Technological Platform Manufuture.si STRATEGIC RESEARCH AGENDA (SRA)

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1. Presentation

The technology platform TP Manufuture.si is connected with the European platform Manufuture and other similar platforms. It focuses on R&D processes and also influences innovation and education in the field of manufacturing technologies and systems. All of these efforts will encourage Slovenian industry to produce parts with a high added value.

2. Technological positioning

The connections between Slovenian strategic areas and the strategic areas of the European TP Manufuture are shown in the following diagram.

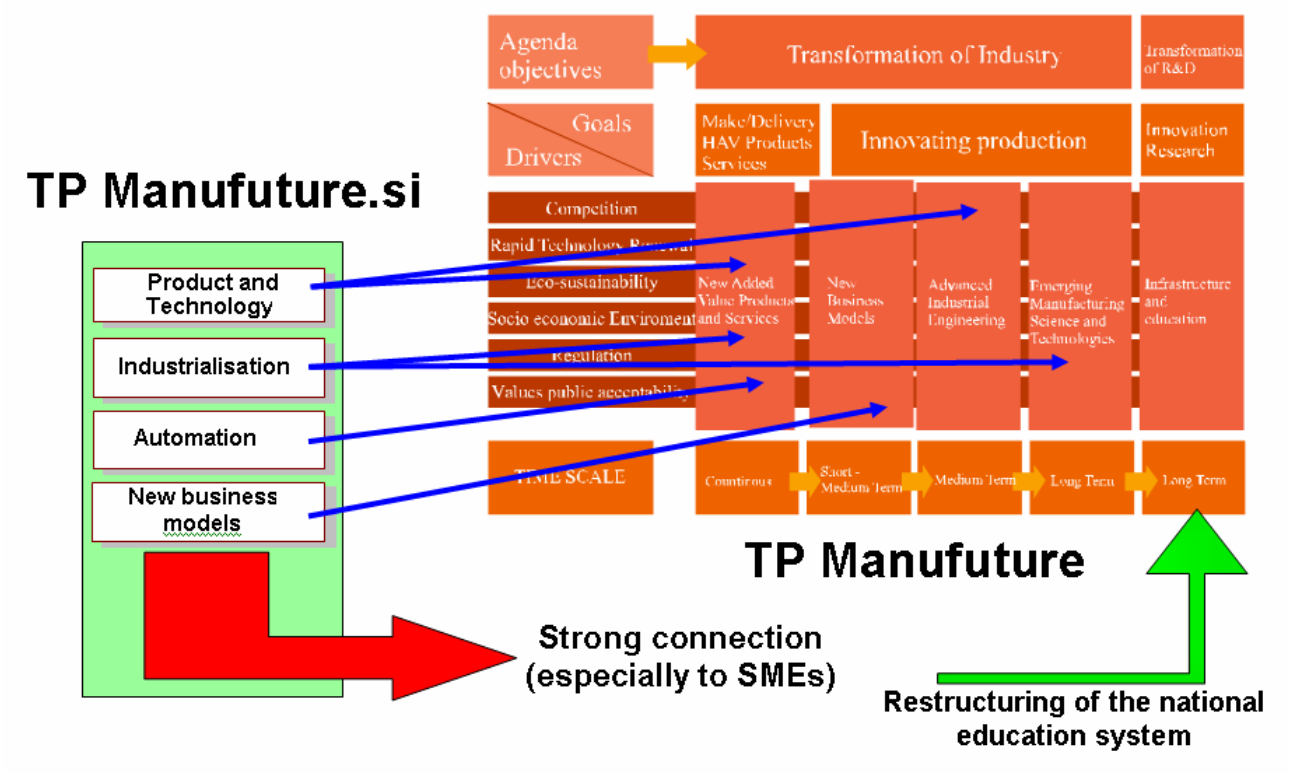

Diagram 1: Overview of connections between the national and European platforms

3. Development of TP

The development of TP Manufuture.si will take a similar path to the TP Manufuture in the EU. The structural scheme of Manufuture.si is presented in Diagram 2.

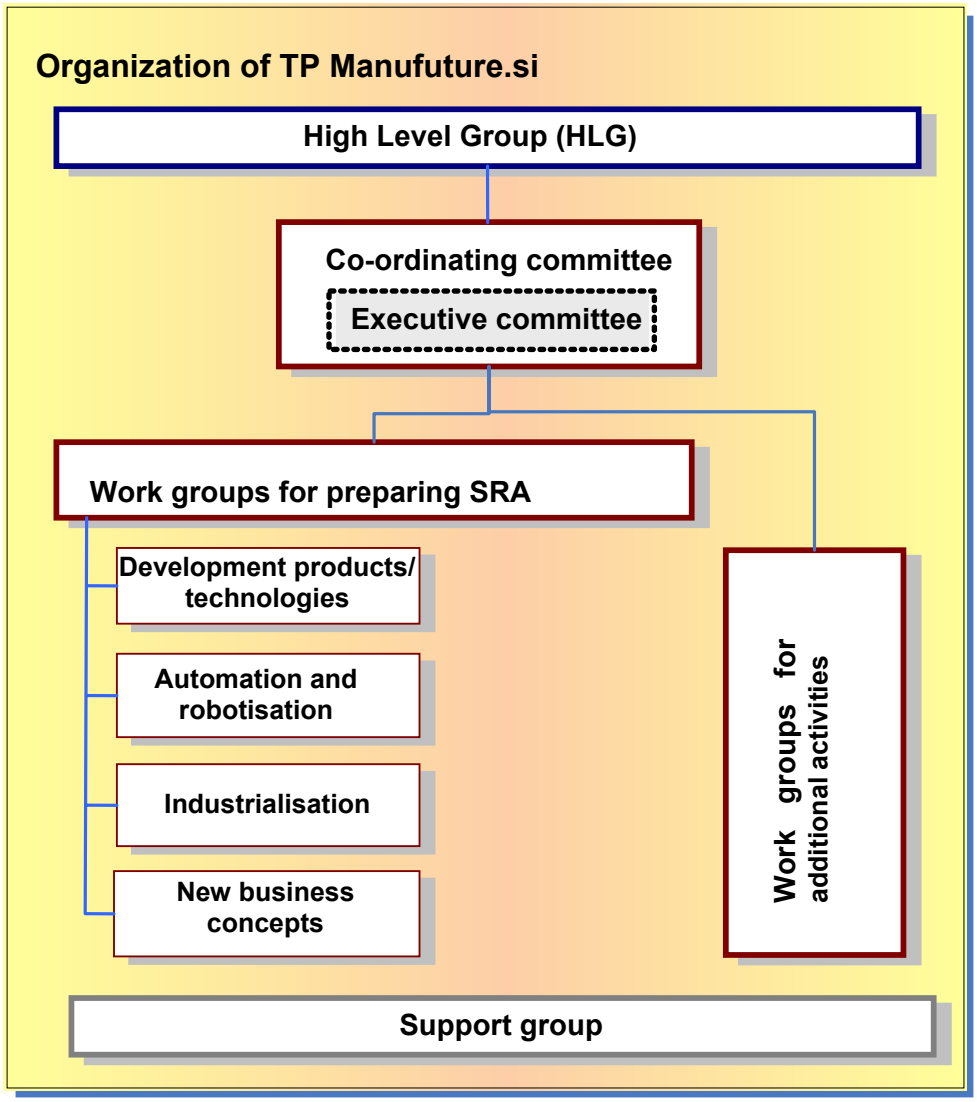

Diagram 2 – The organisation of TP Manufuture.si

4. Vision

TP Manufuture will become the basic technological platform and was established for the development of manufacturing technologies with the aim that the European level will acquire the most effective and progressive working group.

By 2008 our SRA will be accepted by the Slovenian government. In addition, some of our goals will be implemented in the EU commission and in EU projects. Communication and collaboration will be undertaken within the group. We will be a catalyst assisting our companies to work together on projects. In the education field we hope that the suggestions we make will be accepted.

5. Priority Research and Development Fields of the TP

At workshops the stakeholders of TP Manufuture.si have defined work groups and subtasks in each group.

Work group	Subtask
Development of products and technologies	➢ Creativity by part design (industrial design) ➢ Technical development of the parts ➢ Technological development of parts – mould-makers support ➢ Development of assistance technologies
Automation and robotisation	➢ Production informatics ➢ Support system for decision-making in production plants ➢ Quality assurance of the production process ➢ Production logistics ➢ Automation of machines, equipment and processes ➢ Managing of the infrastructural production sphere (energetics, ecology)
Industrialisation	➢ Co-operation between research & development and production ➢ Optimisation of a part in the research process ➢ Installation of a process in a production plant and an extended area ➢ Process of continuous improvement ➢ Transfer of production to other areas
New business concepts	➢ Production concepts ➢ Production models ➢ Integration of management business ➢ IT-support technologies ➢ Knowledge-based production ➢ Benchmarking characteristics, follow-up and decision-making systems

6. Needs in the Technical Area

6.1. Needs in the Technical Area – Development of Products and Technologies

Growing competition along with new customers in the international market are channelling new investment in Slovenian industry towards new technologies and new production techniques. The process of introducing these new production techniques is too slow because several Slovenian companies are oriented more to organisation than innovation.

When comparing between production techniques the forming technique is gaining an ever better position and enhanced importance. The ratio between strength and density is favourable; therefore the elements produced by using these techniques are lighter and cheaper. Today increasingly more techniques are combined with each other. Forming, joining or separation technologies can be combined.

Slovenian industry feels the pressure of automotive and other industries so it has to take care to continuously implement knowledge, new technologies and education. There are several trends Slovenian industry must comply with so as to satisfy its customers. These are:

- cheaper moulds, machines and services
- a continuous improvement in competitiveness
- a heterogeneous structure of business processes
- just-in-time production
- fast adaptation of production capabilities

The most competitive companies have organised themselves to respond to such demands. They have implemented co-operation, efficient organisation, CA-x technologies and modern manufacturing machines involving new techniques.

Traditional mould-making companies have to reorient themselves as companies with high-tech technologies. Through structural and organisational updates companies have to apply innovative technologies in the research and development and production processes. A precondition of further progress is to accept and undertake new processes, technologies and co-operation activities.

Testing and Sampling Centre for New Technologies, Moulds and Parts

Stakeholders in TP Manufuture.si strongly agreed at the workshops that Slovenian industry needs an independent testing and sampling centre to allow the testing of new technologies, new materials, new moulds etc.

The establishment of such a centre would bring several benefits like:

- Production capabilities will not be disturbed by sampling procedures.
- New technologies will be tested and their limitations and technical requirements identified.
- New parts and new moulds will move more quickly into production capabilities. This acceleration of R&D will be reflected in a cheaper final product.
- The centre will have infrastructural and personnel resources to undertake the research & development process and testing activities.

6.2. Needs in the Technical Area – Automation and Production Informatics

It is well known that both automation and production informatics contribute significantly to the competitive advantage of production companies. Applying the results of these two technical areas contributes to the growth of production, its flexibility, quality improvements to products, the reduced consumption of energy and raw materials, lower pollution levels, better safety conditions in the workplace etc. At the same time, investments in production automation and informatics are highly profitable.

In developed Western European countries development strategies in the areas of production automation and informatics were in the centre of interest 10 to 20 years ago. The consequence is that industries in these countries are more or less highly automated and supported by information systems. The current trends in automation and production informatics are based on integrating different levels of production control, optimising different production management functions, a holistic consideration of complex problems, optimisation of the lifecycle of control and information systems, complete computer support for the design of control systems, maintenance and other supporting functions, integrated enterprise management, a balance between technology, the organisation and humans etc. As for research, the stress is on controlling complex and hybrid systems and the development of control systems that are fault-tolerant and reconfigurable.

Slovenia must immediately follow such an orientation to achieve a competitive advantage of the national economy as well as the planned welfare growth. Two studies were recently carried out among production enterprises in Slovenia to check the level of their technological development. The analyses showed a substantial delay in Slovenian enterprises' development of control and information technology compared with those in developed countries. The main reasons for this lie in their lack of knowledge, qualified personnel and investments. Companies providing engineering solutions in the areas of production automation and informatics are mainly small or medium-sized enterprises (frequently connected with foreign partners) which cover the main technologies and successfully operate above all in the domestic market. Yet their investments in development are relatively low. To be present more extensively in the regional market they would need a critical mass of professional staff and knowledge. Universities/institutes have groups with solid theoretical knowledge and certain experiences with applications. However, they are frequently insufficiently connected with the problems users face. One common deficiency is the weak innovative environment which makes the exchange of knowledge less effective.

The chief advantages for users are the existing tradition of knowledge and experiences, the presence of some highly developed enterprises, the high profitability of control technology, the relatively simple attainability of the necessary equipment and services etc. The advantage of engineering firms (solution providers) is that they are very flexible, have access to advanced technologies, are closely connected with users, they also have access to the knowledge in Slovenian institutions etc.

In defining the priorities of development orientations in Slovenia the knowledge and vision of engineering enterprises, the needs of users and development trends around the world were taken into account. It was found that the primary stress must be on the development of production informatics, the holistic control of complex processes, fault detection and quality control, the support of logistics in production enterprises, technologies that improve the quality of life and reduce pollution, the automation of machines and devices and those technologies enabling the development of new tools and building blocks for control systems.

6.3. Needs in the Technical Area – Industrialisation

The »Industrialisation« field encompasses processes in the phase of realising new products which companies offer to the market in different forms. The industrialisation field itself does not deal with basic research and development, nevertheless it involves a continuation of activities in the R&D field performed either within the production system or within groups organised for realisation of an activity (universities, institutes, RR-companies etc.).

The production sphere's co-operation with the R&D field is clearly necessary and sensible since industry with its potential and resources influences the direction of R&D for it best knows the market's reaction to the existing supply and demand for new products. Of course, the precondition for this is an appropriate connection between R&D and industry. In Slovenia this connection works when R&D activity is within a certain system (company), however the connection between industry and independent R&D groups does not work so well. These channels are usually informal and left to the own resourcefulness of both sides.

With its own participation in R&D activities, industry can most efficiently influence the optimisation of a product and simultaneously monitor the starting process and lifecycle of production since, already in an early phase, it realises the need for adequate capacities which is why it directs and ensures them in due time.

A very important process in the industrial field is the process of continuous innovation and technical improvement through which we follow the development of engineering and technology and at the same time provide for the preservation of production profitability. This process can also be used as suggestions for R&D activity.

In industry ever more attention is being paid to the question of where to carry out the production process? The key influence on this in a democratic and free market system is the economy which often only considers the price of labour, while other more burdensome aspects (infrastructure, ecology etc.) are shifted to the wider community (the state or the taxpayers).

6.4. Needs in the Technical Area - New Business Models

Present-day production is still based on the Taylorian paradigm which reached its culmination in the 1930s. If we analyse how product development and production occur in industry today, one can notice that we are dealing with various computer technologies, heterogeneous manufacturing technologies, including high levels of automation at various levels and that primarily we are dealing with a traditional way of organisation and management. New innovative methods such as methods of work that introduce new approaches and methods, e.g. concurrent engineering, teamwork, lean production, kan-ban, the JIT rule of conduct and total quality management are bringing improvements. However, the question is whether this is enough.

Extensive research activities carried out in the last decade demonstrate that these new approaches allows us to make profitable use of achievements in science, manufacturing cybernetics, social and organisational disciplines, and information communication technologies. Thus, entirely new manufacturing concepts are emerging in terms of new working methods and working structures based on autonomy, self-organisation, self interest and competition and which are suitable for co-operation and being adapted in a geographically distributed environment.

The first steps have already been taken in this context. Intensive research is continuing in this direction. In addition, the first prototypes are being developed and implemented on a certain scale. Through the initiative of the technology platform on future manufacturing technologies called 'Manufuture' several different possibilities and opportunities for the research, development and introduction of these new concepts in Slovenia as well as across Europe can potentially enable industrial companies to achieve a competitive advantage in global markets.

7. Priority Research and Development Directions

7.1. Priority Research and Development Directions–Development of Products and Technologies

In the field of developing new parts and new technologies several activities have been identified. The most important are mentioned below:

- **Industrial design** will have to accelerate faster in Slovenia. Many Slovenian companies do not have a clear interest or sense of industrial design. The TP Manufuture.si will have to take an active role in work on the organisation of industrial design, which is a generator of new ideas, new parts and needs for new parts, that are in turn creating industrial prosperity.
- **High-speed cutting – HSC technique**. Highly effective production can be achieved with high-speed cutting and fast movements between operations. HSC has been developed especially for the machining of hardened materials with a combination of TiAlNi, CBN and TiCN cutters.
- **Machining of materials in the dry stage**. There is demand for high accuracy, perfect surface quality and primarily the purity of the working place, parts and machines. Machines and processes are not polluted with a cooling emulsion, which also benefits the environment.
- **Sheet-metal forming technologies** are gaining a better and better position in comparison to cutting techniques. They have a good ratio between the strength and density of the final parts. Several new technologies of sheet-metal forming have this advantage enabling processes to be faster, production to be cheaper and universal for use in all sizes of mould-making companies. One very important value is the accuracy of production. Trends in processes include the joining of process stages into one die and also incorporating a laser which can be used for cutting, welding, drilling and measuring.
- **Laser sintering of prototype moulds.** The direct laser sintering of metal powders DMLS is nowadays one of the most important procedures for rapid prototyping and rapid tooling.
- **Automatisation techniques.** Special Automation techniques are being developed to boost productivity, improve quality and ensure the greater transfer of data or goods. The following are frequently used:
  - CNC 3 or more axes milling centres
  - Industrial robots
  - Automatisation montage control and testing workplaces
  - Automatisation logistic systems

7.2. Priority Research and Development Directions – Automation and Production Informatics

Development trends in the areas of automation and production informatics are defined with three key components: contemporary research results in the theory of control, the possibilities of implementing these results and the specifics of the two technical domains. During the process of defining the priority research and development areas in automation and production informatics in Slovenia, the knowledge of solution providers, the needs of industrial users and contemporary development trends in developed Western European countries have all been taken into account. It was found that a research and development focus must be given to production informatics, the holistic control of complex processes, fault detection and quality control, logistic support in production enterprises, technologies that improve the quality of life and reduce pollution, the automation of machines and devices and to those technologies enabling the development of new tools and building blocks for control systems. The main research and development activities in the areas of production automation and informatics are:

- Production Information Systems (including the integration of existing IT products and development of new software modules to design a holistic production management information system, an online data linkage with SCADA, ERP systems)
- Decision Support Systems in Production Management (an implementation of the Balanced Scorecard and Key Performance Indicators methodologies in production management)
- Quality Assurance and Management of Production Process (including fault prediction, fault diagnostics, automatic online product quality control, robotisation of production processes)
- Production Logistics (traceability of products and production processes, warehouse logistics, supply chain management)
- Automation of Machines, Devices and Processes (design of embedded control systems and advanced control algorithms for complex machines, devices and technological processes)
- Management of Infrastructural Production Areas (energy, ecology)

7.3 Priority Research and Development Directions – Industrialisation

The priority R&D direction in industry involves adaptations to the market's demands and the recognised potential for production in an environment offering the best conditions.

An industrialist (the owner of a company) is driven by the incentive for competition and the state should provide for the well-being of its citizens. Is the EU a uniform space or just a group of countries with their own interests; this is of course a question for the future development of the EU and the interconnection of incorporated countries. It is a fact that every side is planning its own strategy where the industrialist is obviously faster and more adaptive than the state. It would be proper if both had the same global strategy, however this can only be realised when both sides have the appropriate incentive. The industrialist's drive will remain unchanged; it is the state that has to make a move to offer him conditions that attract his attention and thus trigger a decision to establish his industry in the national territory. Naturally, each country should have a motive to keep the congruent development of industry as its existence has the same strategic meaning for it as agriculture. Industry namely creates products (more or less) necessary for life and thus creates the

purchasing power of the population, enabling other branches to function (services, trade, culture, health care, education etc.).

To be able to offer appropriate conditions, the state (national or EU level) must first identify the available resources (human resources, raw materials, power resources, infrastructure, environmental conditions etc.) and, on this basis, prepare an appropriate strategy for the development of industry and provide the missing conditions for such development.

7.4. Priority Research and Development Directions - New Business Concepts

The priorities of research and development in the field of manufacturing concepts should address: (1) the development of new business models and new manufacturing structures; (2) new methods of work with an emphasis on collaborative work; (3) the development of a web-based environment for collaborative work and virtual networking; and (4) methods and tools for working in a distributed and ubiquitous environment.

The research and development of new business models and new manufacturing structures should include concepts and models of adaptive distributed manufacturing systems and related conceptions, e.g. production networks, the development of new methods of work in product development, design, production and in support of the product lifecycle, the development of concepts and an information complex for establishing the so-called digital factory and integration at technological and organisational levels.

The research and development of new work methods with an emphasis on collaborative work should include the development of methods, tools and the environment facilitating collaborative work, development strategies and methods of marketing resources, along with the development of a platform to support the creative co-design of innovative high-tech products.

The research and development of a web-based platform for collaborative work and virtual networking should also include web manufacturing services of various kinds, e.g. process consultancy, machinability expertise, rapid prototyping, machining etc, and related knowledge-intensive services to support product and process design and development, production, maintenance and the whole product lifecycle.

The research and development of methods and tools for work in a distributed environment should include the theoretical fundamentals of collaborative networks, the development of a company/factory for work in a virtual environment, the design, structuring and control of virtual network organisations, the creation of a virtual laboratory as a professional society in manufacturing, and knowledge management to support the marketing, design and manufacturing of innovative products.

8. Conclusions

TP Manufuture.si has the following aims for its work:

- The number of members of TP Manufuture will constantly grow.
- The SRA will be accepted by the Slovenian government.
- In the education field it is hoped that the new programmes will incorporate our suggestions. Slovenian industry needs more technically educated people because they produce high added value products.
- TP will be a competitive partner of the Slovenian government.
- TP will organise a testing and sampling centre for new technologies, new moulds and parts. The initiative has already been given by Slovenian plastics producers and mould-makers because they need good testing and sampling capabilities.
- We will attempt to ensure our suggestions are incorporated in EU recommendations and EU tenders.
- Manufuture.si will constantly contribute good practices within the TP and beyond.

Manufacturing technologies have and will be one of the most important chains in the European economy. The present turbulent situation means industry has to respond quickly to demands stemming from the market and environment.

Knowledge and innovation will ensure that parts and technologies with high added value will be implemented and produced in Europe because high added value production alone will be enough to compete with LCC.

All these requirements have been established and push us to change our mindset and reorient ourselves to education, innovation and partnership relations with all European actors. European manufacturing technologies have to act co-operatively in the direction of research and innovations for all companies and regions. Research and development should be oriented to new models, new parts and new technologies.

9. Annexes – A presentation of the members of TP Manufuture

	Company
1	Alpina d.d.
2	Danfoss Trata d.o.o.
3	DAPLAST d.o.o.
4	Domel d.d. Železniki
5	DOMPLAST Ostrovršnik Darko s.p.
6	EMO Orodjarna, d.o.o.
7	EMO-TECH proizvodna družba d.o.o.
8	Eta, d.o.o. Cerkno
9	ETI Elektroelement d.d.
10	FORSTEK d.d.
11	Gorenje Orodjarna, d.o.o.
12	Impol d.d.
13	Iskra Asing, d.o.o.
14	Iskra Avtoelektrika orodjarna, d.o.o.
15	Iskra Avtoelektrika, d.d.
16	Iskra pro
17	ISKRAEMECO, d.d.
18	Isokon, d.o.o.
19	Kovinoplastika Lož
20	Litostroj EI
21	LMP, Proizvodnja orodij in naprav d.o.o.
22	MLM, Mariborska livarna Maribor d.d.
23	Modelarstvo Hohler d.o.o.
24	Nafta Strojna
25	Nieros Metal
26	Niko Železniki
27	Polycom, d.o.o.
28	SavaTech
29	SIBO Orodjarna, d.o.o.
30	Tehnos, d.o.o.
31	TPV
32	Trimo Trebnje
33	UNIOR, Kovaška industrija d.d.
34	VAR d.o.o.

	Institution
1	CIMRS, Maribor
2	C-TCS, Tool-making cluster of Slovenia
3	GEA Colleague
4	GIZ ACS - Automotive Cluster of Slovenia
5	GIZ SLOVENIAN PLASTTECHNICS CLUSTER
6	Chamber of Commerce and Industry of Slovenia
7	Jožef Stefan Institute
8	Chamber of Craft of Slovenia,
9	Racio razvoj, d.o.o.
10	Reginal development Agency d.o.o.
11	Regional Technological Centre Zasavje d.o.o.
12	School Center Celje
13	TECOS – Slovenian Tool and die Development Centre
14	University of Primorska Faculty of Management Koper
15	University of Ljubljana, Faculty of Mechanical engineering
16	University of Maribor, Faculty of Mechanical engineering