



Process automation and Industry 4.0

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The technological changes currently observed occur at a rate never experienced before. They are the result of a new approach to the product and processes. The current industrial revolution, identified with Industry 4.0, is mainly based on the digitization of processes. Digitization means not only the introduction of information systems, but above all the integration of technologies and processes very often well known, including the integration of automation systems that were characteristic for the third industrial revolution. Research on the level of technology and the degree of automation and digitalization shows that Polish companies, especially from the sector of small and medium enterprises, show significantly lower parameters in this respect than companies in other countries and require a lot of support and training. Many currently implemented support procedures are related to the Foundation - Platform of the Industry of the Future established in 2019 by Polish Ministry of Entrepreneurship and Technology. The tasks of the foundation is to coordinate work in this area, primarily through competence centres. The Silesian University of Technology has been conducting research related to the development of technologies of Industry 4.0 for many years. Especially in the field of automation and integration of processes using IT systems. A very intensive cooperation with the industry, and above all with the Katowice Special Economic Zone, allows for identification of current industry needs and planning as well as conducting scientific research aimed at developing the technologies that are mostly expected by the industry. The close contact with the industry also allows planning and continuous updating education at all levels, from the 1st level through implementation PhD, and postgraduate study and at the 5th level. The research aimed at automation and integration of production systems is conducted in many teams of the Silesian University of Technology. The teams that develop the most intensive these topics include the Faculty of Automatic Control, Electronics and Computer Science and the Faculty of Mechanical Engineering. A number of laboratories was established at the Silesian University of Technology to carry out scientific research and applied work in the field of integration of control, manufacturing and automation processes. The main directions of research works aimed also at implementing their effects in industry. These directions include the development of (1) information technologies, including the processing of large data sets, cloud computing, cybersecurity, the Internet of Things, horizontal and vertical software integration, (2) simulations of industrial processes (3) virtual and augmented reality, and (4) 3D printing, reverse engineering and rapid prototyping. All the enumerated directions of the research allow for the development

of technologies of Industry 4.0 and the broadly understood automation of industrial processes, and above all their digital integration. In the last 5 years, 3 grants financially supported from the 7th EU FP were carried out, over 10 Opus projects financed by the National Science Centre were performed, and grants awarded by the Ministry of Science and Higher Education were implemented. A significant percentage of articles written by scientists from SUT whose interests include the mentioned fields of the research are in the top 20% of JCR journals. A large part of this work was created in cooperation with foreign centres, including those representing universities located in the top 100 according to the QS ranking. The activity of the Silesian University of Technology in the field of automation and technology of Industry 4.0 was and is pioneer in the comparison to other Polish scientific and educational institutions. On 21/02/2018, the Silesian University of Technology together with the Katowice Special Economic Zone established the first competence centre in Poland (Silesian Competence Centre of Industry 4.0). The opening of this unit was preceded by a nearly three-year cooperation with the Ministry of Development and later the Ministry of Enterprise and Technology in the scope of planning the structure and activities of such a centre. This allows for the pioneer activity of the Silesian University of Technology in the field of creating standards and guidelines for the activity of other competence centres in other regions of Poland. The measurable effects of research, training and promotion activities in the field of automation and Industry 4.0 include:

- developing and implementing the training program for experts of competence centres; 20 young scientists has been trained; they are currently the staff of the Silesian Competence Centre of Industry 4.0, while conducting scientific work as part of the activities of the Silesian University of Technology (25/09/2017 - 31/01/2018), a project was carried out for the Ministry of Entrepreneurship and Technology,
- obtaining the status of the Digital Innovation Hubs, DIH was created as a result of a positive assessment of the competence centre application. The project was implemented by the European Commission by 137 entities in Europe and only 8 entities in Poland (01.2018 - 12.2018),
- carrying out research and analyses aimed at developing procedures and templates of support mechanisms for enterprises as well as analysing expectations regarding support in the field of implementing new technologies together with the demonstration of Industry 4.0 technology. the project covered 17 companies. The team implementing the project included technology experts as well as work psychologists and sociologists. Thanks to this, the work was interdisciplinary and covered many aspects of development and implementation of technologies. The project was carried out for the Ministry of Entrepreneurship and Technology (10.2018 - 12.2018)
- development of a methodology and two training programs for competence centre experts and selected representatives from the industry. As a part of the project, the analysis was performed to determine the methodology of the personal assessment, and individual potential, which are supposed to be trained in the field of Industry 4.0 technologies and automation. The team, consisting of engineers and psychologists, has developed a number of surveys that allow to determine the path of development of a specialist from the

industry, and then evaluate the effectiveness of the learning process and activities in the company. The project was carried out for the Ministry of Entrepreneurship and Technology (12.2018 - 03.2019).

The establishing the centre has been also associated with several years of activity of the Silesian University of Technology in this area. The most important ones include: participation in the works of the 4th Working Group on education, competencies and human resources for Industry 4.0; Team for Industrial Transformation at the Ministry of Development (22/09/2016 - 20/04/2017), development of a catalogue of competences related to key technologies of Industry 4.0 for the Ministry of Development (04.2017), cooperation with the European Academy of Technology and Innovation Assessment in Germany – the research were carried out not only from technological point of view and their evaluation, but also social aspects of automation and implementation of technologies of Industry 4.0 technology (partners Germany, Poland, Slovenia, Czech Republic)(from 02.2017-present), membership of the Silesian University of Technology in the clusters of Silesia Automotive and Advanced Manufacturing Technology Cluster and Silesian Aviation Cluster (from 01.2017-present), participation of representatives of the Silesian University of Technology in the boards for electromobility appointed by the Ministry of Entrepreneurship and Technology and the Silesian Marshal's Office (from 2018-present). The Silesian University of Technology cooperates with universities from countries where there are developed mechanisms for implementing research results on automation and Industry 4.0. These centres include in particular: Technical Universities in (Germany) Dresden, Chemnitz, Freiberg, (Czech Republic) Ostrava, Prague, (Slovakia) Žilina, (Hungary) Budapest, (Italy) Trento, (Spain) Valencia, (France) Paris, Nantes, Lyon, Compiègne, (United Kingdom) Bath, Leeds, (Australia) Sydney. The most important industrial partners are: Siemens, Rockwell, Kuka, IBM. The Silesian University of Technology, as a part of the activity in the framework of competence centre also cooperates with other centres of this kind in Europe. The most important are: Central European Institute of Technology Žilina, Slovakia, Competence Centre, Dresden, Germany, Chamber of Commerce and Industry, Vienna, Austria, Industry 4.0 Technology Centre, Budapest, Hungary. The Silesian University of Technology, as a partner responsible for establishing main directions of activity of the competence centre, plays the role of a demonstrator of new technologies. On the basis of existing laboratories, the Demonstrator of Industry 4.0 was established, which shows the subsequent stages of the technological process and illustrates the use of such technologies as cloud computing, large data processing, cybersecurity, Internet of Things, simulations of industrial processes, virtual and augmented reality, autonomous robots and 3D printing. In these laboratories, the latest scientific achievements of the Silesian University of Technology are demonstrated, with particular emphasis on the possibilities of implementing these technologies. After creating the P4.0 Demonstrator in May 2018, over 70 companies took part in the presentations, workshops and demonstrations.