

## KNOWLEDGE INTENSIVE SERVICES IN SOCIETY 4.0

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**Abstract:** The contribution brings attention to the growing role of knowledge intensive services in the Society 4.0. Faculty of Economics of the University of West Bohemia in Plzeň joined forces with the Institute of Technology and Economics in České Budějovice in the project “Knowledge-intensive services sector adaptation to the conditions of Society 4.0” supported by the programme ÉTA of the Technology Agency of the Czech Republic. This contribution summarizes the research results of the completed first phase of the project: the development of two studies focused on identification, analysis and evaluation of methods and tools for knowledge intensive services adaptation and catalogue of requirements to competencies and skills to the changing jobs. Those studies were complemented by the questionnaire research among the relevant companies in Plzeň and South Bohemia regions followed by semi-structured interviews with managers of selected companies. The presented findings, observations, recommendations and feedback from business practice form the basis for the second phase of the project, which is focused on creating a methodology for adapting small and medium-sized enterprises in the services sector to the conditions of Society 4.0.

**Keywords:** knowledge-intensive services (KIS), Society 4.0, CEE region, changing requirements to competencies and jobs, risks and opportunities

**JEL Classification:** L21, M19

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### INTRODUCTION

In the Czech Republic, the main emphasize is given to development of technologies applicable in industrial applications, corresponding more to the term “manufacturing”, while the term “industry” in English covers much broader spectrum. Similarly, instead of „technology transfer“ should be preferred „knowledge transfer“ covering broader set of techniques, skills, methods, tools and processes applicable in production of goods and services. It should be taken into account that technology is a necessary, but not sufficient condition of success in the rapidly changing world and while it is the important tool, it cannot be a goal in itself. This concept is strongly supported e.g. by the book (Kane, G. C. et al., 2019) summarizing the three years of extensive research reflected in its title and subtitle: “Technology Fallacy: How people are the real key to digital transformation”.

It can be expected that, similarly to other developed economies, the focus will shift to service sector and its role in the economy and employment will be increasing. Incoming wave of digitization, automation, artificial intelligence, and other components of the 4-th industrial revolution will put additional emphasize on the knowledge intensive services (KIS). We can also expect the increasing importance on pre-production and post-production phases bringing higher added value than the production phase itself. While applications of technologies as robotics, automation, etc., in production phases is rather straightforward, it is not the case of the front- and back-end processes provided by knowledge intensive services.

Table 1 shows the increasing employment in knowledge-intensive services in the Czech Republic.

Tab. 1: Employment in knowledge-intensive services in the Czech Republic (thousands of employees)

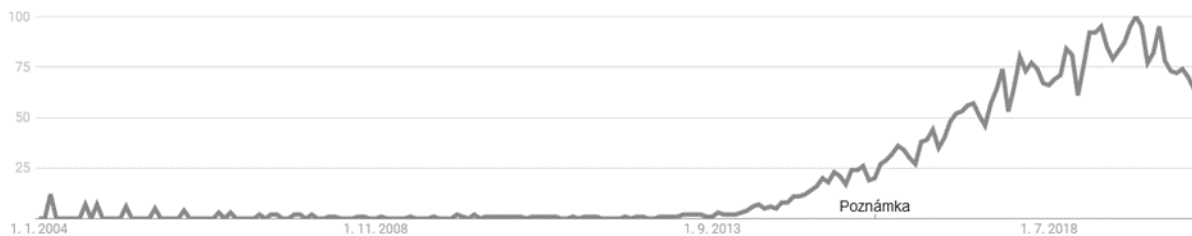
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total	4,885	4,872	4,89	4,937	4,974	5,041	5,138	5,221	5,293	5,303
J	137.1	145.4	125.3	139.8	148.7	141.5	147.6	149.3	169.8	169.9
M	202.1	198.7	212.4	220.8	222.4	237.5	251.5	266.6	266.6	259.1

Note: J - information and communication activities, M – professional, scientific and technical activities

Source: processed from (CZSO, 2019)

The growth of interest in the topics related to the 4th industrial revolution (4IR) can be illustrated by the number of Google searches with key words „Industry 4.0“, „Society 4.0“ and „Service 4.0“. Interest in Industry 4.0 (see Figure 1) is substantially higher than in the case of Society 4.0 and Service 4.0. The relatively lower interest in non-industry areas is reflected also in number of publication, especially academic ones, related to services.

Fig. 1 Number of Google searches with key words „Industry 4.0“



Source: <https://trends.google.com/trends/explore?date=all&q=Industry%204.0>

As declared in (Mařík et al., 2016): „Extremely important and irreplaceable role in the realization of the Industry 4.0 will play social sciences. The gradual realization of this initiative is historically the greatest challenge to this segment of applied research in history and its outcomes can significantly influence the impact of the fourth industrial revolution in the Czech Republic“. However, it must be recognized that this kind of research cannot – unlike industrial applied research – rely on funding from private sector and the understanding of their importance should be reflected in higher share of support from public funds.

The reasons mentioned above inspired the authors of this contribution and the project team to pay closer attention to the service sector and within it especially to Knowledge Intensive Services (KIS) facing new challenges. Due to the location of two project participants in Plzeň and České Budějovice it was decided to focus within this sector on small and medium size companies in the NUTS2 South-West region of the Czech Republic.

The pace of growth of technologies and knowledge is more rapid than the absorption capacity of the society. To fully exploit the potential of technological advances they must be followed by profound changes in the chain Industry & Services -> Work -> Education -> Society, therefore the project attempts to cover the road to be followed throughout this complete chain leading to Society 4.0.

The initializing activities of the project consisted in desktop research, the results of which were presented in two studies. These studies were closely followed by field research – the questionnaire survey and semi-structured interviews with managers of selected companies.

## Goals, methodology and data

Main goals of the presented research are focused to three areas:

1. Identification, analysis and evaluation of principles, methods and tools for adaptation of the knowledge intensive services to technologic, economic, social and environmental conditions of Society 4.0.
2. Identification, analysis and evaluation of changes in requirements to knowledge and skill of the workforce related to the dawn and expansion of Society 4.0.
3. Field research of the current state, preparedness and needs of selected micro, small and middle enterprises in the knowledge intensive sector in the area of the usage of methods and tools of Industry 4.0 and Society 4.0.

Achievement of goals 1 and 2 was supported by the analysis and evaluation of secondary sources using the desk research and explanatory, interpretation and comparative methods. Field research (goal 3) was performed by questionnaire research and structured interviews in selected knowledge intensive service SMEs in Pilsen and South Bohemia regions. Collection and processing of acquired data and information from businesses took place in the second half of 2019. Characteristics of the sample of companies selected for questionnaire research and structured interviews are documented in section 2.

## 1. DESKTOP RESEARCH

Desktop research consisted in preparation of two introductory studies, which will be complemented by new attainments accumulated during the project. The findings and insights gained in these studies will belong, together with other research studies, the starting point for the final product output – the methodology of KIS adaptation to Society 4.0.

### 1.1 Results of the study 1 - Identification, analysis and evaluation of principles, procedures, methods, and tools for adapting the service sector to the technical, economic, social and environmental conditions of Society 4.0

The study (Vacek et al., 2019) consists of the following sections:

- **The present state and trends**

This section describes the present state and the trends in the sector of knowledge intensive services, their share in economy and employment and links to regional, national and EU development strategies.

It can be concluded that not all managers realize that without timely preparation their companies will not be able to keep pace with digitization. Nearly half of population is afraid of disappearance of jobs. The system of STEM education lags behind requirements.

- **Classification of knowledge intensive services (KIS)**

We adopted the definition of services of Vargo & Lusch (2014): “The service is application of competencies to the benefits of others.” In developed economies we can observe the ongoing transformation from traditional manufacturing industries to services.

Among KIS we include services with great intensity of knowledge usage. In their classification we adopted the OECD approach (OECD, 2006). This type of services can be subdivided into two distinct groups:

- **Knowledge providers:** their prevailing activity is creation of new knowledge increasing the company intellectual capital. The knowledge is then commercialized by providing licenses, know-how, consulting, etc. to their users. For these companies is extremely important intellectual property protection.
- **Knowledge users:** companies using knowledge created by its creators for innovation of their products and processes.

The open innovation concept is typical for those two categories of KIS. Specific category of KIS are Knowledge Intensive Business Services (KIBS), assisting in solving problems requiring external knowledge sources. Their share in value creation and employment is increasing and their performance influences that of their clients.

- **Knowledge services and innovation**

Increasing complexity of innovation implies that their success depends on the extent of necessary knowledge, competencies and skills. KIS can play here the important role as:

- **Innovation resources**, if they act in initialization and development of clients' innovation activities,
- **Innovation facilitators**, supporting organizations in their innovation processes,
- **Innovation brokers and intermediaries**, if they transfer knowledge among organizations, industries, and networks.

- **The road from Industry 4.0 and Society 4.0 to Society 5.0**

This chapter focuses on the broader context of the 4th industrial revolution (4IR) – the chain that can start by Industry 4.0, but must be followed by the road through concept of Work 4.0 and Education 4.0 resulting in systems approach to Society 4.0 with prospective outlook to Society 5.0. This whole chain should be consistent, synchronized and coordinated. Changes induced by the 4th industrial revolution will not affect only industry and services, but also jobs and employment structure, social systems and education, they penetrate into company processes and even to personal life.

The impacts of the 4IR can be numerous, e.g.

- Positive changes in productivity, agility, innovativeness, customer satisfaction, optimization of company processes, increased turnover, ways of thinking.
- Linking of all activities from R&D to final outputs.
- Increased precision and speed of company processes supporting increased quality, variability and customization of products and services.
- Increased agility, preparedness, and ability to flexibly react to changes.
- More significant importance of human workforce related to necessity of timely and effective decision making and requiring development of soft skills as creativity, teamwork, flexibility, and others.
- Fast feedback and responsibility leading to better customer service.
- Complex connectedness of all company processes, additive manufacturing, preventive maintenance.

- **Work 4.0 and Education 4.0**

These topics, including the impacts of digitization on the job market, are in greater detail described in the second study (see section 1.2).

- **KIS as support of life quality**

Economic, financial, and quantitative indicators can reflect only a part of the life quality including more than satisfaction of basic needs, more than the quantitative indicators can capture. Great role here play the subjective attitudes of individuals and requirements to health, work satisfaction, economic sufficiency, functional social relations and pleasant environment.

According to WHO (2018) „Life quality is the subjective perception of the individual life situation in the context of culture and value system in which the individual lives and which are related to its life goals, expectations and common standards and interests.”

KIS can contribute to the improvement of life quality e.g. by:

- R&D, knowledge transfer,
- Consulting, legal, and financial services,
- Information and communication services,
- Job related services, requalification, development of competences.

- **Principles, approaches, methods, and tools for the service sector adaptation**

This chapter focuses on overview of principles, approaches, methods, and tools for the service sector adaptation. Briefly characterized are technologies that can support entrepreneurship and convergence of which can lead to exploitation of their synergetic effects and emergence of new phenomena.

Leading consulting agencies (McKinsey, Accenture, Deloitte, PwC, BCG), universities (MIT, Harvard, Stanford, ...) and organizations (WEF, The World Bank, ...) publish many surveys of the most important

technologies for business, however they all share their similar classification. In this study is adopted the classification of Likens (2019), which identifies the eight essential technologies that matter for most businesses today: Artificial intelligence (AI), Augmented reality (AR), Blockchain, Drones, Internet of Things (IoT), Robotics, Virtual reality (VR), and 3-D print. These basic technologies are then combined to become potential driving forces of new innovation waves, see Table 2.

Tab. 2: Convergence of technologies

Combined technologies	Components
Embodied AI	3-D print, AI, drones, IoT, robotics
Intelligent Automation	AI, Robotic process automation (RPA)
Automating Trust	AI, Blockchain, IoT
Conversational Interfaces	AI, IoT, RPA, robotics
Extended Reality	AI, AR, IoT, VR

*Source: authors, adapted from (Likens, 2019)*

The full text of the study briefly characterizes each technology including examples of its application. (Tucker, 2019) provides the overview of technologies prepared for broader use and help them to attract new customers, progressing from development to application phase. They can be applied as innovation tools even in SMEs and help them to attract new customers, innovate existing products (incremental innovation) or develop new ones (radical innovation), increase the productivity of work and open new ways to the future. This chapter presents some examples of the use of new technologies in practice.

- **5G** is coming: it is supposed that it will be 10-times faster than current 4G and can catalyze development of technologies as self-driving cars, telemedicine, big data, drones, virtual reality and Internet of Thing and Services (IoT, IoS). Study of 20 industries that can be influenced by 5G see (CB Insights, 2019).
- **Artificial Intelligence (AI)** is already applied in many routine activities and it is supposed to become an important tool in big data analyses, support of decision making and many other applications. Its development brings attention to its ethical and legal aspects. (CB Insights, 2020).
- **Applications (Apps)** become a tool for added value creation for customers: they can lead them through offer of services, provide guidance in various situations and help in decision making in emergency situations.
- **Wearable technologies** are already becoming familiar in services during big festivals, sports and cultural events.
- **Big Data** are becoming available also to SMEs, the data analytics can be used in market research, personalization of services and support of decision making. Clouds will support the data storage and processing, software as a service (SaaS) will gradually replace the local SW installations, facilitating access of SMEs to sophisticated SW packages.
- **Language assistants** allow communication between people and machines by natural language. They can transform spoken language into text and vice versa, assisting among others the people with impaired vision or in situation where the text form is difficult or impossible to use.
- **Advanced robotics** are crossing borders of factories and provide the personalized services in hotels, health care, logistics. Robots are also used in dealing with emergencies in dangerous environments.
- **Drones** have a broad spectrum of usage - delivery of shipments, inspection of constructions, agriculture and other, naturally they are used by the army.
- **Virtual and augmented reality** uses special glasses or 3D projection to simulation of reality. Today it finds broad use in gaming industry and increases its application in design of complex products and training of their operators.
- **Case studies, examples of best practice**

The concluding section presents selected case studies and best practices that can be interesting to Czech SMEs in the knowledge intensive sector.

### **SW companies**

As at the beginning of development of a new application is not always possible to exactly define the final product, software companies often apply agile project management. They employ its internal capacities for specification, design, development, and implementation, however often they outsource the strategy, finance legal services. Great added value can be created by the post-product services consisting of maintenance, upgrades, and distance preventive maintenance.

### **Tourism, leisure time**

Development of these industries is driven by higher living standard, higher education, and growth of leisure time. Clients often buy packages of additional services; the growing demand can be seen in "adrenaline experience" including specialized services and courses.

### **Innovation impulses**

The innovation impulses are often coming from customers (paragliding, zorbing, and diving were initiated by enthusiasts and only later were accepted by companies). In recent decades were introduced new concepts of innovation strategies: the blue ocean strategy (Kim, Mauborgne, 2005) and Jobs To Be Done (Christensen, Hall, Dillon & Duncan, 2016).

**Health care and social services** have big potential, as those activities cannot be easily automated. The main obstacle is their financing.

**Education:** There are numerous agencies offering courses both for individuals and companies, many of them more extensively use the learning management systems and other interactive applications.

**Consulting:** Legal, accounting and auditing services are typical examples of KIBS. Many of their routine activities can be influenced by incoming technologies including artificial intelligence.

**Gig economy:** The currently prevailing way of employment will be in many companies substituted by hiring independent providers and external workers.

**Circular economy** is a concept that is an integral component of the sustainable development. It is one of the priority initiatives of the EU. It offers better use of natural resources and opens space for investments and creation of new jobs. It focuses also on the development of products with longer service life that could be easily modified, maintained, and repaired.

**Intellectual property protection** is extremely important for KIS, especially for companies working in open innovation mode supposing sharing of knowledge across company borders. For knowledge creating KIS the intellectual capital can represent substantial share of its value, as can be shown on examples of SW, pharmaceuticals, biotechnology, and other knowledge intensive companies. For SMEs is often not purposeful to secure those services internally, as they are often necessary only rarely.

## **1.2 Results of the study 2 - The catalogue of changes in knowledge and competency job requirements in Society 4.0**

The study (Hejduková et al., 2019) introduces the reader to the issues related to Society 4.0 mainly from the point of view of impacts on labour market, requirements on competencies, qualifications, knowledge and skills of the workforce, including a necessity of life-long education. It starts with description of current state and continues by identification of jobs endangered and newly emerging as a result of technological and socio-economic changes.

According to (Frey & Osborne, 2013; Manyika, J., Chui, M., Madgavkar, A., & Lund, S., 2017b) jobs in services, and especially in knowledge intensive services, are among least susceptible to automation. Similar conclusions for the Czech Republic were confirmed by Chmelař A. et al. (2015) and Kohout, P. & Palíšková, M. (2017). Another view at the structure of work and jobs given by (Harris, Kimson & Schwedel, 2018). Manyika (2017a) and Manyika et al. (2017c) analyze the impact of technologies on employment, loss of old jobs and creation of new ones.

The conclusions and recommendations of the study can be resumed as follows:

- Routine, repeatable jobs will be among the first to be replaced by digitization, robotics and automation. It is estimated that within 20 years 10 % of jobs will be endangered by digitization, informatization and robotization and 35 % of jobs will be significantly affected.

Most endangered will be positions engaged in routine, repeating activities and processes (not only manual ones!).

- New job positions, hardly imaginable today, will emerge.
- The work character will undergo deep transformation. Innovations in job market will provide more space for harmonization of work and family life. The work will become more flexible – gig economy, home office, part-time employment, virtual teams, etc. This transformation should be reflected in social systems.
- The demand of highly qualified jobs as ICT professionals, specialists on data and physical objects protection, robotics, systems architects, data analysts, etc., will be increasing. Increasing demand can be expected in operators of sophisticated machines, services and sales.
- Companies are looking for engineering graduates with competencies and skills for work with new technologies including artificial intelligence. Highly valued will be those with interdisciplinary outlook, strategic and innovative thinking, higher than average education and developed soft skills.
- The educational system has to be substantially reformed to prepare future generations on new challenges with their opportunities and risks. Education should not be any more focused on premature narrow competency, but should emphasize complexity, interdisciplinarity, creativity and flexibility. The transformation should start already at secondary level (or even in nurseries and basic schools with non-traditional approaches), higher focus must be paid to STEM disciplines. New interdisciplinary study programs crossing the border between mechanical, electrotechnical and informatics disciplines, which could (and should) be developed and shared in clusters of universities.
- The engineering students should gain deeper insight into socio-economic and ethical consequences of their work and, vice versa, the student of social disciplines should gain the basic understanding of technological processes.
- Digitization will positively influence global competitiveness of workers with advanced digital literacy. Digital literacy should be promoted in the whole population.
- Digitization could significantly increase the efficiency of the public sector, which should be transformed to effective and efficient e-government.
- Multiplications effects will emerge as a result of the combination of advanced technologies and interdisciplinary research.
- Additional jobs will be created in personal services as recreation, leisure time, domestic care

## 2. SUMMARY RESULTS OF FIELD RESEARCH

### 2.1 Questionnaire survey

Due to the location of two project partners the survey focused on the situation in the NUTS2 region Southwest joining two regions – Pilsen and South Bohemia. Potential respondents were identified by filtering the database Albertina (Bisnode, 2019). This database synchronizes data from broad variety of resources and its partnership with Dun and Bradstreet agency provides access to global databases. Bisnode processes big data to smart data available to its customers. The data can be filtered according to many selection criteria.

The following selection criteria were used in our search:

- Company location - Pilsen and South Bohemia regions.
- Company size - small and medium size business according to the EU definition of the SME (EU, 2015).
- Industry sector - prevailing NACE sections J – information and communication activities, and M – professional, scientific, and technical activities. This classification was used in our sample selection, as it is possible to use it in filtering the database.

The search was performed under the Bisnode license to the University of West Bohemia.

622 companies were identified in Pilsen region and 853 in South Bohemia region. 296 companies were identified in NACE section J and 1179 companies in section M.

The questionnaire, prepared using application Google Forms and distributed to the companies identified in the selection process, is available (in Czech) at <https://forms.gle/FWoeQSuhw2X8Mh6A>.

By November 16, 2019, the online questionnaire was completed by total of 141 respondents (10 %). Data were collected from June 5, 2019 to November 15, 2019.

The rather low response rate can be considered one of the limiting factors of this project phase. Nevertheless, it brought interesting findings to be used in the following research.

This initial survey helped to establish connections with the broader sample of relevant companies, what is the extremely important factor for the continued research requiring feedback from the companies and other stakeholders, including application guarantees.

The detailed results of the questionnaire survey were submitted for publication (Dvořáková et al., 2020) and allow us to try to formulate basic characteristics of knowledge intensive companies participating in our research:

- Majority of knowledge intensive service SMEs are micro and small enterprises.
- Over 60 % of respondents have been working in the organization for more than 5 years, rather few are the newcomers.
- About 2/3 of respondents work in managerial positions. This can be explained by the questionnaire distribution – the mails asking for response were directed to company owners or managers.
- The highest share of respondents from our sample can be found in repairing and service activities, followed by other professional and scientific activities, advertising and marketing, legal and accounting services, and IT.
- Most respondents receive the knowledge from external resources, i.e. they are more knowledge users than providers. It means they operate in the open innovation mode, but mostly in one direction only (knowledge import).
- The intellectual property protection is mostly informal (business secrets) or automatic (copyright) – about 3/4 of companies. The formal industrial property protection as patents, etc., is not broadly used.
- The majority of companies already use their current knowledge or expect to use it within 1 – 5 years.
- The highest added value is created in customer service, while the lowest one in risk management. The approach to risk should be researched more deeply – it can negatively influence the company operation.
- The use of existing competencies significantly prevails over seeking new ways of doing business. Such an approach can negatively influence the company competitiveness.
- Enforcement of new knowledge creation and seeking new ways of doing business can be supported by job development. The majority of companies use and support learning through work followed by lifelong learning. A bit surprising is no use of job rotation, the possible reason may be the prevailing share of small companies with frequent face-to-face communication. More than half of respondents prefer continuous upgrading of knowledge and skills.
- In the rapidly developing environment the companies are – and will be – ever more forced to change. In our sample the managers declare themselves as supporting the change (75 %), a bit less optimistic are respondents at lower levels (50 % says their management is supporting the change).
- Concerning management competencies, as the most important were evaluated those related to soft skills. It can be concluded that in the future should prevail leadership (doing right things) over management (doing things right). What is surprising is the low rating of decision making under uncertainty – it may become, together with rather low importance of risk management prevailing in Czech companies, the weakness of many companies.



- Prevailing number of companies (about 75 %) answer that their company sufficiently supports introduction of new tools and technologies.
- Main difference between knowledge intensive and traditional companies see respondents in better access to tools, methods and knowledge, culture and mindset of KIS.

## 2.2 Semi-structured interviews

The questionnaire survey was complemented by semi-structured interviews with representatives of 20 SMEs in the knowledge intensive service sector in Pilsen and South Bohemia regions. The interviews with company owners and managers lead by trained members of both project teams were realized in the second half of 2019. Interviews consisted of 11 main and 24 supplementary questions complementing the insights gained in questionnaire research (for more details see Dvořáková & al., 2020). The purpose of those interviews was to deepen and enrich knowledge and information about the current state, preparedness, trends and needs of service sector companies on the implementation of methods and tools of Industry 4.0 and Society 4.0. Their outcomes contributed to deepen the insights gained in the questionnaire research.

Among significant augmenting findings can be mentioned the following:

- More than 60% of investigated companies states that the barrier of faster adaptation to Society 4.0 conditions they see in the lack of qualified workforce and financial resources needed to acquisition of new technologies.
- Urgent need of competent, well trained workers is perceived by 50% of investigated companies and they feel their shortage as critical. The companies hiring graduates of secondary and higher education schools are often disappointed by their insufficient professional competencies and skills, including digital ones.
- Nearly 50% of investigated companies do not use financing from public resources allocated to support of automation and digitization due to their administrative complicacy in the preparation and execution of projects and lack of time and personal capacity.

## CONCLUSION

Documented outcomes of the field research confirmed that micro, small and medium sized companies in the knowledge intensive sector perceive introduction and development of automation, digitization, and changes in work organization as important part of competitiveness, motivation to innovation of business processes, and higher quality of their services. More than half of investigated companies introduce new technologies gradually, according to their needs. However, they usually miss strategic approach to design, implementation and control of related changes.

The investigated companies appreciate the support of the research project team in effective and efficient transformation of their business processes and models on the conditions of Industry 4.0 and Society 4.0 and they are interested in sharing experience in the form of workshops, trainings and public accessibility of outputs of the project "Adaptation of knowledge intensive services on conditions of Society 4.0"

The findings of presented project activities summarized in this contribution together with the feedback from companies and other project stakeholders combined with continued desk and field research form a sound basis for achievement of the main project goal - now entering the next stage – the use of gained insight into the sector of KIS in proposal of the methodology supporting its adaptation to the forthcoming era of Society 4.0, considering the risks and opportunities of this demanding transition.

Economic and social impacts of the COVID-19 pandemics further significantly strengthen the necessity of digital transformation of small and medium size companies in the service sector.

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