SRIP MATPRO

Key orientations of SRIP MATerials as end PROducts (SRIP MATPRO)

1.) The key objectives

The key objective of SRIP MATPRO is to create value chains with a focus on the production of materials for use in complex products with high added value and a strong potential for positioning in global value chains. Connectivity will be based on promoting and enhancing the development of ambition and quality as well as on strengthening the strategic alliances and the establishment of horizontal networks, thereby achieving a critical mass of competences and capacities, complementing various technologies in terms of the development of new materials, products and services, the integrity of covering the whole cycle from development to marketing, and addressing technological and non-technological innovations, promoting entrepreneurship as well as providing other common services. The joint development of the R&D initiatives will be carried out in two basic directions i.e., through a common pre-competitive development between companies from related branches, where it is to solve the fundamental challenges, and to joint development within the established value chains between companies from different branches. MATPRO members will be provided with an appropriate research environment, which is especially important for medium and small enterprises. In doing so, we will contribute to reducing the risks of investing in high-tech equipment, achieving a critical mass of competencies, capacity and investment potential, increasing the utilization of equipment and contributing to establishing long-lasting business relationships.

<u>The main objectives of the operation:</u>

- To strengthen the cooperation of producers of materials that already achieve high added value and play a significant role in international value chains, among themselves and with knowledge institutions.
- Identification of the value chains (SLO): 2017 - 2023: 5 chains, 2019 - establishing at least 2 chains; 2023 - establishment of at least 3 (additional) chains, of which identification of the value chains (international): 2017 - 2023: 3 chains, 2019 - establishment of 1 chain, 2023 - establishment of 2 chains. All of these goals represent the lowest values that we expect to be exceeded.

<u>Objectives by 2023</u>

- Increase in added value per employee for companies active in the production of alloys and metals (participating in established and appropriately supported value chains) by 25% by 2023.
- Increase in export and added value per employee in the area of smart coatings (participating in established and appropriately supported value chains) by 20%.
- Increased investments in development by 15%, added value by 5% and exports in the field of smart multicomponent materials by 10%.
- Increased intensity and quality of representation of Slovenian interests within international organizations, partnerships and consortia (6).
- Number of commonly developed services (10).
- Number of relevant initiatives in terms of development policy e.g., initiatives for the implementation of innovative public procurement (8).

2.) Key global indicators

The performance indicators presented in the tables are designed to monitor the performance of all the value chains included in SRIP MATPRO. The purpose is to verify and monitor the business results of the different forms of established cooperation. In the case that the value chain during a given 3-year period (first or second) does not reach the planned growth at in least four out of seven (all indicators are given in the text of the Action Plan) of the performance indicators, it is considered not to be economically viable. The exceptions are predetermined risks, which particularly affect all companies in certain activities, but in this case the value chain must also achieve better business results than a comparable activity (a smaller drop in added value).

SRIP MATPRO		till 2018	till 2022	Activities: C20, C22, C23 in C24
Added value/ Employee	Productivity of labour. The higher the value added per employee, the higher the potential gross salary of the employee.	**2,3% Per year**	**2,8% Per year**	Higher value added rise is expected than the number of employees due to larger investments in automation and optimization of production.
Exports (turnover on foreign markets)	Higher exports, on average, mean higher competitiveness of the company or a general increase in demand abroad.	**1,8% Per year**	**2,3% Per year**	Net sales in the non-domestic market
Investments in R&D	Higher R & D investment is expected to be reflected in a higher value added, but there is an expectation of a lag between investments and a positive impact on the financial statements	**2,0% Per year**	**2,0% Per year**	This includes both expenditures and R & D investments. Companies are not required to report these values, so the comparison between companies is limited to a statistically significant sample (companies that together account for at least 25% of sales).
EBITDA	EBITDA is a cash-flow from operations before depreciation. The higher the EBITDA, the more profitable business is.	**2,3% Per year**	**2,8% Per year**	
Net profit	Net profit represents the final result of the business. Attachment "net" means that a particular SRIP company can have a loss, but the aggregate result is still positive.	**2,3% Per year**	**2,8% Per year**	Net profit is calculated "cleared", excluding impairment of financial assets (fixed and current assets) and revaluations (Financial investments)

In 2013	**Metallurgy and metallic materials** (activities 23 and 24)	**Chemical industry and industry of multicomponent materials** (activities 20 in 22)
Share in total sales	**3,03%**	**4,12%**
Share in total sales of manufacturing branch	**9,96%**	**13,53%**
Export orientation (% of sales)	**67%**	**71%**
Employees in R&D (FTE / 100,000)	**1.220**	**5.771**
Researchers in R&D (FTE / 100,000)	**558**	**2.693**
Investments in RR	**23 mio €**	**29 mio €**
% GNP	**0,06 %**	**0,08%**
Added Value / Employee	**38.200 €**	**43.000 €**

3.) SRIP Strategy

SRIP MATPRO is focused on materials and, preferably, on materials production. The materials are divided into metallic materials, which include metallurgy, foundry and technologies of production, and processing, as well as multicomponent materials, whose main characteristic is that they are not homogeneous but include different materials/components, combined in very different ways (from coatings, nanocomposites, Multi-layered films, glued structures, to classic composites). The main objective of SRIP MATPRO's work is to create value chains and networks for joint developments in the field of materials; therefore, in addition to the production of materials, suppliers of basic components and raw materials, materials processing as well as final product manufacturers are included in the cooperation. SRIP MATPRO gives strong emphasis to both materials and technologies.
The field of materials as final products has a particularly high priority in Europe, which directly and completely follows the principles of smart specialization, and supports the regional advantages of Slovenia. The analysis of the field of materials, world markets and trends, industrial needs and R&D challenges, competence advantages, R&D capacities, and above all, the potential of Slovenian companies demonstrated that the comparative advantages of the main players in Slovenia stand out in the following areas: (i) high specialization and high degree of flexibility, (ii) high technological intensity and strong focus on innovations, (iii) relatively good organization, (iv) responsible attitude, effective use of resources and a high recycling rate, (v) close cooperation between companies and knowledge institutions in the use of public R&D funds, (vi) integration into global chains, (vii) niche mode of operation for medium and small enterprises, (viii) good market knowledge and (ix) the exploitation of local providers. On the basis of the conducted analysis, a set of focus areas was identified that meet the criteria for the development of breakthrough initiatives. The key competences, critical mass and the potential of integration into chains that would allow the development of breakthrough solutions were the most important criteria.

Composition of SRIP MATPRO:

- Slovenian Chamber of Commerce (as a notifier) with 2 industrial associations and its members (86 micro enterprises, 47 small enterprises, 61 medium-sized enterprises and 37 large companies, of which approximately half are located in the eastern Slovenian region, and another half in the western one), represent the immediate supporting environment.
- Direct members of SRIP MATPRO (20 companies and 4 knowledge institutions), where scientific research institutes and knowledge institutions form a broader support environment
- Cooperation talks run with many subjects, both with companies and with knowledge institutes, including two of the largest Slovenian universities.

SRIP membership provides a critical mass of competencies and capacities. The field of human-resources development is one of the key elements of the long-term achievement of the set goals, so SRIP MATPRO pays special attention to it. The work will include the prediction of competence needs, the identification of gaps in current and required competences, and development of appropriate programs for acquiring the necessary competences. SRIP MATPRO supports the internationalization of activities, which has three key orientations: 1) Integration into European initiatives (S3 thematic platforms including pilot projects (e.g., Vanguard Initiative), entry into European development projects (e.g., H2020), 2) Connecting with foreign partners within the framework of the development of value chains. The starting point represents the existing relationships between Slovenian and foreign companies, 3) Promotion of Slovenian industry abroad through the organisation of events or visits.

4.) Focus areas with identification of the activities of joint development

Identified focal areas on which SRIP MATPRO will promote joint research and development tasks are:

a) The area of steels and special alloys.

i) In order to achieve high standards of quality, reliability and safety, the purity of steel and alloys, or the control of non-metallic inclusions, errors and irregularities in the microstructure is important. On the other hand, the requirements of the automotive industry by reducing consumption and environmental impact dictate the use of advanced high-strength steels, and lightweight metallic materials which, in addition to extreme mechanical properties, also provide 100% recyclability. The development of new advanced metallic materials for the most demanding applications and working conditions will enable a significant improvement in the processes of obtaining and storing energy, protecting the environment and improving the quality of life.

ii) Areas of joint development, where Slovenia has a potential and critical mass:

1. The concept of ultra-pure steel and alloys - inclusions lower the strength, but above all the dynamic properties of the material, which means lower reliability. The production of ultra-pure steel involves R&D initiatives in the field of steel-making technologies, from the development and understanding of secondary metallurgy to thermodynamic calculations, understanding and modelling processes of the motion of inclusions in the melt, in-situ observation of non-metallic inclusions in the melt (formation, elimination, dissolution and interaction between inclusions), the influence of slag, new methods for the characterization and analysis of inclusions, re-metallurgy, vacuum treatment of steel melt and special metallurgical processes.
2. High-strength steels for lightweight constructions and their transformation - with the transition to high-strength steels and steels enabling the construction of products having minimal weight, which above all combine high strength and elastic properties, besides the development itself, we also encounter difficulties in transforming, machining and joining these materials. Potential and competences are in the field of complex thermo-mechanical processing, the development of high-strength martensitic steels and their heat treatment, the third generation of high-strength steels and nano-structured and nano-bainite steels, low density steels, new multi-layered steels, the production of suitable tool steels, the protection of tool surfaces, the preparation and protection of high-strength steels, steel transformation, production and functionalization of the surfaces of products.
3. Advanced metal materials for demanding applications – the Slovenian metallurgical industry has the significant advantage of rapid adjustment to niche production compared to mass producers. With this, it has the potential to develop advanced metallic materials, which includes the production of new steel grades, for example, maraging steels, nickel super alloys, special steels for high-temperature applications, thermo-electrical alloys and sensors, new electro steels with super low power losses, new magnetic materials, and biocompatible metallic materials, supported by simulations and optimization of the entire process path. Recently at the development of new materials, an important role is given to the imitation and transfer of solutions found in nature, and their application to a wide range of technological areas (biomimetics).

b) Aluminium:

i) In addition to the automotive and aerospace industries, Al alloys also have enormous potential in a wide range of other fields, such as medicine, pharmaceuticals, military industries, interiors, etc. The development of new high-strength and corrosion-resistant aluminium alloys is expected to combine 100% recyclability, low weight, high carrying capacity and maximum energy absorption.

ii) Areas of joint development, where Slovenia has a potential and critical mass:

1. New high-strength and ultra-pure Al alloys – The properties of standard aluminium alloys, including high-quality ones, do not meet the stringent requirements of high-tech applications, which require a

tensile strength of more than 600 MPa. Therefore, R&D initiatives are aimed at the development of new high-strength and ultra-pure Al alloys with better mechanical properties and corrosion resistance, which include the introduction of new alloying procedures, melt refinement, treatment with trapping and modifying agents and an appropriate curing process and thermo-mechanical processing. Al foams represent a significant segment of kinetic energy absorptive materials. New segment is being formed on the field of joining of newly developed Al alloys.

2. Alternative manufacturing methods and maximum recycling of Al - Al alloys are divided into quality classes with special properties and with very narrowly defined alloying elements, which limits their production by using only secondary raw materials. In order to achieve a higher recyclability, the development focuses on new recycle- friendly alloys based on a basic understanding of the complex impact of a large number of trace elements on the properties of Al alloys, the replacement of existing standards based on the purity of primary aluminium, the standards of purity of waste and the introduction of appropriate procedures in the sorting of waste and introducing new melt purification technologies. On the other hand, the production of alloys with the highest quality requirements (for the aerospace industry) still requires the use of a certain portion of the primary Al, which requires further development in order to achieve cheaper and faster production of primary Al.

3. Die cast Al alloys - Trends are aimed at the production of new high-strength, temperature-stable and corrosion-resistant moulded Al alloys for production of complex Al castings for aerospace, and automotive industries. With a large network of foundries and aluminium alloy production, Slovenia has a considerable potential, which requires the acquisition of new technologies for special casting processes and rapid clamping, the development of new alloys, and the investigation of the modification of foundry Al alloys, as well as the determination of the influence of chemical composition, conditions of solidification and cooling, and heat treatment.

c) Technology.

i) The field of classic manufacturing technologies is developing into the optimization and improvement of machining processes, the development of new tools and manufacturing technologies, with the recycling of both basic as well as auxiliary materials and by-products becoming an increasingly important segment of the production process of metallic and non-metallic materials. The greatest advancement and change in the field of technology comes from the additive 3D printing technology.

ii) Areas of joint development, where Slovenia has a potential and critical mass:

1. Rapid Prototyping and additive Technologies – R&D potential and emphasis will be on the development of new metal materials ready for 3D printing, mastering the microstructure and the influence of the direction of construction and density, the introduction of combination of different additive technologies, the production of printed products of large dimensions, printed composites and nanocomposites, greater precision of the printing and surface quality and gradient phase structure with continuous gradient of properties.
2. Recycling - (Metallic materials, rare earths, composites, auxiliary materials, by-products) – successful recycling begins with the development of material, component design and planning of the production process, which also includes the recycling of auxiliary materials, secondary products and waste materials. The potential and competence of maximum recycling capacity exist in the production of raw materials and auxiliary materials, the production of steel and aluminium, foundry, metal products and permanent magnets, the production of composites, elastomers, and auxiliary decomposition, handling and the use of secondary products. A special segment represents the transport, storage and utilization of CO_2 generated in the production of materials, as well as the reduction of energy consumption, the utilization of generated waste heat, and the use of bio-metallurgical processes in the recycling of alloying elements.
3. Advanced casting technology – With the development of materials and above all with the increase in the complexity and dimensional accuracy of castings, the trends in casting techniques and technologies change significantly, which applies both to casting in both single and permanent forms. The main focus is the ability of the melt to fill a thin wall, modification, development and complementation of casting technologies, integration of heat treatment with temperature controlled casting engineering, the development of ecologically acceptable sand mixtures, and the introduction of an integrated simulation product optimization and production.

4. Modern technologies for processing polymers and hybrid materials - In the production of products, it aims to install lightweight, but in mechanical properties comparable materials to classically-used metals, and look for cheaper and more energy-efficient solutions to manufacturing processes that make complex components possible. In the segment of modern processing technologies, there is a strong potential in the field of multi-component polymer spraying, functional integration of structural components into injected products, pressing polyurethane plates with long fibre spraying and hybrid manufacturing.
5. Modelling of materials manufacturing processes - modern development of materials and technologies cannot be imagined without modelling of the processes that take place during material production. Modelling can be done by combining already developed models or by developing new models that cover several phenomena under one framework. The biggest challenges in this field are mainly related to the problem of transitions or clustering of models between different spatial and time scales. The design of the microstructure, which defines the final properties of the material, is in the field of production of materials carried out on all four main spatial scales, i.e. on electron, atomic, mesoscopic, and macroscopic scale, respectively.

d) Multicomponent smart materials.

i) smart integration of the various components into a single material exceeds the existing properties frame and opens the way to completely new materials with so far inaccessible properties.

ii) Areas of joint development, where Slovenia has a potential and critical mass:

1. Multi-component smart fibres and textiles - a new generation of multi-component fibers and textiles with built-in functions (environmental responsive components, sensors) that passively or actively contribute to safety (antibacterial action, discharge), provide information (UV sensors) or provide comfort (passive or active conservation Optimal temperatures). At the same time, basic material functions such as strength, stability, etc. are increased or maintained. The technology reforms to use the renewable or recycled materials, aiming for increased durability.

2. Composites - conquering and exceeding state-of-the-art composition, production, processing and re-use of key components in most high-tech sectors (e.g., aviation, automotive, energy, leisure / sports, construction). Automation and shortening of production cycles, new raw materials (thermoplastic resins), combination with additive technologies. The maintenance and especially decomposition and successful recycling of composites represents for the time being an untapped potential.

e) Functional coatings and advanced binders (for metals).

i) The key role and scope of the application of coatings and binders to protect products and joining multicomponent structures are increasing, but coatings/binders must meet ever-increasing requirements, which requires a new generation of materials.

ii) Areas of joint development, where Slovenia has a potential and critical mass:

1. Functional coatings – next-generation coatings will combine environmental acceptability (no volatile organic solvents, renewable components), functionality (functional nanoparticles, wear and damage indicators) and durability (self-renewing coatings).

2. Resins and binders - new generations will have smaller discharges (solvent abandoning/replacement), modified composition with improved functionality and wider application, as well as quick application (suitable for rapid production of composites or glued structures). Emphasis will also be placed on introducing renewable components.