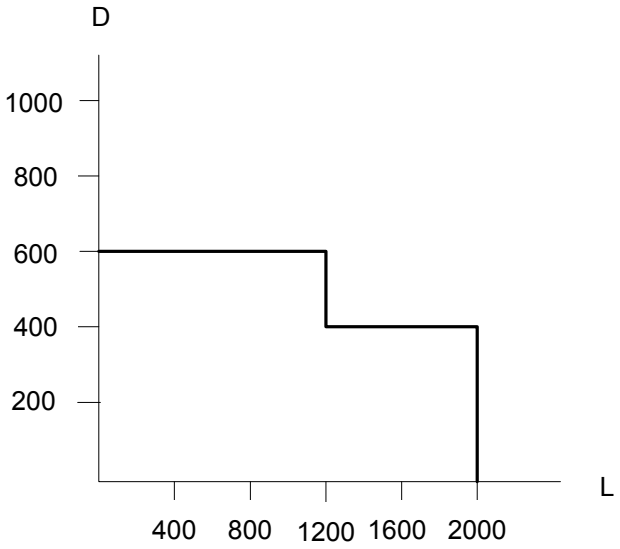
Figure 17 Defining machining possibilities on the basis of equipment within the class of technological capability



L ≤ 1200 mm
D ≤ 630 mm

L ≤ 2000 mm
D ≤ 400 mm

L ≤ 400 mm
D ≤ 400 mm



l ≤ 2000 mm; d ≤ 630 mm
Generalized possible technological path for a work piece manufacturing

General analysis of company's technological capabilities

Table 6 Groups of technological capabilities

Company	Technological capabilities									
	Machining	Processing of sheet material	Welding	Moulding	Methods of surface finishing	Electro-chemical treatment methods	EDM	Heat treatment	Powder metallurgy	Engineering methods

Table 7 Type-based analysis of toolmakers` technological capabilities

Company name	Machining									EDM		Heat treatment				Powder metallurgy		Engineering methods			
	Turning	Milling	Drilling	Grinding	Threading	Planing	Broaching	Hobbing	Slotting	Ram	Wire-cut	Volume-tempering	Surface tempering	Cementation	Nitriding	Pressing	Sintering	CAD / CAM	DNC	FEM	MRP / ERP

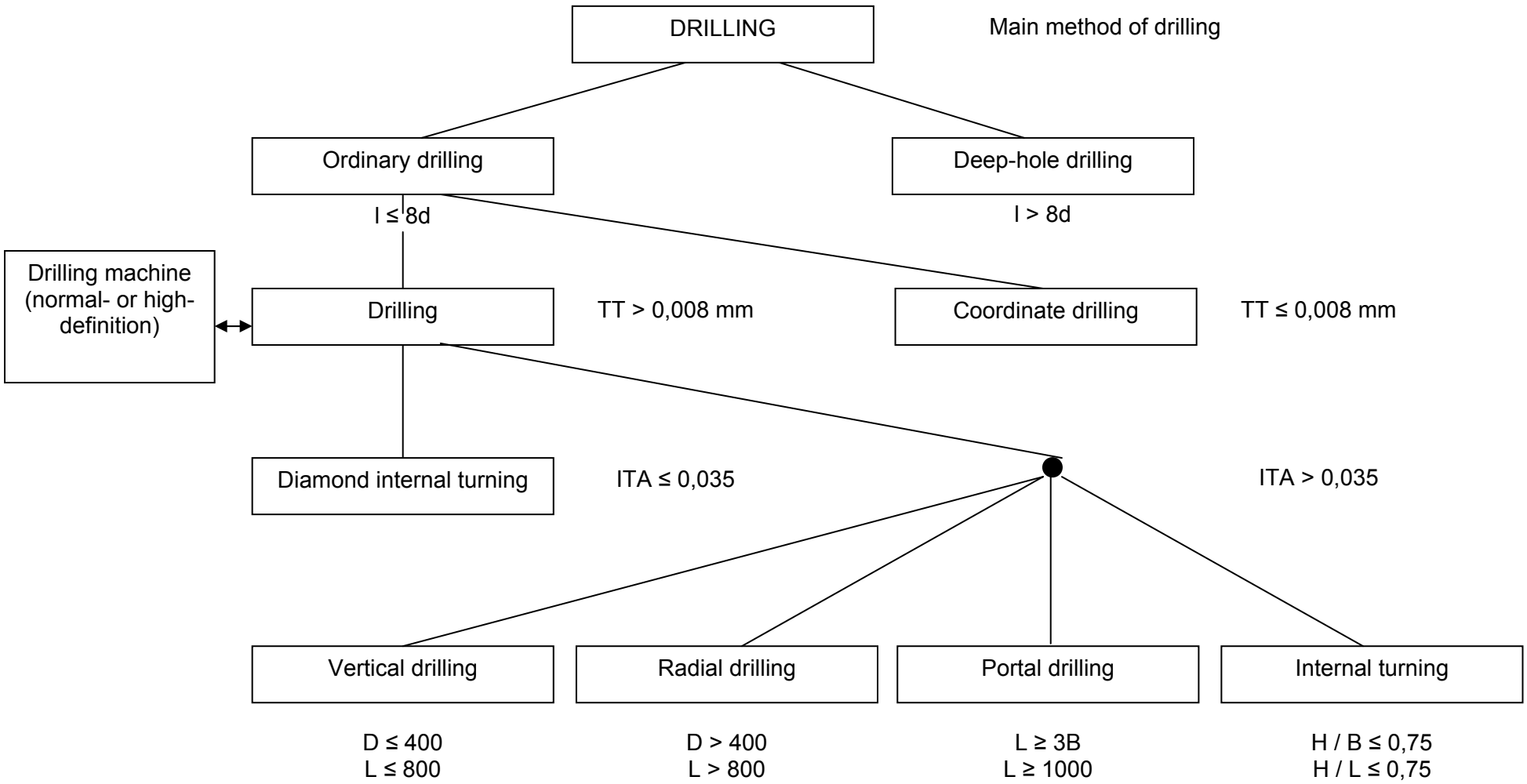
Table 8 Type-based analysis of metal engineering companies` technological capabilities

Company name	**Technological capabilities**																								
	Processing of sheet material									Welding							Finishing methods						Engineering-methods		
	Guillotine cutting	Plasma cutting	Gas cutting	Water cutting	Laser cutting	Bending	Folding	Sheet punching	Automatic-punching	Gas welding	Electrode wire welding	Spot welding	MIG / MAG	TIG	Laser welding	Automatic welding	Liquid painting	Powder painting	Chemical preparation of	Preparation of mechanical surface	Cold-zincing	Heat-zincing	CAD / CAM	DNC	MRP / ERP

Table 9 Exploitation analysis and description of technological capabilities of mechanical processing

Company name	**Technological capabilities**																														
	Turning					Milling					Drilling					Grinding						Threading			Gear making					Planing	Shapering
	Universal	Semi-automatic	Automatic	Internal turning	CNC	Vertical-	Radial-	Horizontal-	Portal-	CNC	Vertical-	Radial-	Coordinate-	Diamond-	CNC	Surface	Cylindrical	Centerless	Profile-	Thread	Gear	Cutting	Rolling	Milling	Cutting	Milling	Rolling	Honing	Shaving		

Figure 18


DRILLING
Main method of drilling
Ordinary drilling
Deep-hole drilling
l ≤ 8d
l > 8d
Drilling machine (normal- or high-definition)
Drilling
TT > 0,008 mm
Coordinate drilling
TT ≤ 0,008 mm
Diamond internal turning
ITA ≤ 0,035
ITA > 0,035
Vertical drilling
Radial drilling
Portal drilling
Internal turning
D ≤ 400
L ≤ 800
D > 400
L > 800
L ≥ 3B
L ≥ 1000
H / B ≤ 0,75
H / L ≤ 0,75

SUMMARY

INNOCLUS - **Inno**vative **clus**ter development in Metal-Machinery-Electronics Sector

THREE REASONS WHY INNOCLUS PROJECT WAS INITIATED:

- Necessity for activation of co-operation
- Need for mapping of technological capabilities of enterprises
- Need for analysis of existing networking bottlenecks

INNOCLUS II is focused on cluster development through specific research in following fields:

Development of economic clusters (business environment);

Development of integration clusters (industrial sector oriented business models);

Development of business-aid networks (rational use of company capabilities).

Objectives

Main objective of INNOCLUS II project is to strengthen cooperation of enterprises within metal, machinery and apparatus sector and to stimulate economic development through promotion of networks/clusters and increase of competitiveness by implementation of innovative measures at recreated European economic environment.

The idea of INNOCLUS II project came from necessity to activate co-operation not only between enterprises, but also among educational and science institutions, supporting structures of entrepreneurship as well as governmental institutions.

Activities of the Project:

- Development of integrated business area – business research and analysis
- Development of global co-operation network (manufacturers, enterprises, suppliers, educational institutions, engineering bureaus) - research and analysis
- Analysis of co-operation networks (Enterprises in the field of tool making industry, automobile industry, Machinery and apparatus industry) - research and analysis
- Establishment of virtual environment for rational management of resources of enterprises and increase of efficiency and productivity - placing research analysis into virtual environment
- Development of international co-operation through immediate introduction of sectoral and individual enterprises' capabilities (study trips in Finland - October 2005 and in Estonia - November 2005)
- Publication of project results/summary

Three main orientations of cluster-based economic development

1. Study and analysis of economic cluster

Expenditures of the companies increase due to continuous rise of the prices of the resources, also continuously increase customers' expectations regarding quality of the products and services and duration of the realization cycle. To ensure sustainable development, it is essential to be aware more and more about the essence of business environment (human capital, financing possibilities, sources and spread of information, legislative support, and operating environment) and its influence factors.

Development of the organization can be accomplished also through development of business environment. The company functions in the economic environment within governmental, juridical, educational etc support structures. What is the nature of appropriate economic cluster that would promote business activity and help an organization to make objective, rational, and timely decisions?

Such model is created on the basis of machine building, metalworking, and apparatus industry companies (5 + 5 companies), (6 companies), and support structures. The regional factor (Tallinn – Tartu) is taken into consideration.

2. Study and analysis of integration cluster

To realize its economic activities, a company has to be in cooperation with the elements of business chain (management, development, realization, logistics) in addition to the economic environment where the company operates. The most problematic is logistic cooperation of producers and suppliers (optimization of the supply chain). To ascertain and transmit to the companies the essence of the relevant economic structure, it is purposeful to elaborate the structure of the integration cluster that would enable to shorten delivery dates and arrange supply chains.

3. Study and analysis of cooperation network

Development of cooperation network on the assumption of the standpoint of various objective functions:

- Retrenchment of resources;
- More rational usage of technological appliances;
- Flexibility in order fulfilment;
- Rational usage of engineering resources;
- Shortening order time;
- Quality improvement and assurance.

The objective of INNOCLUS II is development of practical cooperation in virtual environment (resource estimation and allocation) to make order-handling process more effective and operative.

Primary target groups of project results:

- Enterprises of this sector - 4000
- Companies participating in the research and mapping (3 different researches include 50+10+6 companies)
- Representatives from business support organisations from both countries (Estonia-Finland)

Cross-border impact:

- To strengthen co-operation and specific networking between Finnish and Estonian companies and other business support organisations;
- To develop cluster-oriented activities of this industry and sector (metal-machine-apparatus);
- To analyse network situation in local level and to find the **transfer possibilities to the global network**.

Project partners

- Tallinn City Enterprise Board (TCEB)
- Federation of Estonian Engineering Industries (EML)
- Tartu City Government (Tartu Linnavalitsus)
- Regional Council of South-West Finland (Varsinais-Suomen liitto)
- Technology Industries of Finland (Teknologiateollisuus ry)

Project website: www.emliit.ee/innoclus