



Final Report INNO PROVEMENT Project Final version

Introduction

The Ministry of Industry and Trade (hereinafter “MPO“) is providing solutions in the thematic area of the *Effectiveness of Public Money used to Support Industrial R & D under I4.0.* in the INNO PROVEMENT Project supported by the INTERREG EUROPE programme. Attention will be paid in particular to the possibilities to improve the evaluation of the effectiveness of R & D projects relevant to Industry 4.0. in relation to the selected Policy Instrument Operational Programme Enterprise and Innovations for Competitiveness (hereinafter “OP PIK“) Priority Axis 1: Development of research, and development for innovations. The following steps have been proposed to analyse the thematic area:

1. Definition of Industry 4.0 and existing solutions in public support programmes;
2. Summarization of general principles to evaluate the effectiveness of R & D projects;
3. Analysis of the existing system of project evaluation in selected public support programmes;
4. Selection of project models and assessment of the cost-effectiveness in relation to project benefits;
5. Proposal of a multicriterial system to evaluate project benefits in short, medium, and long terms;
6. Selection of model projects of good practice;
7. Formulating proposals for better targeting public funds focused on improving the quantification of impacts of the implementation of results into practice.

This report focuses on evaluating the cost-effectiveness of R&D projects, using the existing knowledge and experience gained in the Czech Republic. The following programmes were selected and will be examined: OP PIK, programmes financed by the Technology Agency of the Czech Republic (hereinafter “TAČR“)¹ and programme TRIO financed by the MPO (national funding dedicated to support R&D projects). The submitted report is divided into seven chapters as follows:

Chapter 1 defines the concept and nature of Industry 4.0 (hereinafter “I4“), its inclusion in the Czech Republic's strategic documents, and furthermore, it summarizes how this area is currently supported by public support programmes; the chapter deals with the evaluation of R & D projects in relation to I4 Epsilon – TACR programme in more detail; the key question then is whether I4.0-

¹ www.tacr.cz/index.php/en/

focused projects are so specific that they need a completely new evaluation methodology that we can use, and in a number of programmes we already use multi-criteria evaluation tools that can assess wider social impacts of I4.0 implementation.

Chapter 2 summarizes general approaches to the evaluation of R&D projects; the chapter briefly defines important terms and contexts of cost-effectiveness, effectiveness and performance, and provides a clear scheme of evaluation criteria and indicators (economic, social and environmental), that can be used to evaluate R&D projects; the chapter briefly deals with the method of evaluation by opponents applied by TAČR;

Chapter 3 compares the areas of evaluation of R&D projects identified in Chapter 2 with the current evaluation system of programmes that support industrial R & D projects and have been selected as the subject of analysis; the following (sub) programmes were selected: programme Application and Cluster (that belong to the Policy Instrument OP PIK – 1st priority Axis) and national R&D programme TRIO (financed by the MPO budget)

Chapter 4 is dedicated to the discussions with INNO PROVENT project partners and it is structured to two sub-chapters: the first one lists common issues relevant to the thematic area the thematic area of the *Effectiveness of Public Money used to Support Industrial R&D under I4.0* and the latter summarizes approaches to solve these issues.

Chapter 5 provides a comprehensive analysis of the evaluation criteria based on the evaluation reports of selected projects

Chapter 6 provides conclusions of the analysis of current evaluation criteria, provides proposals for adjustment and formulates proposals for better targeting public funds focused on improving the quantification of impacts of the implementation of results into practice.

In order to provide a brief document, a detailed analysis is included in the Annex; three Annexes are structured as follows:

- Annex No. 1 gives a detailed analysis of all three selected programmes made on the basis of evaluation criteria for particular calls
- Annex No. 2 gives a survey of supported projects of selected OP PIK
- Annex No. 3. Provides more detailed information concerning the assessment systems and tools focused on the implementation of I4.0. in each INNO PROVENT country.

The submitted report is a contribution to discussions and is intended to promote the exchange of experience from the field of approaches of INNO PROVENT project partners.

Content

Introduction	1
1. I4 Specification	4
2. Approaches to the evaluation of R & D	6
3. Evaluation criteria – current status	9
3.1. Evaluation of OP PIK – Application and TRIO	9
3.2. Evaluation of the OP PIK – Cluster	12
3.3. Summary	13
4. Project Evaluation and Enhancement of I4.0 in INNO PROVEMENT Regions	14
4.1. Evaluation of I4.0 Concept.....	14
4.1.1. Maturity Benchmark (Finland)	15
4.1.2. Evaluation Model (Poland).....	15
4.1.3. I4.0. Classification (Portugal).....	15
Pic. 1. Portuguese Good Practice	16
4.2. Project Benefits Evaluation and the Level of Commitment	16
4.2.2. Obligation for Applicant (Hungary).....	16
4.2.3. Grant Schemes Criteria (Portugal).....	17
4.3. Evaluators and Evaluation procedures	17
4.4. Barriers and I4.0 Public Support.....	17
4.4.1. Regional Assesment (Poland)	18
4.4.2. Qualified Human Resources for I4.0. Implementation (Finland)	19
Pic. 2. Budget & funding sources Kainuu Policy Instrument.....	19
5. Case project analysis	19
5.1. Evaluation criteria and evaluation reports.....	20
5.2. Project Benefits Evaluation.....	21
5.3. Projects Type A Good Practice.....	23
6. Recommendations	27
List of tables	32
List of abbreviations	34
Annex No. 1.....	35
Annex No. 2.....	42
Annex No. 3.....	43

1. I4 Specification

The term "Industry 4.0" was used for the first time in the strategic plan of the German government in 2011; the above plan focused on the implementation of high-tech systems into production. Subsequently in a short time, due to economic and other ties to Germany, this concept put through in the Czech Republic. However, we can see it in other countries as well. In the Czech Republic I4 includes production based on technological progress, which wipes out boundaries between the digital and physical worlds and enables us to implement smart interconnected systems supporting activities throughout the whole production value chain; it includes smart world of industrial devices that communicate with each other. In other words, production is transformed from stand-alone automatic units into fully automatic and continuously optimized manufacturing environments. Production facilities will be connected to make cyber-physical systems (CPS), which will be basic building components of so-called "smart factories". Thus, **the nature (main idea) of I4 lies in**

- computer interconnection of manufacturing equipments and machines, shaped/machined products and semi-finished products and all other systems and subsystems of an industrial enterprise (including marketing, trade etc.) to create an intelligent network of heterogeneous entities throughout the value-creating chain (i.e. network across manufacturing, economic, business, logistic and other sections);
- working subsystems that communicate with each other according to requirements (and as for the development they head for self-awareness and autonomous prediction);
- and production, or logistics as the case may be, enabling product customization according to demand and customer needs under conditions of highly flexible factory production. The implementation of smart information systems into production processes will provide for effective reconfiguration of production lines, thus mass production in factories will be replaced with optimized series of products.

These days, I4 has been integrated into the concept of the digital Czech Republic prepared in accordance with EU requirements and documents.

In a number of expert papers and documents the term 'Fourth Industrial Revolution' is used (see, for example, OECD, WEF, Klaus Schwab, etc.); in the vast majority of cases it can be simply replaced with the term Industry 4.0. In many countries, initiatives of this type are known under different names (i.e. the Industrial Internet Consortium or the Smart Manufacturing Leadership Coalition in the USA, Made in China 2025, the Industrial Value Chain Initiative in Japan, Manufacturing Industry Innovation 3.0 in South Korea, Industrie du Futur in France etc.). Sometimes we talk about the concept, sometimes about the initiative.

Evaluation of the R&D Public Support focused on I4

There are no explicit requirements defined for persons/entities submitting projects, or evaluators concerning the assessment of the relation of their R & D solutions to the implementation of I4 in OP PIK. This might be caused by failing to define this term for evaluation purposes. However, this does not mean that any or a number of I4 elements could not be subject to a research solution. It is implemented in the programme EPSILON - TAČR programme in the form of higher evaluation for projects with elements of the Industry 4.0. In addition, an updated National Research and Innovation Strategy for Smart Specialization of the CR (National RIS3 Strategy) of January 2019 specifies requirements for supporting R & D programmes of modern key

technologies related to the digitization of the economy, including, among other things, Artificial Intelligence more distinctly.

As a result, in these days projects implemented in the Application or also in TRIO (national funding dedicated to support R & D projects by MPO) could be selected from the viewpoint of their content orientation to any of the particular I4 elements: Internet of Things (IoT), Internet of Services (IoS), analysis of Big data, data storage and clouds, autonomous robots, cooperative robots, extended production, additional production, cybernetic security. The criterion of benefits is, for instance, reduction in costs in the field of autonomous robots, time reduction, effective production of even small quantities associated with their launching. As for data storage and clouds, it may be lower investments in its own business IT infrastructure. A large data analysis can be evaluated with respect to the benefits of predictive maintenance of equipment and energy and materials savings.

As regards TAČR I4-related programmes, we can find an explicitly state-supported research. Within a DELTA - TAČR programme, which focuses on supporting cooperation between Czech research organizations and enterprises with their foreign partners in applied research and experimental development through joint projects and technology and innovation agencies, a public tender for co-operation with Germany in the field of I4 was declared and accomplished. This tender was prepared by the TAČR in cooperation with the Federal Ministry for Education and Research (Bundesministerium für Bildung und Forschung) and resulted in seven supported joint projects. The EPSILON - TAČR Programme focuses primarily on improving the position of the Czech, and in global contexts also European, industry so that applied research and experimental development projects were supported, the results of which have a high potential for rapid application in new products, manufacturing processes and services; the programme focuses in particular on the following priority areas: a competitive knowledge-based economy, the sustainability of energy and material resources and the environment for quality living. The EPSILON - TAČR programme provides for a point advantage if the project intent is in line with the I4 initiative, whereby the evaluator decides on the allocation of points based on:

- how virtual models and simulation tools for working with them (digital factory) are described in the project in terms of details;
- whether the solution includes artificial intelligence systems, including the method of how knowledge databases are established;
- whether physical systems are designed to be integrated into modern platforms, implementation of remote services, etc.;
- whether it involves working with big data, automatic evaluation in real-time, or ensuring cyber security;
- whether the project contains a description / use of the cyber-physical model including its relations, creation / utilization of a digital twin, providing for collection and on-line automatic data processing (IoT, IoS, etc.); or if a physical system with automatic control of autonomous subsystems is implemented / used, whether the solution includes the creation / utilization of new processes and services communicating with the digital environment automatically, or if new open standards are newly implemented and disseminated.

Within a BETA - TAČR programme (which focuses on supporting research, development and innovation for the needs of government and state authorities), the project "Design of Thematic Areas of Research, Development and Innovation in the Context of Industrie 4.0" was announced. The solution is provided on the basis of the so-called minitenders according to the themes defined by TAČR together with the Office of the Government of the Czech Republic, the Ministry of Industry and Trade and the Ministry of Education, Youth and Sports, or other state authorities. There are some

studies at disposal, e.g. those concerning shared economy, critical mapping of conceptual and strategic documents and governmental activities in the field of I4 and digital agendas, digital infrastructure of primary and secondary education, digital education, so-called digital legislation, analyzes of readiness of small and medium-sized enterprises for I4 etc. Recently, also research of the potential of artificial intelligence in the Czech Republic has been made. In this context, it is also necessary to mention the ÉTA – TAČR programme aimed at supporting applied socio-scientific research, in which there are some digitization-related projects.

In the given context a long-term problem becomes evident: subsidies to R&D for a specified purpose are provided in a number of programmes implemented by different providers with inconsistent evaluation methods. The most significant part of the support is provided within generic programmes whose contribution to the development of key segments of the economy is rather limited. In the Czech Republic there are still no programmes focused on specific technological areas, programmes corresponding to current (or future) needs of enterprises as well as programmes covering the entire innovation cycle.

There is no benchmark for evaluating projects focusing on Industry 4.0. Also differences between programmes in monitored and assessed eligible expenditures of R & D projects may pose problems. The key question then is whether Industry 4.0 - focused projects are so specific that they need a completely new assessment methodology. Implementation of Industry 4.0 is a social issue, not just in terms of impacts, it is not a narrowly productive and economic issue. Nevertheless, from the viewpoint of this necessary broader view, tendencies of the multi-criteria evaluation, which have been applied in recent years in the evaluation of R & D, are satisfactory and have already been reflected in a number of OP PIK programmes.

2. Approaches to the evaluation of R & D

The multi-criteria approach to the evaluation of R & D is gradually upheld in practice: not only purely cost-related approaches and economic effects (expressed in monetary units) are taken into account, but various non-economic effects (social, environmental) as well. However, it is often a problem to use an appropriate quantification and conversion to a common unit of measurement.

From the viewpoint of economic effectiveness of R&D projects, methods such as cost-effectiveness analysis (hereinafter “CEA”) and cost-benefit analysis (“CBA”) which belong to a broader group of impact analysis methods applied in project management are in use. However, in communication on international level we sometimes meet insufficient distinction between the terms effectiveness and efficiency. The most used method of assessing the economic effectiveness of R&D projects is probably the CBA, which is linked to the efficiency of used funds. It applies in two main areas: 1. finding whether a project is acceptable or not, and whether and to what extent the benefits (effects) outweigh its costs; 2. establishing a basis to compare project variants when total expected costs are compared with total expected benefits for each variant. Both benefits and costs in the CBA are expressed in monetary units and are adjusted according to the principle of the present value of money (all revenue and cost flows over time are expressed on a common basis as for its net present value (hereinafter “NPV”), regardless of whether it has been incurred/spent at different times). Among asserted dynamic methods of evaluation of the effectiveness of R&D projects, or innovative projects as the case may be, which unlike statical methods of the evaluation take into account the effect of the factor of time and the factor of risk, there are, in addition to NPV, the internal rate of return (IRR) and the discounted time of return (payback method).

Relating to the availability of credible information and data it is also important at which point of time we make ex-post evaluation of R&D projects (termination of a project by a prototype, patenting etc.,

launching a product on the market or using new technology in a production process, 2-3 years after the end of the project).

In expert literature, the issue of evaluation is usually part of R&D performance management. Literature devoted to R&D performance management recognizes a wide range of quantitative and qualitative approaches to the evaluation of R & D (EIRMA, Industrial Research Institute, Pearson). The existing knowledge in the field of measuring performance of R&D is divided by specialized literature (Chiesa, Král) to the level of cost-effectiveness management (in the form of economy or efficiency), effectiveness management (evaluation of committed resources). At other levels, the impact on business performance, contribution to the branch and the innovation system as a whole is evaluated. To assess the cost-effectiveness, it is possible to use the calculation of the quantified costs and budgets prepared as preliminary (planned) and to analyze deviations. The term "performance" is referred in expert literature as the assessment of the course, how a certain activity is performed and the comparison according to a specified criterion scale, by the expert literature (Wagner, Král), and is divided into the components of effectiveness (doing right things), and efficiency (doing these things correctly).

Expert literature provides a variety of methods, approaches, and criteria according to which performance can be assessed; they can be divided into several viewpoints: - complex, partial; financial, non-financial, etc. One of the most sophisticated approaches in the field of performance management is Balanced Scorecard, the benefit of which is using non-financial performance benchmarks and their balancing. This tool makes it possible to take into account a long-term innovation process in which new markets, customers and their needs are defined, and the value of exploiting these opportunities is fully achieved (Bremser & Barsky).

Tab. 1. Criteria for the evaluation of R&D projects

Evaluation criteria	Method of evaluation	Examples of indicators
Economy	<ul style="list-style-type: none"> – comparison of planned and actual costs – cost adequacy assessment (in relation to cost standards, usual prices etc.) – assessment of costs and market price and the cost adequacy and effectiveness 	<ul style="list-style-type: none"> – Total cost of R&D – R&D expenses as % of sales income (turnover) – Average cost of the development per product
Profitability Effectiveness	<ul style="list-style-type: none"> Return on invested capital Profitability of a new product 	<ul style="list-style-type: none"> – Growth in income from sales associated with new products – Growth in export generated by new products – Contribution to the growth of margin and profit associated with new products
Market position	<ul style="list-style-type: none"> Maintaining the market share Increase in the market share and acquisition of new customers 	<ul style="list-style-type: none"> – Lifecycle of a product on the market (expressed as a course of revenues and costs)

		<ul style="list-style-type: none"> – Customer satisfaction with new products (soft data)
Innovation performance	<p>Performance of R&D (time period from the development to launching on market)</p> <p>Degree of innovation culture</p>	<ul style="list-style-type: none"> – Quantity of new Products launched on the market Average time and cost of the development cycle Accuracy of cost and profit calculations (comparison of planned and final calculations) – Competitiveness of own R&D compared with that of competitors – Number of granted patents
Employee development	Employee development	<ul style="list-style-type: none"> – Gaining new knowledge – Increase in qualification – Employee fluctuation rate
Contribution to long-term sustainable development	<p><u>Social area</u></p> <p>Creating new jobs</p> <p>Improving the quality of life</p> <p><u>Environmental area</u></p> <p>Reducing negative impacts on the environment</p>	<ul style="list-style-type: none"> – Number of newly created jobs – Engagement in local communities (both financial and non-financial) – Employee involvement in activities of local communities – Replacement of non-renewable resources (quantity over the life cycle of the product) – Better use and secondary use of raw materials (elements of the circulatory system, quantity over the life cycle of the product) – Positive effect on one of the environmental components (soil reclamation, water quality improvement, reduction of emissions in product life cycle)

Source: adjusted according to Bremser & Barsky, Sohn)²

² According to an AVO survey pool focused on enterprises doing R & D, more than 90 % of respondents use the following indicators: number of successful projects; total cost of R & D; percentage of sales income incurred due to new products; R & D expenditures expressed as a percentage of turnover. The average cost of development of a (one) product is used by absolute majority of respondents.

Proper setting of criteria and correct defining their content is an important condition of the quality of the evaluation process. Furthermore, the quality of the evaluation process is influenced by work of evaluators, requirements for their experience, expert knowledge, discussions about expert opinions (see, for example, evaluation of projects in the H2020 programme). Nevertheless, it is also necessary to take into account administrative requirements for the evaluation and the length of the evaluation process. One of the ways to evaluate evaluators is a TAČR system, which is based on two or three opponent expert opinions and a supervisor. The role of the supervisor is to prepare a final expert opinion on the project and at the same time to comment on the quality of the expert opinions. This evaluation system is used in the initial evaluation of projects, as for the next stages, the project is monitored by the supervisor only.

3. Evaluation criteria – current status

To propose an improvement of the accuracy and completeness of the current evaluation system within programmes supporting industrial R&D projects, the following programmes have been selected as the subject of an analysis: two sub programmes of OP PIK Application and Cluster and the programme TRIO financed by the MPO (national funding dedicated to support R&D projects). The existing evaluation system has been analyzed according to the following criteria:

1. Economy and CEA
2. Evaluation of project results
3. Quality of the outlined implementation
4. Monitoring of the project implementation after project termination
5. Relation to I4

The OP PIK sub programme Applications and the programme TRIO support in particular R&D, while the sub programme OP PIK – Cluster supports R&D activities conducted by a cluster and therefore the cluster has to be evaluated as well. Therefore, we divided this chapter into two sections; section 3.1 compares evaluation criteria of the programmes OP PIK – Applications and TREND; section 3.2. is focused on evaluation criteria of the OP PIK – Cluster programme.

3.1. Evaluation of OP PIK – Application and TRIO

The comparison of the current evaluation method of R&D according to the above five criteria are summarized in the following table. The detail of the evaluation is provided in Annex 1.

Tab. 2. Comparison of the evaluation of OP PIK – Application and TRIO programmes

Evaluation	OP PIK – Application	MPO – TRIO
1.	Economy and CEA	
Content of	Cost adequacy assessed in	

<p>evaluation</p>	<p>accordance with the criterion of economy, through the comparison of planned costs and market price, adequacy and cost effectiveness</p> <p>Economy is a binary criterion and bonification criterion (in calls I–V)</p> <p><u>The quality of project preparation, key milestones and outputs, technical feasibility includes adequacy and cost effectiveness</u></p>	<p>The adequacy of the timetable and financial requirements</p> <p><u>Criterion No. 4 Adequacy of the timetable and financial requirements</u></p>
<p>2. Evaluation of project results</p>		
<p>Content of evaluation</p> <p>Criteria</p>	<p>Demanding character of outputs (from the most difficult)</p> <ul style="list-style-type: none"> – Semi-operation, proven technology, prototype – Utility model – Certified methodology, functional sample, software – Industrial design <p>Non-economic project benefits</p> <p><u>The quality of project preparation, key milestones and outputs, technical feasibility</u></p> <p><u>Non-economic project benefits</u></p>	<p>Novelty, complexity of the proposed solution, comparison with competing products and processes</p> <p>Non-economic project benefits</p> <p><u>Criterion No. 3 The technical and economic level and complexity of the proposed solution</u></p> <p><u>Criterion No. 2 Utility (technical) parameters of the result</u></p> <p><u>Criterion No. 6 Topicality and necessity of the project and suitability of its support from public funds</u></p>
<p>3. Quality of the outlined implementation</p>		
<p>Content of evaluation</p> <p>Criteria</p>	<p>Knowledge of the target market, market potential and probability of using the output, and competitive potential</p> <p><u>Company / consortium development strategy and</u></p>	<p>Knowledge of the target market, market potential and probability of using the output, and competitive potential</p> <p><u>Criterion No. 6 Applying results</u></p>

	<p><u>capacity to implement project results</u></p> <p><u>Market potential of planned results, probability of real implementation of project outputs in industry</u></p> <p><u>Competitive potential of expected R & D results</u></p>	
4.	Monitoring of the project implementation after the project termination	
Content evaluation	<p>Project monitoring according to the indicators set out in the call</p>	<p>The beneficiary submits to the provider an overview of real achievements of the project per year for a period of three years, in particular</p>
Criteria	<ul style="list-style-type: none"> ▪ number of newly created jobs in the R & D with gender specification ▪ number of enterprises cooperating with research institutions ▪ number of research organizations working with enterprises ▪ number of applied research results (certified methodology, utility model, proven technology etc.) 	<ul style="list-style-type: none"> ▪ a specific way of using results ▪ benefits and quantification of income from sales, profit, exports, number of newly created jobs, number of licenses sold etc. ▪ non-financial benefits of the project ▪ comparison of results and their use with the status of the issue in the CR ▪ comparison of actual results achieved and their benefits with expected benefits stated in the application for support
5.	Relation to I4	
Content evaluation	<p>The relation to the knowledge domain identified in the National Research and Innovation Strategy for Smart Specialization</p>	<p>The relation to the knowledge domains – compliance with the vertical priorities of the so-called national RIS3 strategy (priorities of the application sectors)</p>
Criteria	<p><u>Relation to the project to selected knowledge domains identified in the National Research and Innovation Strategy for Smart Specialization</u></p>	<p><u>Criterion No. 1 Fulfilling the Programme's objectives and compliance with vertical priorities of the national RIS3 strategy, including the development of potential in the field of</u></p>

Key Enabling Technologies

Source: Adapt by programme documents of OP PIK – Application and TRIO programmes

3.2. Evaluation of the OP PIK – Cluster

A brief preview of the current evaluation method of projects of the OP PIK Clusters is summarized in the following table. The detail of the evaluation is provided in Annex 1.

Tab. 3. Evaluation of the OP PIK – Clusters programme

The field of evaluation	Content
<p>Economy and CEA</p>	<p>Criteria of economy, through the comparison of planned costs and market price, adequacy and cost- effectiveness</p> <p><u>Economy</u> is a binary criterion and bonification criterion (in calls I–V) set identically with the OP PIK – Application programme</p>
<p>Evaluation of project results</p>	<p>Innovative and application potential of results of the evaluation of R & D workplaces (qualification, infrastructure, experience)</p> <p><u>Criteria Application potential of technology, Progress in technology, Cluster experience with R&D projects management and implementation</u></p>
<p>Quality of the outlined implementation</p>	<p>Potential for improving existing or launching fully new products and probability of real using the R&D results</p> <p><u>Criteria Application potential of technology, Market potential of planned results</u></p>
<p>Monitoring of the project implementation after the project termination</p>	<p>Project monitoring according to the indicators set out in the call:</p> <ul style="list-style-type: none"> ▪ International R&D projects; ▪ Number of newly created jobs in the R&D with gender specification ▪ Number of enterprises cooperating with research institutions. ▪ New joint R&D&I projects ▪ New joint projects focused on development and internationalization. <p>Evaluation of the results implementation plan between SMEs,</p>

	transfer and evaluation of results <u>Criterion Dissemination plan</u>
Relation to I4	The relation to knowledge domain identified in the National Research and Innovation Strategy for Smart Specialization set identically with the OP PIK – Application and TRIO programme

Source: Adapted by programme documents of OP PIK – Cluster programme

3.3. Summary

The current evaluation system of R&D projects is indeed very sophisticated. The individual criteria are specified very clearly and comprehensively. A wide range of aspects are taken into consideration. Cost-effectiveness, cost adequacy and assessment of budget items with a common / market price are addressed in the examined programme. The quality of output in terms of novelty and innovation potential are evaluated as well. The profitability and effectiveness of committed resources is ranked according to the knowledge of the target market, market potential, and by comparison of competitive products and solutions.

The implementation of results and identification of benefits after the project termination are monitored in the TRIO programme in the most detailed way. On the other hand, the OP PIK programmes examines the quality of dissemination plan and application potential. In addition to the above-mentioned parameters, the OP PIK - Clusters assess the quality of research team, research capacity and experience of key researchers as well. The evaluation of market potential is very well linked to the evaluation of the users' committee involvement and knowledge of SMEs needs and demands. The assessment of the relation to knowledge domains (identified in the National Research and Innovative Strategy) and key enabling technologies can be considered as a certain relation to I4.

4. Project Evaluation and Enhancement of I4.0 in INNO PROVENT Regions

INNO PROVENT partners presented feedback on the Initial Report of the thematic part “*Effectiveness of Public Money used to Support Industrial R & D under I4.0*” prepared by the MPO at the project partners' meeting organized in Prague on March 13, 2019. Project partners also presented problems they are dealing with and also information of the I4.0 support tools applied in INNO PROVENT regions. We approached some project partners with additional questions; we did receive interesting inputs and we analysed all materials, the analysis is provided in this chapter and in detail in Annex 3. Hereby we would like to express our gratitude to all INNO PROVENT partners for the cooperation.

We have studied all these background materials and we can name the following two key common problems of all INNO PROVENT partners – the need to:

- define criteria or to improve the evaluation with a primary focus on the support of I4.0 concept;
- improve the evaluation of project benefits and explore the possibility how to integrate project impacts to monitoring criteria.

We prepared a summary of possible solutions of the above-mentioned problems with specific examples used by individual partners in the following section of this chapter,

4.1. Evaluation of I4.0 Concept

INNO PROVENT partners do not directly specify the definition of I4.0 nor do they explicitly require creation of a common definition. I4.0 is typically understood as a number of processes and productions in enterprises based on digitization. Overall the I4.0 implementation is combined with digitalization transformation of the economy and society; we can say this apply to all INNO PROVENT partners. The public support programmes are based on both national industry profile, research and innovation strategies, these strategies are focused on economy growth and I4.0 implementation. Although partners do not explicitly express the need for common definition, this need implies indirectly from several statements. We can name only a few: “*In order to optimize existing solutions, however, it is necessary to develop criteria that will take into account specific requirements of Industry 4.0*” (Poland), or “*Scope of calls potentially stronger preferences to projects in I4.0*” (Hungary).

We can summarize the approach to I4.0: targeted innovation support focused on technological process and product innovations as well as on process innovations connected with changes in the management system in companies based on digitization with emphasis on digital readiness of SMEs prevailed. Partners do not provide details concerning individual phases of I4.0 implementation.

The common question in evaluating I4.0 projects is to define relevant investments and the evaluation mechanism of this investment (Portugal). Furthermore, there is a need to develop criteria that would consider specific requirements of I4.0 (requirement of the Polish partner).

There exist already multicriterial evaluation tools to evaluate R&D. These tools may also measure wide impact of I4.0 implementation. I4. Hereby it might be sensible to modify the existing evaluation tools and managerial methods rather than develop new ones. The country-specific solution tools are listed in the following section of this charter

4.1.1. Maturity Benchmark (Finland)

The **maturity assesment** will be provided by an expert to **tailored** the recommendation concerning I4.0 implementation to the specific needs of the concrete company. Concretely two workshops will be provided, the first will introduce I4.0 practice the latter will provide **maturity benchmark** The recommendation or precisely guidelines for I4.0 focused on the case company will follow.

4.1.2. Evaluation Model (Poland)

Lodzky Region provided a research „*Project selection system with particular focus on project selection criteria*” provided that resulted in a need to develop criteria for assessing applications for co-financing projects implementing Industry 4.0 technologies - to develop a precise definition of this concept. In addition, due to the level of complexity of the transition from the traditional production model to the model based on

- advanced network solutions (e.g. cloud computing),
- IT (e.g. CAT - computer aided technologies,
- MES - manufacturing execution system)
- automation and robotics.

4.1.3. I4.0. Classification (Portugal)

The Managing Authority applies the following classification of I4.0 to consider if the project is I.4.0 or not. These criteria must always be relevant on the investment project itself.

Pic. 1. Portuguese Good Practice

Good Practice

I4.0 Referential - Technologies

Advanced information systems	Connectivity between systems, equipment, products and people	Advanced production systems
<ul style="list-style-type: none"> • Digital Infrastructure • Digital Infrastructure Artificial Intelligence and Predictive Algorithms • Advanced Data Analysis • Cloud computing • Cybersecurity 	<ul style="list-style-type: none"> • Advanced sensors and IoT • Remote operation • Increased Reality • Intelligent machines 	<ul style="list-style-type: none"> • Advanced and connected products and materials • Modular Operations • Additive production • Autonomous robots

4.2. Project Benefits Evaluation and the Level of Commitment

As we already mentioned, there is a strong need to improve evaluation criteria in the initial evaluation procedure. There are a great variety of benchmark models already applied in the evaluation process; projects are forced to focus on a particular technology or a specific production based on digitization. Project impact is measured by various economic and non-economic criteria such as jobs created, sales growth, operating profit, gross value added, etc. The concrete indicator depends usually on the particular grant scheme. In Hungary there is a relatively strict point rating applied together with firm intervals for individual evaluation criteria.

Financial models may influence the responsibility of beneficiaries and consequently also the efficiency of public investment. We mean not only the level of public support, but also the repayability of the grant. The increase of the non-repayable grant proportion is usually combined with the fulfillment of set indicators after the project accomplishment (Portugal; the period from 1 to 3 years after project determination is perhaps implied). The use of subsidies or loans also reflects the selected grant scheme (technical innovation or upgrading of skills).

However, it is not clear from the provided documents to what extent the research risk (material, financial and market risk) is taken into account. The consideration of research risk and uncertainty also remains a big unclear from our point of view. The specific responsibilities of the project beneficiaries in each country are listed in the following section of this chapter.

4.2.2. Obligation for Applicant (Hungary)

There is an obligation for the applicant to commit to the growth of turnover or growth of operating profit.

4.2.3. Grant Schemes Criteria (Portugal)

The beneficiaries **can't choose grant criteria, only propose values for them**, whereby the main criterias are: jobs created, sales growth, international sales intensity, gross value added

The criteria are different in various grant schemes, the following example was provided :

- Productive Innovation – high qualified jobs created (only qualifications at university level are quantified), sales growth, gross value added
- Internationalization - international sales intensity
- Qualification – Number of competitiveness imaterial domains covered by project (Marketing, Organization, Circular economy, Industry 4.0, ...) and number of new innovative activities in Marketing and organization
- Vouchers – only the realization of the services proposed

The Managing Authority uses the mechanism of conversion of the reimbursable grant to non reimbursable grant in *Productive Innovation* this criteria determine if part of the reimbursable grant is converted in non reimbursable. The following example was provided:

Evaluation of the indicators, 2 years after the end of the project implementation. If achieved in 125% or more, half of reapeyable grant becomes non-repayable (between 100% and 125% less than 50% becomes non-repayable). Calculated as follow:

Loan is adjusted accordingly the result of the evaluation. In the other schemes are importante to keep the Grant, but not the only ones, **the good implementation of the project is more relevant.**

4.3. Evaluators and Evaluation procedures

None of the project partners announced to employ experts to evaluate solely market potential or project benefits. In Hungary, a so-called evaluation pool is used. This pool is used only for national projects financed by the EU. Likewise in Poland, project application potential and project benefits are evaluated by the same group of evaluators.

4.4. Barriers and I4.0 Public Support

SMEs have limited capacity and resources that can be invested in I4.0. SMEs are not equipped with adequate technologies, there is a lack of skills, SMEs don't have access to experts, who would analyze the current situation and provide an adequate strategy. Therefore in all INNO PROVEMENT regions there are public programmes focused on enhancement of I4.0 in SMEs. Moreover several studies were provided to map the barriers among SMEs (e.g. Hungary, Portugal and Poland). There are several conclusions:

- need to change the business models (process innovation, management and marketing innovation);
- to introduce modern intelligent and flexible production systems and related technological innovation and product innovation;

- need to achieve adequate qualification of employees (professional competences in new technologies, etc.).

The key results of Polish survey are described in more detail in the 4.4.1..

4.4.1. Regional Assessment (Poland)

The regional assessment carried out by the Lodzkie Region shows that, apart from programs intended for the implementation of high-technology, very important are also solutions improving the qualifications of employees of SME sector.

- lack of knowledge of research conducted on universities in the field of Industry 4.0 internal factors hampering the process of implementation of advanced technologies, the respondents pointed out, among other things: lack of own financial resources (64.5%), lack of time (62%), lack of properly educated staff (53%). In turn, among the major external barriers to the process of modernisation of enterprises, the report indicates: red tape (78.5%), difficulties with recruiting competent employees (71.5%), lack of support from the public authorities (71%), unfavourable tax regime (66%), unfavourable regulations (64.5%), difficulties with obtaining EU grants (58.5%), and difficulties with obtaining loans (29%).
- The most commonly used technologies and solutions related to technology innovation in the Polish industry include automation of production processes (52%) and data analyses aimed at optimisation of production (51%). Further on, the respondents indicated: software reducing costs of prototyping and launching new products, Internet of Things, automation of production lines, Industrial Internet of Things, 3D spacial printing, collaborative robots, digital twin and digitisation of production, cloud computing, Big Data, artificial intelligence.
- As for the level of difficulty in implementing Industry 4.0 technologies, entrepreneurs are of the opinion that the following solutions are the easiest to implement: data analyses aimed at optimisation of production processes (41%) and 3D spacial printing (39%), while the most difficult ones include: artificial intelligence (67%) and digital twin (51%). The automation of production lines was indicated as a solution difficult to implement by 49% of the surveyed.
- The respondents also provided their opinions on different ways in which the State could support the implementation of technological innovations in companies. The most frequently indicated answer **concerned tax incentives (79.5%)**

The above mentioned evaluation study „*Project selection system with particular focus on project selection criteria*” provided that brings the following results:

- there is no support instrument in the RPO that would be directly dedicated to Industry 4.0. Entrepreneurs interested in modernizing their companies in this area can only use the funds available as part of financing innovation and research and development
- It is important that the support under the new instrument does not only concern investments in technologies, but also in training that raises the qualifications of personnel in the field of operation, programming and maintenance of devices as well as data analysis

There are several tools and Financial Mechanism implemented to enhance I4.0. in INNO PROVENT regions such as: Regional OP, innovation vouchers and also soft tools (i.e. workshops, advisory services or benchmark analysis in Finland). The Finnish program is summarized in the subchapter 4.4.2.

4.4.2. Qualified Human Resources for I4.0. Implementation (Finland)

Kainuu policy instrument supporting Industry 4.0: Robotics investment and knowledge support project.

Problem: Business productivity and needed automation skills for long term competitiveness improvement.

Objective: To build up facilities for teaching and learning robotics in companies and in learning institutions KUAS and KVC in Kainuu region and to improve and raise the knowledge and skills concerning robotics and automation linked with it. In addition this will guarantee the sufficiency of professionals in the future.

Beneficiaries: The main focus groups of the project are the students and personnel of KUAS and KVC and the personnel of the partner companies.

Duration: 1.3.2016 – 31.3.2019

Pic. 2. Budget & funding sources Kainuu Policy Instrument

Funding	Total (€)	Participation to the project cost (%)
1 ERDF (RCK as intermediate body)	214 395	70,00%
2 Municipal funding	11 656	3,81%
3 Other public funding	49 601	16,19%
4 Private funding	30 628	10,00%
Total funding	306 280	100,00%

Results: Better competitiveness for the companies, more cooperation between companies and learning institutions, knowledge and skills of robotics will be improved inside the partner organisations, students will be more interested in studying in Kajaani and there will be enough skilful specialists for the companies in the future.

The learning facilities have been built to companies and students have used these companies as a learning environment. The learning facilities of I4.0 have also been built to learning institutions (KUA and Kainuu Vocational School).

5. Case project analysis

8 projects supported by the OP PIK – Application subprogramme and 5 projects supported by OP PIK – Cluster were selected by the Managing Authority. All projects were approved in the first calls of both subprogrammes. The initial evaluation reports in the approval process and also the final evaluation reports (drafted in the final opponent procedure) were provided³. All examined projects delivered planned results, no restrictions were applied. Vast majority of them ended last year, some even in the beginning of this year, therefore there are no data available concerning the monitoring period yet.

³ In order to comply with confidentiality agreement we anonymized project acronyms.

5.1. Evaluation criteria and evaluation reports

At first the evaluation reports were examined, particularly the aspects of economy and cost efficiency, evaluation of project results, quality of project implementation. The results are summarized in the following table.

Tab. 4. Summary of evaluation reports

Case projects OP PIK - Application	
Economy and CEA	There were no budget reductions or requirements for budget modifications in any evaluation report. All project received 100% points for this criterium. Some evaluators even referred to the methodological instructions provided by the Managing Authority.
Evaluation of project results	<p>Substantial differences were identified in the provided evaluation both in the project scores and in the clarification. There were a few cases, were just a single statement was provided (e.g. <i>the level of innovation is / is not equal to domestic / global competition</i>) without further explanation. There were also rather different point scales assigned to similar comments.</p> <p>The criterium of novelty developed was defined differently in the first call compared to the criteria in the latter calls. The provided project sample encompassed projects from the first call only.</p> <p>Interestingly there were no significant differences of the non economical impact. However the environmental, social impact and relation to the national / EU priorities should be considered, the arguments in the evaluation reports referred to the economical or development of the innovation capacity of the applicant.</p>
Criteria	
Quality of the outlined implementation	<p>The criterium consists of three sub categories:</p> <ol style="list-style-type: none"> 1) solid strategy of project results implementation coherent to the corporate strategy 2) market potential of the newly developed products, export possibilities and real commercialization and application for the industry purpose 3) costs estimation of project result accomplishment and final product providing and comparison with the expected revenues <p>It was the criterium of project implementation and market potential that distinguished one project evaluation from the other. There were also some evaluation reports were only a single statement was provide (e.g. <i>the level of competitive advantage is rather high or a solid analysis was provided</i>) without further explanation in contrast with relative comprehensive justification in other evaluation reports.</p>
Criteria	

	<p>The analysis of the comments revealed some inconsistency in the interpretation of the criteria (analysis of competition including foreign commodities, exact content of market research, proof of preliminary orders, etc.).</p> <p>There were several cases where the evaluator provided justification relevant to all three above mentioned categories. Nevertheless the third subcriterion particularly <u>costs estimation of project result accomplishment</u> was in vast major evaluation report missing. Precisely the evaluator did not notice if the data were provided at all or not.</p>
Case projects OP PIK - Cluster	
Economy and CEA	<p>All examined projects except one were evaluated by 100% in the criterium economy and cost efficiency with no need to modify project budget. Only in one case the evaluator considered the forecasted financial sum for software purchase inadequate.</p> <p>The evaluation was focused though on market prices and adequate cost of the person month, there was no cost benefit ratio evaluated.</p>
Evaluation of project results	<p>The comments in the evaluation report differed a lot in details provided in the criterium of project result evaluation. Some rather brief statements were found, in several comments. In several cases the provided comments did not correspond to the assigned criterium score, the potential of multi-sector application of project results.</p>
Quality of the outlined implementation	<p>The provided evaluation reports were very detailed and provided rather comprehensive discussion of the demand and competitive advantage of project results likewise the quality of dissemination plan. In comparison to the evaluation report of OP PIK – Application there were minor cases when a statement rather than justification was provided, the evaluators assessed the need for project implementation, the advantage for industry and also the foreseen dissemination.</p>

Source: Own

5.2. Project Benefits Evaluation

As the second step benefits of selected projects were analyzed. The quality of projects (primarily feasibility study resp.. business plan) rather differed. Therefore we divided the case projects in two types, their characteristic are summarized in the Table No 5..

Tab. 5. Case project analysis – OP PIK Application

Case projects OP PIK - Application	
Type A	Type B
<p>The applicants</p> <ul style="list-style-type: none"> ▪ described the planned results very clearly including the implementation; in several cases (particularly IT solutions) the potential further use was disclosed ▪ provided benchmark of competitive solutions ▪ described the end users in details – i.e. final customers of the project results (prototype, software etc) ▪ thoroughly estimated project-related benefits based on the selling price calculation, and also reasonably justified quantity of expected production ▪ provided rough estimations of any additional investment expenditure that might be connected with launching the product on the market – however there only very <u>few such projects, despite the fact that this is an evaluation criterion</u> 	<p>The applicants</p> <ul style="list-style-type: none"> ▪ provided a very brief statement on the usability of the results only; no additional information about planned demand was disclosed ▪ benchmark of competitive solutions was not provided at all, only a sole simple statement was mainly revealed ▪ justified the application of project results with the forecast of a particularly sector, however the analysis of competition was missing ▪ focused on a narrow group of customers; nevertheless, this risk is not taken into account in the project risk analysis ▪ when estimating future income, they only noted "unspecified number of millions" of a selected currency

Source: Own

There were no differences in the description of non-economic benefits between the two groups; in several cases very detailed estimates with reference to the literature was provided. Likewise all projects presented a solid clarification of the total budget including explanation of the cost structure.

OP PIK – Clusters Projects were analysed in a similar way, for results are shown in the table below.

Tab. 6. Case project analysis – OP PIK Clusters

Case projects OP PIK - Clusters	

Type A	Type B
<p>The applicants</p> <ul style="list-style-type: none"> ▪ presented very clearly user requirements that were also reflected in project objectives, the end users were mainly cluster members ▪ outlined clearly project objectives and results ▪ described well the target market and prepared a comprehensive preliminary calculation of the new product ; the application of project results was well defined; ▪ specified the expected date of launching products on the market 	<p>The applicants</p> <ul style="list-style-type: none"> ▪ chose an insufficient methodology to evaluate project application potential, project results should serve not only cluster members, but also other entrepreneurs ▪ provide inappropriate explanation of project demand, the description of end user was rather vague and there is no relation between project results and users' demand ▪ omitted a benchmark of competitive solutions

Source: Own

There were no differences in the description of non-economic benefits between the two groups of OP PIK – Cluster projects, too. There was only one project (B Type) where the evaluators considered the cost clarification inadequate, all other projects received 100% of the criterion economy.

5.3. Projects Type A Good Practice

We considered the application potential of Type A being higher than Type B and we therefore labeled them as good practice projects. We assembled the initial and the final evaluation of good practice projects to summarize key features with a primary focus on implementation of the project results and their application in practice.

Tab. 7. Good practice project analysis – OP PIK Application

Case projects OP PIK – Application Evaluation	
Initial	Final
PROJECT I.	
<ul style="list-style-type: none"> - project idea corresponds to the applicant's development and fully comply with the strategic goals - project dispose of a rather promising market potential as a consequence of a unique position of the applicant on the national market 	<ul style="list-style-type: none"> - unique project with a practical application at this moment (e.g. final opponent procedure) - the only questions are relate to the result implications to other sectors

<ul style="list-style-type: none"> - commercial application of project outputs is ensured by several preliminary contractual agreements - the expected benefits of project implementation are predicted for a 5 year period, the evaluations are solidly based on applicants experience - The return on investment in a 3 year period seems realistic 	<ul style="list-style-type: none"> - the product can be immediately launched on the market both in the Czech Republic and abroad
<p>PROJECT II.</p>	
<ul style="list-style-type: none"> - applicant provided a realistic strategy of results implementation, the marketing analysis is well prepared - applicant has been actively involved in the sector right from the beginning, the project objective is based on strategic goals - applicant has a clear idea of the commercial use of project outputs, the implementation is also supported by declared demand from current customers - forecasted revenues can be considered as realistic - comprehensive analysis of domestic and foreign competition, that would contribute to mapping the domestic and foreign markets and would allow to demonstrate the position of the company in the given segment, is missing 	<ul style="list-style-type: none"> - during the opposition proceedings, a contract with the customer was provided - project has a high potential concerning practical application of project results
<p>PROJECT III.</p>	
<ul style="list-style-type: none"> - project implementation arised from the current development and fully complies with strategic goals - methods and proposed strategy of result application is rather solid and moreover it is based on the current market position of the applicant - market potential can be considered as very 	<ul style="list-style-type: none"> - the expanding the product portfolio is the key benefit (measured by sales forecast) - sadly no business plan and exploitation plan were provided - the application is not yet fully prepared, but the output has a great potential

<p>promising, the implementation of project results will depend significantly on the applicant's ability to fulfill the proposed marketing strategy and in particular the ability to succeed in the target markets</p>	<ul style="list-style-type: none"> - the project output should have been final products immediately applicable
<p>PROJECT IV.</p>	
<ul style="list-style-type: none"> - project idea si based on current business activities, the final product has a real chance of being launched on the market so there is a high probability the project can enhance increasing applicant's business potential - forecasted sales are not supported by any pre-orders - forecasted revenues based on the project result implementation are in line with the development strategy of the applicant - forecasted revenues are realistic and based on the expected demand - new product - new therapy device equipped with new diagnostics functions opens up a new area of business, new markets; project objective – the evelopment and production of terrestrial device complies fully with the business strategy - expected earnings are fully justified by analysis of real interest of potential customers, and based on solid market analysis that provides details such as product pieces and product prices - project output meets market requirements for innovation of therapeutic device 	<ul style="list-style-type: none"> - new product was emcompassed to applicant's portfolio - marketing activities have already been in progress during the opposition proceedings - expression of interest from the first potential customers are already available, several presentations at fairs already happened and the product is well presented on the applicant web pages

Source: Own

A similar analysis of OP PIK – Cluster projects was also carried out, the results are summarized in the following table.

Tab. 8. Good practice project analysis – OP PIK Clusters

Case projects OP PIK – Clusters Evaluation

Initial	Final
PROJECT I.	
<ul style="list-style-type: none"> - the project results will reinforce performance of the industrial sector and also enhance the efficiency of the operation procedure, however, it cannot be assumed that the application of the projected results will move this industrial sector to a higher technological level - project outputs are currently targeted directly to the suppliers in the automotive industry, the possibility of implementation the result in another industrial sector is rather high - project results represent new technology procedures for the production of tools, respectively new products (new materials and technology of processing) are project outputs - it is highly possible that project outputs will enlarge possibilities of application - project proposal fully corresponds to the needs of the cluster members; project aims to solve problems that are beyond capabilities and capacities of the individual SMEs - selection of the user committee members corresponds to the project topic, cluster members have undeniable potential to implement the solution into practice 	<ul style="list-style-type: none"> - implementation and application of project result is based on new technological knowledge of the cluster, which will strength position of the cluster and indirectly also its members - new technological and affirmed knowledge might enhance technological innovation and encourage innovation activities in the cluster members and also companies that are not yet members - three intellectual property rights agreements are concluded between the cluster and its members, the contractual relationship is determined for three years with the possibility of extension - project intensify the cooperation among cluster members
PROJECT II.	
<ul style="list-style-type: none"> - project application potential certainly exists, project can contribute to the implementation of new technology in several SMEs, mainly cluster members - project has a hight application potential as it improves the existing products - high quality dissemination plan is elaborated; the dissamination plan, likewise the project application itself, describes project preparation, 	<ul style="list-style-type: none"> - implementation of project results is indeed a strong point of this project - high quality of project accomplishment - no others remarks, the quality of project does indeed exceed the average - the application of results cannot be reasonably expected without a good promotion and

realization and also the implementation of project results	dissemination
--	---------------

Source: Own

The following statements appeared in vast majority of evaluation reports:

- project idea corresponds to the applicant's development and fully comply with the strategic goals
- commercial application and project results implementation is ensured by several preliminary contractual agreements
- feasible strategy of results implementation is provided
- high quality dissemination plan is provided, it describes the implementation of project results in a great detail
- project proposal fully corresponds to the needs of the cluster members
- selection of the user committee members corresponds to the project topic
- cluster members have undeniable potential to implement the solution into practice

6. Recommendations

The recommendations are based on the analysis of the evaluation criteria (Chapter 3), analysis of the feedback and materials provided by INNO PROVENT partners (Chapter 4) and also on the analysis of the evaluation reports (Chapter 5). Generally, **the recommendations are focused primarily on how the evaluation system can be improved to ensure approval of highly beneficial projects and hereby to increase the efficiency of public investment to R&D.** We also discussed possible solutions for the evaluation of I4.0 projects. We classified the recommendations in four categories.

a) Content of the Evaluation Criteria Adjustment

- **The current evaluation system of R&D projects is indeed very sophisticated.** The individual criteria are specified very clearly and comprehensively. A wide range of aspects are taken into consideration. Cost-effectiveness, cost adequacy and assessment of budget items with a common / market price are addressed in the examined programme. The quality of output in terms of novelty and innovation potential are evaluated as well. The profitability and effectiveness of committed resources is ranked according to the knowledge of the target market, market potential, and by comparison of competitive products and solutions.
- The implementation of results and identification of benefits after the project termination are monitored in the TRIO programme in the most detailed way. On the other hand, the OP PIK examines the quality of dissemination plan and application potential. In addition to the above-mentioned parameters, the OP PIK - Clusters assess the quality of research team, research capacity and experience of key researchers as well. The evaluation of market potential is very well linked to the evaluation of the users' committee involvement and knowledge of SMEs needs and demands. The assessment of the relation to knowledge domains (identified in the

National Research and Innovative Strategy) and key enabling technologies can be considered as a certain relation to I4.

- The justification concerning market potential was very often based on the current position of the applicant. We can agree that the declared business development in the past is a good guideline for estimating future developments. However, on the other hand, the assessment of the potential of the new product for the new companies should not be primarily derived from the development of the company applying for support. The applicant / the consortium development strategies should also include the strategy of I4.0 and its related impact on staff knowledge and skills.
- In the evaluation reports evaluators often commented the missing or insufficiently elaborated analysis of the competition. The requirements for this analysis should be clearly stated in the evaluation criteria, including a description of its scope of this analysis. The providing of this analysis could help to identify the real need of the project.
- In several cases of OP PIK – Applications Type A evaluators were concerned about missing pre-orders. All OP PIK Application projects contend research and development activities. The nature of research and development activities implies research uncertainty. It is not certain at the project submission stage, whether the applicants will be able to meet all expected parameters, and of course, the price may not be entirely clear. In our opinion pre-orders shall not be required, but expressions of preliminary interest instead. These are common practice for projects of TAČR or H2020 programmes. For OP PIK – Applications Type A projects, applicants described well the future customers (users) in details, they should demonstrate a market niche, discussing the current view of product novelty with customer perspective and competitive potential, too. The applicant should also describe clearly added value of the R&D activity for the customer. To capture the competitive potential might be a problem as the whole area of digitization is becoming an attractive market (attracting new entrants, even foreign) and there is indeed a dynamic development.
- The evaluation reports of OP PIK – Clusters were even more consistent as the evaluation criterion refers to users committee involvement.
- The current criteria do not address the degree of readiness to market results (or products). Technology Readiness Levels (TRLs), adjusted in H2020 programs, should also be taken into consideration for precise assessment of market potential and also additional costs to launch result on the market (if such costs are likely to incur; if so also their reimbursement should be discussed). Even in the case of outputs with a lower TRL, the applicant should demonstrate knowledge of the needs of potential future customers and indicate the estimated costs related to the transformation of outputs into the final product. However there is anyway a difference in between the demand pull market (essentially the evolutionary innovation market) and technology push (the supply side market coupled with revolutionary innovations); the analysis of the future demand shall be adapted accordingly.
- The competitive potential of the expected R&D results should be describe in more details and the comparative analysis to the competitive solutions (particularly the key product characteristics) should be provided; the good example is the new public programme of MPO TRIO program.
- The contribution to I4.0 should be considered, such criteria are provided by TAČR – sub programme EPSILON:

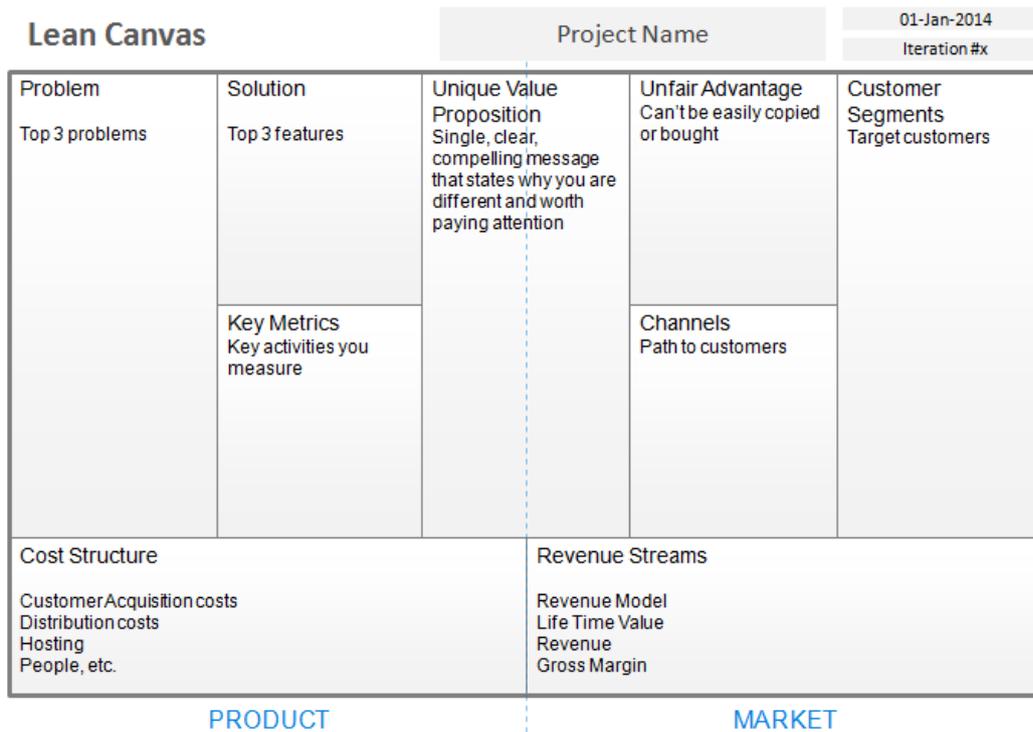
- 6 = maximum points (align with I4.0) occurs when a project includes complex sensor systems and data generators that have intrinsic intelligence and the ability to autonomously reconfigure, data to evaluate and work with metadata that is further used to create, or new sharing the service platform, the Internet (IaaS, SaaS, PaaS), for creating new business models and horizontal processes across a large part of the value chain or product / service life cycle.
- 4 points (partly correspond to I4.0) should be allocated if the virtual models and digital factory simulation tools are clearly described in the project, the solution includes artificial intelligence systems, including the method of creating knowledge databases, physical systems designed to integrate them within modern platforms, implementation of remote services, etc., the project involves working with large data, automatically evaluating them in real time, or providing cyber security.
- 2 points (low level of I4.0 implementation) should be assigned by the opponent if the project includes description / utilization of the cyber-physical model including its links, creation / utilization of digital twin, ensuring collection and on-line automatic data processing (IoT, IoS, etc.) or if a physical system with automatic control of autonomous subsystems is implemented / utilized, the solution involves the creation / use of new processes and services communicating with the digital environment automatically, or when open standards are newly implemented and extended.

We believe it is necessary to assess whether I4.0 implementation is consistent with the overall business concept. Therefore a brief business digitization strategy should be developed and the need for digitalization should be based on this strategy. There is no need nor efficient for every entrepreneur to transform to a digital factory. The above-mentioned EPSILON benchmarks favour a high degree of digitization in the context of cutting-edge research. The OP PIC projects should rather assess the benefits of implementing the I4.0 concept to increase the competitiveness of the applicant. Each entrepreneur needs a different level of digitalization, also pilot projects and step by step digitalization is recommended. In the OP PIC – sub programme Cooperation Technology Platforms there is a requirement for a road map. This may be an appropriate tool for mapping the need for digitization. This procedure would help to eliminate the digitalization activities solely because it is financed by public support.

b) Additional Information and Documents in Project Application

- The evaluators commented the absence of a business plan and an exploitation plan. We consider that one way, how to increase the possibility of project results application is to add a requirement to submit a business plan together with project application and elaborate the final form during the final opponent procedure. A similar concept is used by TAČR for projects in the Alpha and Epsilon programs; the business plan content can be inspired by the business plan that H2020 requires in the SME instrument.
- The initial business plan, especially the analysis of the real interest in the product and sales, can be based on the Lean Canvas Method, that is a simple one-page rating created for new businesses (start ups). The applicant should describe clearly and in what way the value of the result of its R&D activity to the customer (customer). The problem here may be to capture the competitive potential. The whole area of digitization is becoming an attractive market (attracting new start ups and also foreign entrepreneurs), it is a very dynamic market.

Obr. 1. Lean Canvas



Source: www.leanstack.com

- In order to balanced the requirements for the evaluators we recommend to introduce a fixed page limit (the information on the additional pages shall not be considered). This might enhance brevity, clarity and conciseness of the business plans.

c) Project Benefit Monitoring and inspirational Indicators

- We recommend to enhance applicants’ motivation to maximize benefits of the project outputs (i.e. their R&D activities) by setting a system of appropriate indicators. Managerial theory (primarily managerial accounting) disposes of a great variety of methods, tools and also indicators that can be modified to fulfil the needs of a given company and applied in management. It is a common knowledge, that what cannot be measured can hardly by managed, we recommend to add reporting. Precisely, the applicant should be asked to set a system of indicators (they can correspond with mandatory monitoring indicators but not necessarily). The applicants will report fulfilment of these indicators in the project realizations and also in the final review procedure. We can recommend the balanced indicators of Balanced Scorecard (the Table 1 of this report).

d) Evaluators

- We recommend to monitor quality of evaluation reports. There are some examples of evaluation procedures applied in various R&D programs we can describe for inspiration. The initial evaluation in the Czech National Agriculture Agenda programme consists of four evaluation reports, the main one is provided by an employee of the Ministry of Agriculture. This evaluator is also responsible for the final consensus of the four evaluators and if the project is funded, (s)he is monitoring the whole project life cycle. The TAČR programs use the function of a key evaluator too, three evaluation reports are provided, and the key evaluator provides a synthesis and also evaluates the evaluators. If the project is funded, (s)he is monitoring the whole project life cycle. Similar procedure is applied in research programmes in Slovakia.

Future research and analysis

The present study did not include projects that are already in the monitoring phase; the future analysis should focus on projects in the monitoring phase to examine the long-term impacts (such as projects from 2007 -2013 period, TIP or TRIO programmes). The analysis could consider the whole process – initial evaluation, implementation and also project benefits and effects in the monitoring period. Further analysis may also provide case studies with a focus on indicators and digital strategies being built on experience from INNO PROVEMENT partners or available examples from Germany.

List of tables

Tab. 1. Criteria for the evaluation of R&D projects	7
Tab. 2. Comparison of the evaluation of OP PIK – Application and TRIO programmes.....	9
Tab. 3. Evaluation of the OP PIK – Clusters programme	12
Pic. 1. Portuguese Good Practice	16
Pic. 2. Budget & funding sources Kainuu Policy Instrument.....	19
Pic 3. Lean Canvas	30
Tab. 4. Summary of evaluation reports	20
Tab. 5. Case project analysis – OP PIK Application.....	22
Tab. 6. Case project analysis – OP PIK Clusters	22
Tab. 7. Good practice project analysis – OP PIK Application	23

List of abbreviations

- CEA cost-effectiveness analysis
- CBA cost-benefit analysis
- NPV net present value
- MPO – Ministry of Industry and Trade
- OP PIK - Operational Programme Enterprise and Innovations for Competitiveness
- TACR - The Technology Agency of the Czech Republic

Annex No. 1

- A. [OP PIK – Application programme - evaluation in detail](#) **Chyba! Záložka není definována.**
- A. [TRIO programme - evaluation in detail](#)..... **Chyba! Záložka není definována.**
- B. [OP PIK – Clusters - evaluation in detail](#)..... **Chyba! Záložka není definována.**

A. OP PIK – Application programme - evaluation in detail

Source documents: Criteria for the evaluation modified according to Annexes to the calls for Applications I – IV; (B), evaluation criteria of projects under calls I – VI were subject to comparison, such as the criteria for the Readiness of an applicant to implement the project (B), Necessity and relevance of the project (C) and Economy (D), as well as Qualifying criteria (A).

A detailed comparison of the criteria is given in the Annex (table).

1) Economy and CEA

In the current version of assessment, the adequacy of costs is assessed on the basis of the criterion of economy, by comparison of planned costs and market price, and adequacy and cost-effectiveness.

Economy is one of the qualifying criteria and is defined as follows:

*"The budget is cost-effective, or the level of its structure makes it possible to achieve cost-effectiveness by cutting its items. All resources and costs must be identified and assigned to particular activities. Their structure must be sufficiently detailed at the level of particular costs and activities. Costs must comply with the **principles of economy, efficiency and effectiveness**. Costs must be adequate to the scope of activity both in terms of particular items and the total (summary), they must correspond to prices usual at the place and time.*

The budget must include a clearly made breakdown of project expenditures including a detailed breakdown of eligible and ineligible expenses. Proposed expenses are necessary to implement the project and are related to project activities.

The evaluator identifies all items with no reasons for the project implementation, and proposes to reduce all costs that do not correspond to the amount usual at the place and time.

If the sum of overcharging budget items, items unnecessary for the project implementation and insufficiently described or documented exceeds 50 % of the budget proposed by the applicant, the project does not fulfill the binary criterion of economy."

Evaluation criteria for calls I – II made it possible to increase the score (points) for projects the price of which was identical to the usual market price while projects whose budgets were overstated by more than 5 % of the market price did not receive any point in this criterion. The definition of this criterion was related to the purchase of fixed assets, machinery, technology, advisory services and contractual research. Acquisition of an investment is not an eligible cost under the Application programme.

Evaluation criteria for calls III – V also specified wages of workers, but the criteria were not set up strictly. The projects could have achieved 12 points if their budgets had been within the range of 5 %

above the usual price, 6 points if they had been in the range of 10 %; no points were allocated to projects whose prices were more than 10 % higher.

In the last sixth call the budget economy was evaluated only as a qualifying criterion.

The adequacy and cost effectiveness is assessed within the criterion of the Quality of Project Preparation, key milestones and outputs, technical feasibility. Nevertheless, in this criterion, the cost relevance assessment is linked to their breakdown between industrial research and experimental development and to a real time schedule of their own solution. In calls III – VI evaluators also scored particular types of outputs. The outputs of the project, which the applicant undertakes to achieve, were evaluated according to the difficulty of their achievement, as follows:

- Industrial design 1 point
- Certified methodology, functional sample, software 2 points
- Utility model 3 points
- Semi-operation, proven technology, prototype 7 points

2) Evaluation of project results

In the current form of evaluation, outputs and non-economic benefits of the project are evaluated. Outputs of the project classified according to the level of protection of intellectual property were eligible for bonuses from Call III.

As for the evaluation of all six calls, the evaluation of non-economic benefits of the project, as benefits that can not be expressed by economic criteria was altered. In papers/documents to be evaluated positive impacts on the environment, social innovations or contribution for solving social calls defined at the national (national priorities R&D&I) or European (Horizon 2020 programme) level, or to the development of international cooperation in R & D (e.g. Cooperation within the IraSME network) are specified.

3) Quality of the outlined implementation

The current evaluation model takes into account knowledge of the target market, market potential and the probability to apply outputs, and competitive potential.

The evaluation of market knowledge and application of results is reflected in the criterion of the Development strategy of a company / consortium and the capability to implement results of the project where the applicant demonstrates knowledge of the target market and knowledge of similar solutions abroad.

The evaluation criteria provide bonuses to projects that are assumed to provide for real application, in concrete terms the criterion Market potential of planned results, the probability of real implementation of project outputs in industry. This criterion takes into account the feasibility of the strategy to implement results, potential of entering a new industry, **comparison of costs and expected revenues from the implementation of results**.

The project contains a real strategy for the use of results or the method of their dissemination and this mode of use is in line with the applicant's business strategy. The project logically follows up on the company's development and development plans of the applicant. (up to 6 points)

The potential of the product to be developed to enter a new business area is evaluated and according to the company's business strategy strengthen its position on the market. Positively is also evaluated

the potential to strengthen already documented unique position of the company in the given segment and the potential of the new product's applicability on foreign markets. The actual application of the developed product in practice in industrial production is assessed. (up to 7 points)

Comparison of project costs and other necessary costs to complete the preparation of the new product to be launched to the market and expected revenues from the implementation of results. Emphasis is given on demonstrating the reality of the declared expected income from sales and the compliance with the company's business strategy. (up to 3 points)

Criterion The competitive potential of the expected R & D results takes into account the technical level of the expected result compared to the rest of the world.

Competitive potential of expected R & D results.

The number of points will be allocated based on expected outcome parameters as follows:

The result does not exceed the parameters of comparable products in the Czech Republic. (0 points)

The result exceeds the technical level of comparable products in the Czech Republic but does not reach the world level. (1–4 points)

The resulting product complies with world-class parameters. (5–9 points)

The result exceeds the technical parameters of the known solutions or does not have any comparison. (10–13 points)

4) Monitoring of the project implementation after project termination

Monitoring of the project is currently linked to the indicators set out in the call. The call adjusts the indicators.

- 1) Mandatory for selection (monitoring, no target value is set up, but the applicant is required to monitor and report them)
 - number of newly created jobs in the R & D with gender specification
 - number of enterprises cooperating with research institutions
 - number of research organizations working with enterprises
- 2) Obligatory for fulfillment (mandatory, the applicant undertakes to accomplish the target value as he has defined)
 - Number of applied research results (certified methodology, utility model, proven technology etc.)

Under the terms of the call, projects set a non-zero value only for the indicator Number of New Reported Research Results (or the Number of Research Organizations Cooperating with Firms if the applicant is a research organization).

5) Relation to I4

The current evaluation model takes into account relations to the knowledge domains identified in the National Research and Innovation.

A. TRIO programme - evaluation in detail

Source documents: TRIO Programme, Information and Documents for the Implementation of projects of the TRIO programme (Table showing real benefits of the project), Tender Specifications for public tenders I – IV, Notice regarding changes in Tender Specifications for public tenders II - IV.

For detailed comparison of the criteria see the Appendix (table).

1) Economy and CEA

In the current version of the evaluation, the cost adequacy is assessed in Criterion No. 4 The adequacy of the timetable and financial requirements that monitors the adequacy of financial requirements for project solving according to a detailed breakdown of eligible costs of the project and justification.

2) Evaluation of project results

The current criteria evaluate the novelty, the complexity of a proposed solution (Criterion No. 3, the technical-economic level and the complexity of the proposed solution) and in the 4th public tender also technical and utility parameters of expected results (Criterion No. 2 Utility (technical) parameters of the result). This new criterion allows you to evaluate how a new product is in comparison to competing products and processes.

The non-economic benefits of a project are taken into account in Criterion No. 6 The project's topicality and necessity and the suitability of its support from public funds, including both expected positive impacts on the environment and human health and relations to the H2020 programme or the Automotive sector.

3) Quality of the outlined implementation

The current evaluation model takes into account *knowledge of the target market, market potential and probability of using the output, and competitive potential*.

Criterion No. 5 The application of the results evaluates the application potential of the results from the viewpoint of expected economic benefits. The evaluator has the possibility to take into account the extent to which the applicant has knowledge of the relevant market and to what extent the result is comparable in terms of technical parameters, quality and price. Conclusions of a marketing study, which the applicant must submit from the 2nd call, serve to evaluate the commercialization of results, export potential, and it is recommended that he should prove relevant previous projects and, where appropriate, to demonstrate the interest of a potential buyer.

4) Monitoring of the project implementation after project termination

From the first anniversary of the end of a project the beneficiary shall submit to the provider an overview of real achievements of the project per year for a period of three years, always by January 31 of the next calendar year at the latest. Beneficiaries shall provide information as set out below:

- a specific way of using results;
- actual benefits from the implementation of project results and quantification of income from sales, profit, exports, number of newly created jobs, number of licenses sold etc.;
- non-financial benefits of the project

- comparison of results and their use with the status of the issue in the CR
- comparison of actual results achieved and their benefits with expected benefits stated in the application for support.

5) Relation to I4

The current evaluation model takes into account relations to the knowledge domain – compliance with the vertical priorities of the so-called national RIS3 strategy (priorities of application sectors). As regards Criterion No. 1 Fulfilling the Programme's objectives and compliance with vertical priorities of the national RIS3 strategy, including the development of potential in the field of KETs.

B. OP PIK – Clusters - evaluation in detail

Source documents: Criteria for the evaluation modified according to Appendices to the calls for Cooperation Clusters I – IV; and evaluation criteria of projects under calls I – VI were subject to comparison, such as the criteria for the Readiness of an applicant to implement the project (B), Necessity and relevance of the project (C) and Economy (D), as well as Qualifying criteria (A).

For detailed comparison of the criteria see the Appendix (table).

1) Economy and CEA

In the current version of assessment, the adequacy of costs is assessed on the basis of the criterion of economy, by comparison of planned costs and market price, and adequacy and cost-effectiveness.

Economy is one of the exclusion (qualifying) criteria and is defined as follows:

*"The budget is cost-effective, or the level of its structure makes it possible to achieve cost-effectiveness by cutting its items. All resources and costs must be identified and assigned to particular activities. Their structure must be sufficiently detailed at the level of particular costs and activities. Costs must comply with the **principles of economy, efficiency and effectiveness**. Costs must be adequate to the scope of activity both in terms of particular items and the total (summary), they must correspond to prices usual at the place and time.*

The budget must include a clearly made breakdown of project expenditures including a detailed breakdown of eligible and ineligible expenses. Proposed expenses are necessary to implement the project and are related to project activities.

The evaluator identifies all items with no reasons for the project implementation, and proposes to reduce all costs that do not correspond to the amount usual at the place and time.

If the sum of overcharging budget items, items unnecessary for the project implementation and insufficiently described or documented exceeds 50 % of the budget proposed by the applicant, the project does not fulfill the binary criterion of economy."

Evaluation criteria for calls I – II made it possible to increase the score (points) for projects which include a transparent and clear breakdown of project expenditures, including a detailed breakdown of eligible and ineligible expenditures. The proposed expenses are necessary to implement the project and are related to the project activities.

Under the Criterion, it is possible to assess the level and adequacy of personnel costs (number of staff, total man months, remuneration versus qualification) - including staff personnel costs of a contractor. All costs of the contractor are identified as individual items, they are duly related to project activities and their amount is adequate. Wages, advisory services, services of experts and study costs are eligible only to the level of market prices.

The evaluation criteria for calls III – V made use of % range; the projects could have achieved 12 points if their budgets had been within the range of 5 % above the usual price, 6 points if they had been in the range of 10 %; no points were allocated to projects whose prices were more than 10 % higher.

In the last fifth call the budget economy was evaluated only as a qualifying criterion.

2) Evaluation of project results

The current evaluation model focuses on the innovative potential of results (whether any improvement can be achieved or not, and launching new products), the degree of novelty of innovation objectives, and whether clusters have any equipment necessary for the implementation of a planned research, a team of experienced staff and technological capacities.

Criterion the application potential of technology evaluates the extent to which technology can be improved or whether the given technology can be used in a quite different way or not, whether project results provide for a significant innovation potential to improve the existing or to launch entirely new products (product lines), processes and services, and whether the application potential and usability of technology extends to several branches/ industries. Criterion the technological progress gives points for the novelty of innovative goals and project solutions. Criterion the cluster's experience with management and implementation of R & D projects takes into account whether a contractual research is made by a sufficiently qualified R & D workplace; whether the provider of a solution has a sufficiently qualified team of research and technical staff as well as relevant technological capabilities and equipment/devices.

3) Quality of the outlined implementation

The current evaluation model takes into account the potential for improving the existing or introducing entirely new products and the probability of an entirely new application of R & D results in industry.

Criterion The application potential of the technology assesses the extent to which research and development activities contribute to improving the performance or usability of the technology given, whether it applies that projected results of a project presuppose higher parameters and whether the application of technology involves several branches/industries. When applying the market potential of the planned results criterion, the evaluator assesses a survey pool to review needs of small and medium-sized enterprises, the role of the user committee and membership base.

4) Monitoring of the project implementation after project termination

Project monitoring is currently linked to the indicators set out in the call. The call specifies the below indicators:

- 1) Mandatory for selection (monitoring, no target value is set up, but the applicant is required to monitor and report them)
 - International R & D projects;
 - Number of newly created jobs in the R&D with gender specification
 - Number of enterprises cooperating with research institutions.

- 2) Obligatory for fulfillment (mandatory, the applicant undertakes to accomplish the target value as he has defined)
 - New joint R&D&I projects
 - Joint projects in the field of development and internationalization.

Criterion The dissemination plan assesses the extent to which project results can be extended to small and medium-sized enterprises in the branch/industry given, or to other potential users in other sectors as the case may be, and what is the quality of clusters' planning of particular phases of transfer and evaluation of results.

5) Relation to I4

The current evaluation model takes into account relations to the knowledge domains identified in the National Research and Innovation for smart specialization.

Annex No. 2

Application Programme

Amounts in CZK 000, as at October 31, 2018

Application	Allocation	Support applications			Supported projects		Paid
		Number	Total amount	Amount LE	Number	Amount	Amount
Call I	4 000 000	529	6 339 327	2 105 906	287	3 645 569	901 963
Call II	40 000	4	24 243		2	9 667	3 193
Call III.	4 500 000	261	3 975 186	560 651	158	1 912 537	141 872
Call IV	1 600 000	242	2 770 840	459 389	2	13 946	
Call V	400 000	5	84 673	45 250			
Call VI	1 600 000	11	157 003	46 526			
Total	12 140 000	1 052	13 351 272	3 217 722	449	5 581 719	1 047 028

Source: data file MS2014+, internal processing

Note.: Call V – Clean Sky 2

Clusters Programme

Amounts in CZK 000, as at October 31, 2018

Cooperation Clusters	Allocation	Support applications		Supported projects		Paid
		Number	Total amount	Number	Amount	Amount
Call I	500 000	54	14 007	36	211 106	111 008
Call II	40 000	3	11 007	1	3 946	2 759
Call III.	410 000	30	225 284	18	104 065	10 662
Call IV	300 000	40	240 007	7	20 733	276
Call V	300 000					
Total	1 550 000	127	490 305	62	339 850	124 705

Source: data file MS2014+, internal processing

Annex No. 3

A. Project Evaluation

Finland

There are some elements of I4.0 in SMEs practice in Kainuu but there are rather fragmented. SMEs are using web, cloud or e-banking. Therefore The Regional Council of Kainuu prepared a pilot project to support SMEs for I4.0 getting ready. The pilot action will consist of workshop and consultation to tailored the I4.0 concept to the needs of a particular SME.

The **maturity assessment** will be provided by an expert to **tailore** the recommendation concerning I4.0 implementation to the specific needs of the concrete company. Concretely two workshops will be provided, the first will introduce I4.0 practice the latter will provide **maturity benchmark**⁴. The recommendation or precisely guidelines for I4.0 focused on the case company will follow

Poland

- It is important that the support under the new instrument does not only concern investments in technologies, but also in training that raises the qualifications of personnel in the field of operation, programming and maintenance of devices as well as data analysis
- The need to develop criteria for assessing applications for co-financing projects implementing Industry 4.0 technologies - to develop a precise definition of this concept. In addition, due to the level of complexity of the transition from the traditional production model to the model based on
 - o advanced network solutions (e.g. cloud computing),
 - o IT (eg CAx - computer aided technologies,
 - o MES - manufacturing execution system)
 - o automation and robotics.
- consultations with specialists in the above-mentioned and the initial assessment of the project before submitting full documentation.
- Creating a strategy for implementing the development of Industry 4.0;
- Creating, within ROP, an activity dedicated to Industry 4.0, which will include:
 - o implementation of technological and IT solutions (modernization of production lines, investments in software, systems monitoring production processes, tools for automatic data processing, etc.),
 - o training to improve the qualifications of employees in the field of operation, programming and maintenance of devices, systems as well as data analysis;
- Introduction of initial consultations for potential beneficiaries with experts in fields related to Industry 4.0 technologies;
- Promoting solutions that directly implement Industry 4.0 concepts.

⁴ The benchmarking will be examined in more details in Finland on the second partner meeting based on case examples = SMEs = good practice provided by INNO PROVEMENT partners

Enclosed please find “Assessment of public policy instruments for adaptation to Industry 4.0 requirements in the Lodzkie Region”.

In the chapter “Addressed policy instrument in the INNO PROVEMENT project” you will find some more details about, among the others, evaluation study and Regional Operation Program of Lodzkie Region in general. Please, check also “Recommendations”.

Findings Assessment of public policy instruments for adaptation to Industry 4.0 requirements in the Lodzkie Region”

- lack of knowledge of research conducted on universities in the field of Industry 4.0 internal factors hampering the process of implementation of advanced technologies, the respondents pointed out, among other things: lack of own financial resources (64.5%), lack of time (62%), lack of properly educated staff (53%). In turn, among the major external barriers to the process of modernisation of enterprises, the report indicates: red tape (78.5%), difficulties with recruiting competent employees (71.5%), lack of support from the public authorities (71%), unfavourable tax regime (66%), unfavourable regulations (64.5%), difficulties with obtaining EU grants (58.5%), and difficulties with obtaining loans (29%).
- The most commonly used technologies and solutions related to technology innovation in the Polish industry include automation of production processes (52%) and data analyses aimed at optimisation of production (51%). Further on, the respondents indicated: software reducing costs of prototyping and launching new products, Internet of Things, automation of production lines, Industrial Internet of Things, 3D spacial printing, collaborative robots, digital twin and digitisation of production, cloud computing, Big Data, artificial intelligence.
- As for the level of difficulty in implementing Industry 4.0 technologies, entrepreneurs are of the opinion that the following solutions are the easiest to implement: data analyses aimed at optimisation of production processes (41%) and 3D spacial printing (39%), while the most difficult ones include: artificial intelligence (67%) and digital twin (51%). The automation of production lines was indicated as a solution difficult to implement by 49% of the surveyed.
- The respondents also provided their opinions on different ways in which the State could support the implementation of technological innovations in companies. The most frequently indicated answer **concerned tax incentives (79.5%)**

Evaluation study: „Project selection system with particular focus on project selection criteria”
the evaluation

- was aimed at verification of the system and the process of project evaluation and selection, including project selection criteria for the ROP for Łódzkie Region 2014-2020. The survey began in April 2016 and lasted until November 2017.
- the desk research was carried out, which included mainly program documents and documents related to the process of applying for ROP for Łódzkie Region 2014-2020 funds, as well as analysis of project evaluation cards and analysis of protests from project evaluations submitted by ineffective applicants. In addition, interviews were conducted with representatives of involved institutions (the Managing Authority and Intermediate Bodies)

Basic expectations of potential beneficiaries to improve the ROP for Łódzkie Region 2014-2020 project selection system are:

- simplification of the application documentation and limit the number of documents, which should be read during the preparation of the application for co-financing with the necessary attachments, as well as the need to simplify and harmonize documentation
- modification of the application documentation submitted in the application proces during the project evaluation, eg in response to the initial assessment of the Evaluation Committee for the awarded score in the given criterion, as is the case in the non-competition calls
- possibility of substantive consultations with experts from related fields with a given project and priority axis before submitting the application.

the most comments and doubts of experts evaluating applications and representatives of potential beneficiaries and beneficiaries, aroused the key criterion for this Sub-measure: "Project innovation in the region for the Sub-measure II.3.1 - Innovations in SMEs."

- o The fulfillment of this criterion is evaluated on the basis of information confirming the innovation of the project, contained in the application for co-financing, opinions on innovation or attached documents, such as, among others: research results, scientific publications, patent documents, statistical documents that will allow verification of compliance with this criterion. Experts assessing the conclusions emphasize that applicants very often present positive opinions about innovation which were poorly motivated, anonymous (without the author's data) and also coming from unreliable institutions.
- o evaluator considered it worthwhile to introduce a change to the application documentation of calls for proposals under Sub-measure II.3.1, consisting in introducing a requirement to indicate the criterion in the opinion on innovativeness of data (names, affiliations) of its authors with the proviso that the expert evaluating the application can verify the author's competence (his scientific specialty, list of publications, scope of scientific activity) by means of commonly available, reliable sources, e.g. Google scholar database.

multi-criteria analysis was carried out for the Sub-measure above – 32 projects (16 approved & 16 rejected)

- the major reason for the regection was the Correctness of financial and economic analysis - 37.5%
- Criterion 6. Implementation of research and development results. (Weight = 3); the applicant must indicate to what extent the implemented results of research and development are necessary in the development or improvement of the product, service or process to which the project relates
 - o 4 points - the project concerns implementation of results of research and development carried out by the applicant himself.
 - o 3 points - the project concerns implementation carried out independently by the applicant and partially commissioned results of research and development works,
 - o 2 points - the project concerns the implementation of the results of research and development works purchased from a public university, the state institute of the Polish

- Academy of Sciences or another scientific unit being an organization conducting research and disseminating knowledge,
 - 1 point - the project concerns the implementation of the purchased results of research and development works.
 - 0 points - the project does not concern the implementation of results of research and development carried out or purchased
 - The criterion is very important for the final decision on co-financing the project. Loss of one point significantly reduced the applicants' chances of receiving funding, the loss of two or more points reduced these chances to zero.
- Criterion 12. The level of project innovation this criterion is considered by either scientific unit or a research and development center or scientific and technical association with a nationwide range.
 - 4 points - the project leads to the implementation of innovation applied on a global scale for no longer than 3 years,
 - 2 points - the project leads to the implementation of innovation applied on the national scale for no longer than 3 years,
 - 0 points - the project leads to the implementation of innovations applied on a regional scale for no longer than 3 years.
- Criterion 8. New product or service within the project
 - 3 points - the project will launch of a new product or new service on the market,
 - 1 point - the project will launch a new product or new service to the company's offer, which is not a new product or a new service on the market.
- Criterion 7. Needs analysis to an analysis based on which it can be determined that:
 - the project is a response to the identified needs of the applicant,
 - there is a market demand for products or services developed or improved as a result of the project.
- Criterion 9. Use of information and communication technologies (ICT)
 - 1 point - the project include the use of ICT,
 - 0 points - the project does not include the use of ICT
- Criterion 13. The level of co-financing of the project from the funds coming from the applicant's budget. (weight = 1)
 - 1 point - the applicant's funds in financing the project are bigger than the required minimum own contributionpoints
 - 0 the applicant's contribution to project financing is equal to the minimum own contribution.

Summary & Recommendation

- there is no support instrument in the RPO that would be directly dedicated to Industry 4.0. Entrepreneurs interested in modernizing their companies in this area can only use the funds available as part of financing innovation and research and development

- It is important that the support under the new instrument does not only concern investments in technologies, but also in training that raises the qualifications of personnel in the field of operation, programming and maintenance of devices as well as data analysis
- developing criteria for assessing applications for co-financing projects implementing Industry 4.0 technologies - to develop a precise definition of this concept. In addition, due to the level of complexity of the transition from the traditional production model to the model based on
 - o advanced network solutions (e.g. cloud computing),
 - o IT (eg CAx - computer aided technologies,
 - o MES - manufacturing execution system)
 - o automation and robotics.
- It is necessary to create tools defining the readiness of potential beneficiaries to implement Industry 4.0 technology. Particularly important here may be substantive consultations with specialists in the above-mentioned and the initial assessment of the project before submitting full documentation.
- Creating a strategy for implementing the development of Industry 4.0;
- Creating, within ROP, an activity dedicated to Industry 4.0, which will include:
 - o implementation of technological and IT solutions (modernization of production lines, investments in software, systems monitoring production processes, tools for automatic data processing, etc.),
 - o training to improve the qualifications of employees in the field of operation, programming and maintenance of devices, systems as well as data analysis;
- Introduction of initial consultations for potential beneficiaries with experts in fields related to Industry 4.0 technologies;
- Promoting solutions that directly implement Industry 4.0 concepts.

Below I listed indicators within Regional Operational Program for Lodzkie Region 2014-2020,

- Priority Axis II “Innovative and competitive economy”, measure II.3 “Enhancing the competitiveness of SMEs” and Priority Axis X “Adaptability of workers and companies in the region”, measure X.2. “Development of workers and companies” is implemented (submeasure X.2.1 – “Competitiveness of companies and their workers”) (from the presentation).
- Priority Axis II “Innovative and competitive economy”, measure II.3 “Enhancing the competitiveness of SMEs” result indicators:
 - Increase in employment within supported enterprises
 - Number of implemented results of R & D works
 - Number of introduced product innovations
 - Number of introduced process innovations
 - Number of introduced non-technological innovations product indicators:
 - Number of enterprises receiving support
 - number of enterprises receiving subsidies
 - private Investments complementing public support for enterprises (subsidies)

- Number of supported enterprises in order to introduce new products for the market
- The number of supported enterprises in order to introduce new products for the company
- Number of supported enterprises in the field of eco-innovation

- The number of enterprises receiving support (in general)
- Number of enterprises receiving financial support other than grants
- Private investments complementing public support for enterprises (other than grants)

- Priority Axis X “Adaptability of workers and companies in the region”, measure X.2. “Development of workers and companies” is implemented (submeasure X.2.1 – “Competitiveness of companies and their workers”) result indicators:
 - Number of micro-, small and medium-sized enterprises that have achieved their development goal through participation in the program
 - Number of persons who obtained qualifications or acquired competences after leaving the program
 - Number of people working together with self-employed persons aged 50 and more who have obtained qualifications or acquired competences after leaving the program
 - Number of low-skilled workers who have obtained qualifications or acquired competences after leaving the program

Italy

Key Findings

Managing Authority chce í využít kritéria Trendu v regionálním programu Manufacturing and Labor 4.0 (perhaps some of the criteria implemented in the Czech Republic might be used in the Manufacturing and Labor 4.0, programme

Greece

Managing Authority is interested in evaluation criteria and indicators (economic, social and environmental) that are included within the assessment and more specifically the type of measurement

Hungary

Hungary PI adress I4.0

Non-refundable assistance is granted to prototype, product, technology and service development conducted in-house by innovative businesses, up to at least the MVP or demonstration phase and occasionally to market entry.

Non-refundable assistance is offered through open calls for SMEs

Sectors of the Irinyi Plan are preferred – fairly comprehensive list of sectors

Support for the development of SMEs for industrial digitization (Industry 4.0)

Aim of the call - Development of technological systems, production and management systems for pre-qualified industrial SMEs

Eligible applicants - SMEs with, at least 20 employees and at least 0.63 m EUR annual revenue

Amount of subsidy / intensity rate

Total budget of the call: 20,5 m EUR

Budget per project: 67 000 EUR - 1,7 m EUR;

Intensity rate: max. 50% (depending on the region)

Supported main activities

Purchasing new machineries

Developing automatic production system,

Development production technologies: process automation tools, development of sensor and control technologies using robotics

Industrial cyber solutions, smart manufacturing, machine-to-machine, purchasing IIoT solutions

Licence, know-how, immaterial goods

Obligation for the applicant - Growth of turnover or growth of operating profit

Used criteria

Operating profit ratio

[(last closed year operating profit + last closed year interest expense) / balance sheet total for the last closed year] * 100

4.00% and below 0 points

4.01% to 10.00% 3 points

10.01% -20.00% 5 points

20.01% to 40.00% 7 points

40.01% and above 10 points

Value added per person (thousand HUF / person)

(last closed year pre-tax profit or income or loss + last year closed depreciation + last closed year personnel expenses) / last closed year

EUR 3,125 and below 0 points

EUR 3,126 - 9,375 3 points

EUR 9,376 - 15,625 5 points

EUR 15,626 - 21,875 7 points

EUR 21,876 and above 10 points

Net sales / investment

[2 * total eligible costs / (last year's net sales in the closed year or revenue included in the tax base + last year's net sales before tax or revenue included in the tax base)] * 100

3.00% and below or 85.00% 0 points

3.01% -10.00% or 70.01% -85.00% 4 points

10.01% to 15.00% or 45.01% to 70.00% 7 points

15.01% -45.00% 10 points

Equity / investment value

(total eligible costs / last closed year equity) * 100

10.00% and below or above 150.00% 0 points

10.01% to 25.00% or 115.01% -150.00% 1 point

25.01% -50.00% or 85.01% -115.00% 3 points

50.01% -85.00% 5 points

Applying Industry 4.0 solutions

(25 total score applies only if the answer is yes.)

Production planning, production control

At least 50% of the company's production value uses the MES real-time data collection function (minimum: production plan-fact data, scrap rate, downtime, machine status)?

At least 50% of the production value of the company uses the MES production planning and optimization function (scheduling, fine-tuning, scheduling, routing, work order management) on a daily basis?

Does the company manage or continuously maintain stocks for one of its customers (VMI = Vendor Managed Inventory or CRP = Continuous Replenishment)?

Production and logistics automation

At least 20% of the company's production assets can be programmed (eg PLC)?

Does the company have a system to support product identification and automatic data entry (e.g. barcode, RFID, sensor)?

Does the company have a modern warehouse management solution (e.g. voice picking, light picking, automatic warehouse)?

Maintenance, resource management

Does the company have preventive maintenance practices and support systems (predictive maintenance) for at least 10% of the company's operating assets?

Does the company have an environmental management system certified according to ISO 14001?

Does the company have an energy management system certified according to ISO 50001?

Production management

Do you have at least one senior manager for training in lean, TPS or other advanced production management with a certification or bill?

Does the company have a health and safety management system certified in accordance with IOHSAS 18001?

Quality management

Does the company have industry-specific certification?

Do the company's products have unique product identification and registration / traceability of snap-ins / components, or do they have a batch / lot number and company registration / traceability?

IT infrastructure

Does the company have an ISO 27001 certified information security management system?

Does the company have standard electronic data transfer (e.g. EDI) built with a business partner?

Portugal

Grants and evaluation criteria

Evaluation process

→ **initial criteria**

Eligibility in I4.0 Referential

→ Technologies

Advanced information systems (Digital Infrastructure, Artificial Intelligence and Predictive Algorithms, Advanced Data Analysis Cloud computing, Cybersecurity)

Connectivity between systems, equipment, products and people (Advanced sensors and IoT, Remote operation, Increased Reality, Intelligent machines)

Advanced production systems (Advanced and connected products and materials, Modular Operations, Additive production, Autonomous robots)

Those technologies are the ones that Portuguese partner consider for classification if the project is I4.0 or not. Must always be relevant on the investment project itself, not exists only in the company.

→ Innovation (Product, Process, Organization, Marketing)

Relevance of I4.0 investments in project

General Criteria: Quality of the Project, Impact in the Company, Economy and Regional

Impacts measure

Implementation of project in area technology, organization, marketing

Indicators of project benefits: jobs created, sales growth, international sales intensity, gross value added

Evaluation of project benefits: 1 to 3 years after the end of the project

The main criteria concerning project benefits are jobs created, sales growth, international sales intensity and gross value added, but its use is different between Grant schemes. For example:

Productive Innovation – high qualified jobs created (only qualifications at university level are quantified), sales growth, and gross value added.

Internationalization - international sales intensity.

Qualification – number of competitiveness immaterial domains covered by project (Marketing, Organization, Circular economy, Industry 4.0, ...) and number of new innovative activities in Marketing and Organization.

The non financial benefits are also used in depending on grants scheme (for example Productive innovation or Qualification).

Using of non- repayable grants and repayable grants:

In *Productive Innovation* criteria concerning project benefits determine if part of the repayable grant is converted in non-repayable grant. *Example:*

Evaluation of the indicators is realised 2 years after the end of the project implementation. If achieved in 125% or more, half of repayable grant becomes non-repayable (between 100% and 125% less than 50% becomes non-repayable).

Loan is adjusted accordingly the result of the evaluation.

In the other schemes these criteria are important to keep the Grant, but not the only ones; the good implementation of the project is more relevant.

Note: The beneficiaries only propose values for these criteria.

Vouchers – only the realization of the services proposed.

Evaluation of market potential of the expected results

Presented by the applicants and validated by intermediate bodies.

Coherence of the statement of reasons, benchmarks and documentation.

Evaluator: The criteria are evaluated by the intermediate body, the same team that evaluates the expenditure.

B. Approaches of INNO PROVEMENT partner countries to support the implementation of I4.0 from public sources

Definition of I4.0 and Phases (Consensus and Differences)

Essentially, I4.0 is associated with the digitization transformation of the economy and society;

Individual partners do not mention the I4.0 definition, but rather their documents with targeted support for individual features of I4.0 implementation such as IoT, clouds, big data, etc., but also with further strengthening of robotics and production automation or AI support. A relatively wide list of innovations and technologies associated with I4.0 is then carried out under the heading I4.0 in the coordinator's material (Hungary).

The support of innovations leading to the implementation of I4.0 is focused both on technological process and product innovations and on process innovations connected with changes in the management system itself in enterprises based on digitization. The partners do not report possible phases of I4.0 implementation.

At partners can then see to varying degrees the emphasis on supporting SMEs in relation to I4.0:

- above all, prepare them for changes in the business system (process innovation in organization, management and marketing);

- further prepare them for modern intelligent and flexible production systems and related technological innovations and product innovations;
- prepare them for the needs of achieving adequate qualification of employees (professional competences in new technologies, etc.).

In this context, in particular, the use of qualified advisory and consultancy services to start SME entry into the I4.0 implementation process (see e.g. Portugal, Finland, etc.) is a form of public support. Vouchers are also used as a tool to support individual projects.

Objectives and instruments of support in individual partner countries (programs / OP, ROP /, innovation vouchers and other tools / workshops, consultations, benchmark, ..), SME support...) in relation to I4.0

Partners work to develop policy tools with use of assessment and analyse of the level of digitization and the introduction of I4.0 solutions, especially in relation to SMEs (maturity of SMEs). Selected examples of Methodology of partner level national / regional assessment.

Hungary

Policy instruments

Hungary is not a forerunner in digital economy indices but the digital infrastructure offers a good base for development.

Greatest challenge for Hungary is make businesses (particularly SMEs) and people use of digital solutions and digital services.

The initial strategy initiative is **Irinyl Plan 2016** (industry strategy of the Hungarian Government with this main objective: industrial production in GDP to reach 30% by 2020). In this context is relevant public initiative with 40 stakeholders **Industry 4.0 National Technology Platform**.

Government has also launched a number of programmes to improve digital readiness of SMEs.

Government backed and non-governmental entities are active in implementing programmes – although initiatives and programmes are largely dependent on public financing. See these semi-public initiatives:

Industry 4.0 priority project under EDIOP (Industry 4.0 maturity assessment for SMEs, Industry 4.0 demonstration factories, Customised consultancy and planning for SMEs)

Digital Welfare Programme and Digital Welfare Programme 2.0 (A collection of development programmes for the digitalisation of Hungary including education, businesses, children, elderly)

Programme for Modern Businesses under EDIOP (complex support for SMEs for their digital transformation)

Programme for Medium-Sized Companies under EDIOP (complex support high-growth companies including mapping, mentoring).

Name of addressed policy instrument in relation to I4.0

Economic Development and Innovation Operational Programme (EDIOP 2014-2020) – Priority Axis 2 “Research, Technology development and Innovation”, Measure 2.1 “Enhancing R&I activity of research and technology intense enterprises”

The aim of the measure is to promote the creation and development of enterprises based on Hungarian R&I achievements competitive in the international market place, and to create an ecosystem to support this.

Support in the form of non-refundable assistance in this PI to I4.0

Non-refundable assistance is granted to prototype, product, and technology and service development conducted in-house by innovative businesses, up to at least the MVP or demonstration phase and occasionally to market entry.

Non-refundable assistance is offered through open calls for SMEs

Sectors of the Irinyi Plan are preferred – fairly comprehensive list of sectors

Portugal

Policy instruments

Program COMPETE 2020

Management Authority for the Operational Programme for Competitiveness and Internationalization

Adresováno pro SME - oblast inovací a kvalifikace (analýza na národní úrovni)

Public strategies and programmes:

Industry 4.0 Initiative

Training and capacitation

Technological Cooperation

Startups I.4.0

Financing / Supporting Investment

Internationalization

Legal

Platform I4.0 - Cotec

Strategic Committee of Industry 4.0 Initiative (private companies, public and private agencies, industry associations, MA Compete 2020).

COMPETE 2020 has a broad circle of stakeholders.

Non-governmental strategies and programmes

Program “PME Digital”

The Digital PME project is co-financed by the COMPETE2020 program and aims to train, provide information and increase business skills of SMEs for digital transformation, fostering the acceleration of the Portuguese Economy for a Digital Economy in the Automotive, Materials, Raw Materials and Commerce.

TICE.pt

Information Technology, Communication and Electronics - TICE.PT was set up in 2008, with headquarters in Aveiro. Involves and mobilizes relevant actors throughout the country, particularly in the regions of Braga, Porto, Coimbra and Lisbon, covering the entire value chain in the TICE area. The TICE.PT coordination platform guarantees and promotes the interfaces between the academic world, represented by universities and R&D institutes, and the business world, represented by members and also through networks, especially SMEs, represented by their associations.

Addressed policy instrument (PI)

Aim of the PI in relation to I4.0:

Innovation on Product, Process, Organization, Marketing

All better supported with I4.0 priorities

How does Portuguese PI adress I4.0?

Vouchers for very small business to start I4.0 theme.

Non repayable grants to digitalization processes on organization or marketing innovation processes.

Repayable grants for technological innovation (product or process), better evaluated if i.4.0 is present.

Support to I4.0 projects

Dedicated scheme – Vouchers

Preferential conditions for I4.0 – Qualification & Innovation projects

+ grant + evaluation criteria

Support to I4.0 projects of SME (v portugalštině PME)

Incentive system "Qualification of SMEs" Valley Industry 4.0 (Vale Indústria 4.0)

The aim is to make available to Portuguese companies (SMEs) a diagnosis for a set of recommendations that will allow companies to set up an action plan to digitize processes and product innovation using new technologies. This initiative is in accordance with the strategy defined in Industry 4.0 of the National Reform Program.

To assist SME qualification and internationalization projects by supporting the setting up of a technology strategy to improve the company's competitiveness, in accordance with the principles known as "Priority of Investment (PI) 3.3. Article 40 (1) (B) RECI".

Project type: Individual SME projects to acquire consulting services to diagnose the current situation and identify a strategy to implement industry 4.0 related technologies and processes 4.0. They are SMEs of any kind and in any legal form.

Two areas of support:

1.) Diagnosics and strategy of e-commerce related processes implementation → solution of the following topics:

- a) Design and implementation of strategies applied to the digital management of markets, distribution, products or customer segments;
- b) Use-Centered Design - design, implement and optimize digital customer-focused strategies (maximizing their attractiveness, relationships and communication);
- c) Web Content Management (WCM) - design, implement and optimize campaign management, customer relationship management (CRM) and e-commerce platforms;
- d) Recording and optimizing presentations on electronic markets;
- e) Search Engine Optimization (SEO), Search Engine Advertising (SEA) - search engine optimization and search engine advertising in order to get a better position in search results (link to first page) and thus more frequent and targeted visitors (keyword search relevant to site awareness and attendance);
- f) Social Media Marketing - design, implement and optimize presentation and interaction with customers through social networks;
- g) Content Marketing - creation and distribution of digital content (short text, long text, images, animations or videos) to attract the attention of target customers to the company's offerings;
- h) Display Advertising - placing advertising on company offers on third-party sites, including search results pages;
- i) Mobile Marketing – design visualization and customer interaction strategies using smartphones and tablets;
- j) Web Analytics - collect, organize, analyze and visualize large volumes of data generated from customer surveys and interaction in the digital environment in order to identify patterns, correlations, and relevant knowledge to improve management and decision making processes.

2.) Diagnosics strategy and implementation of other industry 4.0 related processes strategy, covering:

- a) Systems connectivity; sensors (intelligent sensors and sensing devices);
- b) Big data; augmented reality;
- c) Additive manufacturing (3D print); IoT; cloud; digital twin, machine learning and artificial intelligence; cybernetic systems (information and communication technologies, sensors and mechatronic systems for monitoring and controlling processes and the entire value chain, mechatronics, robotics, etc.);

- d) Solutions for secure connectivity and implementation of cyber security systems;
- e) Interfaces Machine-to- Machine (M2M) and Human –to- Machine; implementation of production digitization solutions: workstation scanning, assembly process and digital applications integration;
- f) Manufacturing as a Service (MaaS) and Apps for manufacturing; systems for intelligent and flexible production.

Support period: within 12 months

Specific criteria for obtaining this support:

- a company with at least 3 jobs;
- consult at least two accredited bodies in this policy area ("service provision in industry 4.0");
- other applications, including those previously approved or concluded in Vale Inovação, should not be approved;
- characterize in the application the current situation in areas 1.) and / or 2.) covered by the project;
- identify and characterize in the application the services to be carried out in order to define an action plan to implement management models in at least one of the supported areas:
- undertake to submit information, evaluate the services provided by the relevant accredited body;
- commit to obtain or update electronic certification on the IAPMEI website to demonstrate the status of micro, small and medium-sized enterprises.

Funding

It is a co-financing system. The final call amounted to a total of EUR 3,4 million (ERDF). The maximum project support is 7.500 € (2.5 for diagnosis and 5 for implementation) and till 75% of eligible expenses for less developed regions NUTS II (Norte, Centro, Alentejo and Algarve), in case of Lisbon region maximal rate of co-financing is 40 %.

From 04/10/2018 until the maximum number of requests listed in the Notification under the Operational Program is received.

Finland

National policies and strategies

No distinct Industry 4.0 policy. Rather, Industry 4.0 is part of Finland's overall Industrial, Innovation and Digitisation policies. Digitisation, especially through Artificial Intelligence (AI) initiatives is a policy in its own right involving the uptake & production of **AI solutions**.

The ongoing structural funds provide excellent funding options for Industry 4.0 - related investments.

Enabling context: VTT certified centres for supporting access of SMEs to KETs, including Industry 4.0.

Drivers: the digitisation of the banking and the public sectors, both very advanced.

Finland not strong in I4.0 uptake yet: strong uptake in the service industry, not so strong in manufacturing.

Industry 4.0 is not a priority in the current RIS3. However, development of robotics solutions is part of the KET applications priorities and, aligned to it, further development of the gaming industry is foreseen.

Regional strategies

The Kainuu regional development programme

In the Regional Development Programme of Kainuu, Industry 4.0 is described under the Smart Specialisation approach. In the Regional Action Plan of the Structural Funds and Rural & Agriculture Funding industry 4.0 is emphasised in chapter 1.3

The Kainuuu RIS3

Industry 4.0 solutions are described as cross-cutting themes through all chosen spearheads of the RIS3 strategy. The Kainuu RIS3 is currently in process of being revised, and various good practices

and relevant policy approaches will be integrated. Advanced manufacturing, I4.0 and transregional (national, transnational, interregional) solutions for cooperation and access to expertise, will be included.

Policy instruments - conclusions

- (1) State of play: Good projects but they address technical aspects, application tools are missing; the comprehensive approach is missing.
- (2) Strong need to raise awareness in depth among businesses of Industry 4.0 concept, benefits and implications.
- (3) The overall maturity of SMEs of Industry 4.0 is a field that could benefit from programmes comprehensively addressing this field, by activating investment priorities 2 and 3d of the current Structural Funds, as well as by forthcoming policies and policy improvements.
- (4) Training of SMEs to understand Industry 4.0 is a priority.
- (5) Project funding criteria to be tailored to reflect Industry 4.0 more literally.
- (6) To promote knowledge and skills on Industry 4.0 in the region.

Poland (Łódzkie Region)

Policy instruments

Instruments supporting SMEs in the development of innovation and competitiveness in the Łódzkie voivodeship are included in the Regional Operational Program for Łódzkie Region 2014-2020, in the Priority Axis II "Innovative and competitive economy", action II.3 "Enhancing SME competitiveness".

In the sub-measure II.3.1 "Innovations in SMEs", the support is intended primarily for investments related to the development of SMEs, changes in the production process, changes in the manner of providing services or organizational changes. Implemented projects under this sub-measure are, for example: implementation of the results of R & D works, implementation of innovative products, product manufacturing processes or provision of services, including eco-innovations. In addition, as part of the sub-measure, projects are supported in the use of information and communication technologies (ICT) by SMEs.

Sub-measure II.3.2 "Financial instruments for SMEs". The intervention under the sub-measure is aimed at improving the access of the SME sector from the region to external sources of financing. Assistance under financial instruments is aimed at supporting enterprises, providing seed capital and start-up capital, capital for expanding operations, capital to strengthen the core business or implementation of new projects, moving enterprises to new markets or new solutions.

In addition, as part of the sub-measure, projects are supported in the use of information and communication technologies by SMEs. Support may include investments in fixed assets and intangible assets as well as working capital in accordance with EU law. In support of financial instruments, you can:

invest in the capital of existing or newly created legal entities involved in the implementation of financial instruments in line with the objectives of the European Fund for Strategic Investments (ESI Funds), limiting support to the amounts necessary to implement new investments;

entrust implementation tasks to: the European Central Bank (EIB) or public or private law (trust fund); or in the case of financial instruments involving only loans or guarantees, take the implementation tasks directly.

Financial instruments may take the form of loans, guarantees and, depending on diagnosed needs, other forms of debt financing.

There is no support instrument in the RPO that would be directly dedicated to Industry 4.0. Entrepreneurs interested in modernizing their companies in this area can only use the funds available as part of financing innovation and research and development

It is important that the support under the new instrument does not only concern investments in technologies, but also in training that raises the qualifications of personnel in the field of operation, programming and maintenance of devices as well as data analysis

Developing criteria for assessing applications for co-financing projects implementing Industry 4.0 technologies - to develop a precise definition of this concept. In addition, due to the level of complexity of the transition from the traditional production model to the model based on

advanced network solutions (e.g. cloud computing),
IT (eg CAx - computer aided technologies,
MES (manufacturing execution system),
Automation and robotics.

It is necessary to create tools defining the readiness of potential beneficiaries to implement Industry 4.0 technology. Particularly important here may be substantive consultations with specialists in the above-mentioned and the initial assessment of the project before submitting full documentation.

Methodology of partner level regional assessment

Hungary

Sources for regional assessment:

desk research (statistics national and EUROSTAT; deliverables, outputs in the Industry 4.0 priority project of EDIOP, Irinyi Plan of the Hungarian government, DESI reports and country profiles, further international indices and studies)

Overview on the digitalisation level of the country/region

Hungary ranks 23th (out of 28) in The Digital Economy and Society Index (DESI) of 2018

Hungary ranks 46th (out of 63) in IMD World Digital Competitiveness Ranking 2018

Hungary ranks 38th (out of 81) in Technological Readiness Ranking of The Economist Intelligence Unit 2017

primary (field) research

Interviews:

Innovation and Technology Ministry, National Innovation Office

IFKA Nonprofit Ltd

Representatives of clusters

Roundtables

No roundtables

Completed online survey

Survey sent out by the Ministry of Finance to SMEs in January 2019

Conclusions of the online survey

90% of respondents think that it is necessary to support the introduction of Industry 4.0 solutions at SMEs (50% strongly agree) by the government

Respondents prefer the following forms of support (most important first):

Non-refundable grant, which includes eligible Industry 4.0 solutions' costs

Training, mentoring, coaching

Loans with favourable terms

Dedicated non-refundable grant

46% of respondents has no knowledge about any form of support to introduce Industry 4.0 solutions and 90% of them did not apply to any support

60% of respondents rather dissatisfied with the support provided to introduce Industry 4.0 solutions
 52% of respondents think that consultants currently available on the market are well-prepared and able to help them in the introduction of Industry 4.0 solutions

Portugal

Sources for regional assessment:

desk research (WEF, DESI, IUS, ad. National statistics diabase and other)

Overview on the digitalisation level of the country/region

Portugal ranks 16th (out of 28) in The Digital Economy and Society Index (DESI) of 2018, losing a place when comparing with the DESI of 2017 (albeit the low increase of 2 points in the total score)

Portugal ranks 34th place (out of 140 countries) in the Global Competitiveness Index 4.0, but is: 17th in Adoption of fixed broadband, 21st in fiber optic broadband, 30th in the usage of e-government, 32nd in Innovation Capability, 37th in ICT adoption, 50th in Digital Skill, 54th in terms of Internet usage.

→ Portugal has good telecommunications infrastructures and e-government utilization, but also needs to improve Its digital skills and internet usage, which mean Portugal needs to improve its digital culture to embrace Industry 4.0 concepts.

Portugal also ranks 35th in 40 countries in the Deloitte “Manufacturing Global Competitiveness” of 2016, being predicted that will maintain that position in 2020.

primary (field) research

Stakeholders Meeting/Focus group (8th of February 2019) with 11 participants: Managing authorities, intermediate bodies, beneficiaries, associations, technological centers)

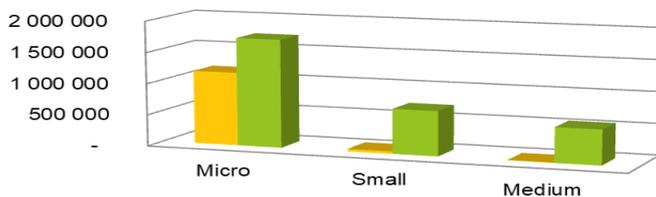
Online survey (between 19th November and 3rd of December 2018) 6.630 Invitations sent to SME’s (approved investment projects), 322 valid replies (4,58% reply rate) → very low

Maturity of SME:

SMEs represent 99% of Portuguese enterprises (2016)

79% of all employees (Adding non SMEs) worked at SME’s (The active population in 2017, was 5,2 million, of which: 57% work at SME’s (3 Million).

Number of SMEs and People employed (2016)



	Micro	Small	Medium
N. Companies	1 167 993	38 866	6 248
People employed	1 724 942	713 513	556 251

71% of Portuguese SMEs consider important to develop a digital strategy

However, 78% of these companies are still at an elementary or non-existent stage of development

The main difficulties in the digital transformation of SMEs are the lack of human and technical resources, skills and capabilities; inefficient use of communication channels; and the lack of analytical culture.

For the digital development of these SMEs, the study clearly highlights the need to bet:

In the development of digital marketing plans with the involvement of specialists (outsourcing);

In the training of human resources and in the creation of small internal structures dedicated to digital;

In defining metrics and business indicators for the creation of an analytical culture.

Source: “Digital Picture of SME in Portugal”, 2017 survey PSE/IAPMEI,
<http://www.pse.pt/wp-content/uploads/2017/07/Retrato-Digital-PME-principais-conclusoes.pdf>