

## Application of Selected Digital Enterprise Tools in Small and Medium-Sized Industrial Enterprises

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### Abstract

*At the beginning of the 21st century, digitization and the digital enterprise came into focus. Businesses that had the financial means to implement new technology began experimenting and found that digitalization was good for business and had a definite return on investment. Today, digitization is a standard, affordable option to make your business more efficient. Transforming to a digital enterprise offers a high return on investment, streamlining production and business processes, reducing lead times in all areas, and, last but not least, simplifying business and manufacturing operations. However, digital tools are constantly evolving, and it is beneficial if the enterprise moves with the times and tries to improve and expand its tools. It becomes more attractive to potential employees and customers and also gains new opportunities in various business processes. The paper addresses the issue of digitalization and digital enterprise, its tools, and implementation in an industrial enterprise. It presents an overview of the subject, explains the benefits it provides, and the possibilities of how to implement the solutions in the enterprise. The first part focuses on the theoretical definition and definition of the concepts of digitalization, its tools, and the digital enterprise. It discusses the opportunities that the field provides and emphasizes the understanding of the issue and its importance. Based on the analysis carried out, the second part deals with the proposal of appropriate measures to make some areas more efficient. It includes design measures in the form of virtual reality to potentially improve business processes in various areas, increasing attractiveness and competitiveness. The last part of the paper is devoted to the evaluation of the provided proposal for the industrial enterprise in terms of the benefits that arise from it and also takes into account the necessary investments for implementation.*

**Keywords:** *Digitization, Digital enterprise, Virtual reality, Digital tools*

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## 1. Introduction

At the beginning of the 21st century, the first solutions for digitizing large factories, such as the automotive and aerospace industries, began to emerge. Today, these technologies are known as digital enterprise technologies. The concept of the digital enterprise has made it possible to integrate the entire interconnection of activities related to production, from product design, testing, production preparation, production system design, and show itself. The digital enterprise also included the digitization of the three most important business areas:

- products,
- processes,
- and resources.

This ushered in a new era in which all primary physical data was replaced by digital copies and models, also called DMUs (Digital Mock-Ups). Businesses that embraced the concept of the digital enterprise suddenly no longer just had an actual production model but also a digital production system with all the static, kinematic, and dynamic digital models. Thus, at the beginning of the 21st century, the two worlds of companies, namely the real and the digital, were connected in parallel [1].

The IMS (Intelligent Manufacturing Systems) research program has demonstrated how production lines will evolve and how manufacturing strategy will be shaped shortly. These new manufacturing concepts will comprise global networks and self-organizing autonomous units that will be their foundation. For production lines in the 21st century, modeling and simulation, the hallmarks of the digital enterprise, are crucial tools [2]. World trade demands fast time-to-market, the highest possible quality at the lowest possible price, and the digital enterprise is proving to be the perfect solution for the demanding market requirements.

Product Lifecycle Management (PLM) solutions require different types of software to control and ensure the operation of other parts of the production cycle. The digital enterprise concept mainly uses CAD systems that define what will be produced. Next is Manufacturing Process Management (MPM), which explains how the product will be made. Manufacturing Information Systems (MES) provide shop floor control and production feedback. These and other systems, plus data warehousing, digitally support communication while eliminating human error, impacting many manufacturing areas [1].

The digital enterprise or digital factory is a virtual image of actual production and the processes it is associated with. It represents a corporate environment integrated with computers and information technology in which virtual models and simulations depict reality. These digital and virtual solutions help resolve and optimize non-conforming situations that arise before production starts [3]. The digital factory also supports analysis, planning, and creating new solutions, but it needs teamwork at the head. Thus, this solution makes room for quick feedback among the team members. Whether they are product designers and layout designers or line operators and technologists. Therefore, in short, the digital enterprise is the linking of CAD systems with ERP solutions, and one of the most important features is the vision to realize process planning and product development with the parallel use of standard data [1].

The implementation of the digital enterprise concept will be directly reflected in economic indicators and the hands of production improvement. Even a small saving made in product design and planning in the digital enterprise can significantly affect cost reduction in the production and operational phases. Thanks to these indicators, we can say that the payback

period for an investment in a digital enterprise is concise. Other advantages of the digital enterprise are, for example [5]:

- reducing business risk when introducing new products,
- verifying processes before production starts,
- the possibility of "visiting" virtual production halls,
- optimization of the allocated equipment for production,
- reduction of space required for production,
- providing analysis of bottlenecks and non-conformities,
- rapid adaptation to different changes,
- better use of available resources,
- off-line programming of machines and equipment, which saves time,
- complete elimination or reduction of prototypes,
- ergonomic analysis, etc.

### **Development of digital enterprises in Slovakia**

The European Commission (2020) states that digitization is expected to bring many benefits and new opportunities for businesses. But according to the DESI (Digital Economy and Society Index) survey, conducted since 2014, Slovakia lags far behind other EU countries. Slovakia's digital transformation is guided by a cross-cutting framework strategy, which aims to make Slovakia a modern country with an innovative and green industry by 2030, using digitalization as one of its main elements. This strategy is slowly starting to create favorable conditions and a solid foundation for Slovak companies to implement digitization and automation. The European Commission's assessment confirms that 21% of the total funds in this recovery plan are dedicated to supporting digital transformation.

Recently, the environment of small and medium-sized enterprises is undergoing rapid changes, which is mainly due to the development of digital technologies and the gradual implementation of Industry 4.0. These technologies help to streamline almost all business processes, competitiveness, and productivity. The development of these technologies is impacting businesses around the world and more and more businesses will take advantage of the opportunities of digitalization. However, this also brings with it various challenges, such as changes in the employment structure, the threatened existence of certain jobs, etc. Businesses in Slovakia themselves, especially small and medium-sized enterprises, are also very stagnant compared to businesses in other countries. This is mainly due to the complexity of the current legislation and excessive bureaucracy, and these aspects affect the time and, above all, the financial cost. If Slovak enterprises want to succeed in the field of smart industry, they too will have to make various changes. The first fundamental one is to change their mindset and approach. The next changes may be, for example, to thoroughly analyze the current state of the enterprise and to analyze in detail all processes and procedures that should be subject to digitization. The management itself needs to be strengthened and a human resources department needs to be created. Last but not least, the organizational structure, all in-house processes, and especially the level at which control will take place also need to be adapted to digitalization and automation. Businesses are gradually realizing the importance of digitization and automation, especially in the area of competitiveness ([www.transport.sk](http://www.transport.sk)).

## **2. Methods and results**

The survey was carried out in small and medium-sized industrial enterprises in Slovakia and showed that enterprises could only function and meet customer requirements if they used

essential software. Based on European Commission Recommendation (EC) No 2003/361/EC and European Commission Regulation (EU) No 651/2014, small and medium-sized enterprises in Slovakia are those enterprises that employ less than 250 persons and whose annual turnover does not exceed EUR 50 million or whose total balance sheet does not exceed EUR 43 million. In addition to enterprises, SMEs also include sole traders, freelancers, and self-employed farmers (SHR). SMEs have long had the largest share of the total number of business entities in terms of the structure of business entities.

A request to complete the questionnaire was distributed by mail to 150 SME entities. The questionnaire was completed by 32 entities, representing a 21.33% return rate. The respondents included 15 micro enterprises (representing 46.88%), 12 small enterprises (37.50%), and 5 medium enterprises (15.63%). The largest number of respondents were from the industrial sector with 19 (59.38%), 8 from the service sector, and the rest (25%) 3 from the construction sector (9.38%), and 2 from the agricultural sector (6.24%). Among the respondents, 34.38% of the respondents have been doing business for at least 11 years, 40.63% of respondents have been doing business between 5 to 10 years, 21.88% of the respondents have been doing business between 1 to 5 years and only 3.13% of the respondents have been doing business for less than 1 year. As many as 62.50% of the respondents are doing business in parallel on the Slovak and foreign markets, 34.38% of the respondents are doing business only on the Slovak market and only 3.12% of the respondents are doing business only on the foreign market [11].

Whether for part design, manufacturing, machining, simulation, programming, etc. Based on our survey of small and medium-sized industrial enterprises in Slovakia, we found that these most often include [4][7][12]:

**SolidWorks 2020 [6]:**

- one of the leading programs used in enterprises,
- used by employees at the design and engineering level, along with other software from developer Dassault Systèmes,
- it is a 3D computer-aided design CAD and computer-aided engineering CAE application,
- It supports powerful volume or solid modeling and working with unlimited assemblies along with the automatic generation of production drawings,
- the main advantages are the ease and visual clarity of operation, which reduces the necessary mouse movements, reducing the need for repetitive or manual tasks interventions, which can save the amount of time a worker can devote to the process itself,
- it also supports a high level of service and technical support.

**eDrawings 2020 [8]:**

- SolidWorks add-on software,
- is the leading communication tool for collaboration between the design and production sides of a product, which also includes external collaborators and potential customers,
- It enables efficient collaboration, speeding up design processes and communicating accurately and clearly, but the main essence is to view 3D and 2D CAD files of different formats and share technical documentation,
- It supports annotation, dimensioning, and data-sharing functions without needing an original file.

### **HSMWorks:**

- software used by three CNC operators,
- it is a tool for designing and generating paths for CAM equipment and is integrated into the Fusion 360 product,
- Fusion 360 provides a complete CAD/CAM system with an excellent user environment, which promotes efficiency and professional processing,
- The CAD part allows working in part/build/drawing mode as is usual with CAD systems, the staff benefits from the SolidWorks and Inventor format translator which ensures the linking of the two systems,
- The CAM part is based on HSMWorks and enables work in turning mode, 2D, 3D, 3D+2, and 5-axis milling, turning and milling centers, etc., this is an advantage for operators, when they can create paths for CNC processing quickly, efficiently, and qualitatively for a part designed in SolidWorks,
- HSMWorks also supports machine simulation where the operator can watch a demonstration of the movement of the machine tool with all its components.

### **Solid Edge ST10:**

- In this program, employees work at the design level with SolidWorks 2020 and eDrawings 2020 software,
- It is a 3D CAD software from developer Dassault Systèmes used for solid modeling with parametric functions and synchronous technology, thus combining the speed and simplicity of direct modeling with the flexibility of parametric design [9],
- provides designers with solid modeling, assembly modeling, and 2D and 3D imaging,
- offers additional PLM functionality through interfaces to other software,
- supports the cloud-based design, providing easy access to the CAD system on different devices, so it is possible to quickly share data, whether with employees, customers, or suppliers,
- in this way, the company's designers can consult and share their designs quickly and easily without the need for file conversion or physical transfer, saving time and allowing designers to focus more on the design and the associated processes.

### **Eplan:**

- Provides CAD and CAE software solutions for electrical engineering, automation, mechatronics, and product development process optimization,
- in companies, this program is used by electrical designers, which represent two employees,
- the core value for the company is mainly the simplification of complex engineering processes,
- in this case, it simplifies the documentation and management of electrical automation and is a CAD and CAE software solution for the design, visualization, and documentation of complex wiring harnesses, control cabinets, and switchgear,
- The Eplan Data Portal provides online access to electronic catalogs of components and products from various manufacturers; thanks to the drag & drop system, designers can transfer products and details directly into the documentation.

### **Robotstudio ABB:**

- software used by three employees of the company who are robot programmers; they mainly use it to simulate robot reaches and to program ABB robots,
- it is the leading software for the offline programming of robotic systems,
- companies mainly use robotic systems when the customer or the contract requires it; these are especially ABB, UR, Wittmann, Sepro, etc. robots,
- supports simulation or offline programming of the robot without the need to suspend production,
- the software is based on the ABB virtual controller, which is an exact copy of the actual software that controls the robot [6],
- provides simulation using real programs and the configuration of the robot used in production,
- additional functions can extend this program to include virtual meetings, digital twin, virtual commissioning, augmented reality, and stop position simulation,
- the advantage for enterprises is a mainly offline simulation with risk minimization, faster optimization, and maximization of productivity
- is one of the best programs to maximize the return on investment invested in robotic systems.

**TIA Portal [10]:**

- TIA (Totally Integrated Automation) from developer Siemens provides access to a complete range of digitized automation services from digital planning to integrated engineering and transparent operation,
- It is used in the plant by two PLC programmers together with the complementary STEP7 program,
- offers access to rapid testing of PLC modules and simulation of machine or assembly automation,
- it can also be used to efficiently create program code and use third-party data such as Eplan while also offering easy access to data using the cloud,
- these outlined points increase the overall flexibility of programmers' daily work while maintaining data consistency regardless of the terminal used.

**STEP7:**

- SIMATIC STEP7 from developer Siemens is a programming space integrated into the TIA Portal,
- Programmers can use it to configure, program, and diagnose all control units, whether PLC or PC based,
- features comprehensive, integrated functions such as machine and equipment diagnostics, commissioning in TIA Portal, automation simulation and functional test, cloud-based management of engineering software, and many more,
- STEP 7's main advantage is that it helps to perform engineering tasks intuitively and efficiently, offering simple workflows and intelligent user navigation at every step of programming,
- for new employees, it means they can learn the software quickly, and for experienced professionals, it is a fast and efficient way to accomplish engineering and programming tasks.

**QI:**

- Software used at the administrative and economic levels by two employees,

- It combines ERP, CRM (Customer Relationship Management), DMS (Document Management System), APS (Advanced Planning and Scheduling), BI (Business Intelligence), HRM (Human Resource Management), and e-shop solutions in one program,
- this system offers different modules that the company can choose and build according to its needs so that only the modules that the company uses are paid for,
- thanks to its complexity and flexibility, it can adapt to the needs of customers and the company itself; if the company grows, the advantage is that there is no need to acquire a system with more functions because QI can grow with it, for the company it is one of the most critical software because it provides many elements for the proper functioning of the company,
- businesses use this software in all their processes, from decision-making, planning, management, projects, production, workflow, picking, and quality to payroll, finance, assets, and overall accounting of the business,
- a great benefit is that all these processes or modules are gathered clearly in one place, and employees do not have to waste time searching for information in different programs or physically in binders.

### 3. Discussion

Despite its highly digitalized operations, the company needs to take advantage of all the opportunities offered by the digital enterprise concept. Even though their processes are sufficiently well-optimized and work very well together. There are, of course, where it would be possible to implement elements that would make the enterprise more productive and attractive to a potential customer or job seeker. By highlighting such aspects, the enterprise would give the impression of a modern, mature enterprise that moves with the times and takes advantage of the conveniences of the 21st century [12].

One area that the enterprise needs to cover more is virtual reality. The enterprise would gain new opportunities in project solutions, product design and optimization, and customer interaction by implementing such technology. It could also be used in the case of service or training. Of course, there are many other areas in which VR could be used.

#### **New possibilities and benefits for industrial enterprises when using VR.**

Virtual reality is an advanced, modern technology that can be an effective solution in various industries. Investing in this technology would be beneficial for a business. The benefit may not be in the form of an immediate return. Still, it would undoubtedly increase awareness of the company, and its modern approach and, above all, give the impression of a thriving business with innovative solutions. These factors would give the business a competitive advantage against companies providing similar solutions [4].

Several areas in the enterprise could benefit from VR capabilities. Be it in HR, design, testing, or CRM. There would also be uses outside these areas, for example, in project meetings and consultations. Areas that would be positively affected by virtual reality are [4]:

1. **HR:** The company is looking for new members to join its team due to the excellent prospects. In particular, designers and mechatronics engineers. Using VR in this process would increase the company's attractiveness to potential employees. It is also possible to train new employees on the software above and virtual models of selected products. In this way, the new employee would learn more quickly about the technology and the area in which they will work. However, training does not have to stay with new members only. They could also be introduced in occupational health

and safety, where employees could try how they would behave in a fire, for example. These scenarios are rare, but the chances are never zero. Therefore, a company would only have to spend a little money to create an accurate model. A simple model with critical elements that would guide the employee through the escape routes or the course of action in a hazardous scenario would be sufficient. The rule of thumb is that it is better to experience once than to hear a hundred times.

2. ***Design and simulation area:*** This segment has two main VR implementation options. The first is virtual reality combined with design and simulation in SolidWorks, and the second is the simulation and project control in ABB Robotstudio. The use of virtual reality in these areas offers several benefits. Better visualization is one of the main ones, and despite this, it is possible to see, for example, how the various movements of an automated unit work. Insight into the hidden parts of the designed products is also an advantage. In particular, Robotstudio offers the possibility of consulting solutions with the help of VR, which better visualizes and brings the programmed process closer even to team members who need to be more proficient in the subject matter. It is also possible to create a digital twin of the workplace with the robot, and thanks to virtual reality, it is possible to observe and optimize the workplace. This also offers the possibility to create extreme situations and analyze the robot's behavior without damaging it or interrupting ongoing production. In the case of designs by design engineers in SolidWorks, it is possible to verify the work they have done or present it to colleagues or clients in VR. It is also possible to manipulate the object or teleport for larger projects. This way, one gets a real sense of the outcome. Of course, there is no need for a business to procure a VR headset for every team member. It is enough to include all competent employees who approve or consult the design. There is a minimum probability that the designers will complete their work in one moment. This allows the use of a single assembly by several employees.
3. ***Customer relationship management:*** in times of pandemic, this convenience of virtual reality would make working with customers much more accessible. The use of VR would be an outright benefit that would save the business from having to turn customers away or keep them waiting. This would put them at an advantage over their competitors, who are unlikely to use virtual reality for these purposes. It would also make the technology attractive to the customer. It would make them feel that the business is taking care of its customers with its innovative solutions and providing convenient solutions for consultation and design demonstrations. Ideally, the customer could be offered the option of either meeting in person or in virtual reality. Compared to a face-to-face meeting, VR offers many more options, such as sharing digital design solutions in web meetings without unnecessary travel, the possibility of viewing the design at a 1:1 scale, and possibly even actual demonstrations of the automated workstation as it would look after installation at the customer's site.

## 4. Conclusion

A global pandemic crisis has hit industries. However, it has not affected industrial enterprises to such an extent that they have had to reduce or even suspend production activities significantly. Enterprises used the situation to their advantage and were able to catch up on older unfinished works and projects. They also did well in the automation segment,



taking on new orders and posting profits. The companies managed to make the most of the difficult situation, mainly due to software, which forms their business's basis. However, they needed more customer contact in the form of not receiving visits to the company. This may have impacted communication with the potential customer as the order approval sequence involves visits and face-to-face meetings. After analyzing the digital tools used in industrial enterprises, we found that implementing virtual reality would be an innovative step currently lacking in most enterprises.

On the other hand, virtual reality would have great potential for use in the design and construction part of projects and other areas such as HR and customer communication. There are many companies on the market offering VR solutions. For businesses, this presents an opportunity to choose virtual reality due to the time and money they are willing to invest in implementing a VR system in the enterprise. After considering all the circumstances and areas of application in enterprises, we have narrowed down the choice to the top three options. It offers the best options and can be used in most business processes. Select the admittedly more expensive but more flexible technology from HTC. It provided the most practical solutions that could cover and streamline all the mentioned areas in the enterprise. We suggest a phased investment only after the technology has been proven in the enterprises, for example, in two sets to start with, as the technology would be a new experience for the individual enterprises. The businesses have many years of experience working in CAD software and are overall experts in automation. Implementing virtual reality would only be a boost in this area and could save a lot of time and money [4].

This proposal is significant for businesses because the activities related to design, production, inspection, and customer consultation do not include similar solutions. It should consider implementing the proposed solution based on increasing the attractiveness of the enterprises, either in the case of potential customers or new team members. Also, implementing similar solutions in subsidiaries would enhance communication between them and reduce the costs spent on travel, as meetings could be held in a virtual environment. Implementing VR poses minimal risk to the enterprise due to its affordability. The critical factor would be the time it would take to be able to put the technology into routine use so that it would be effective. Once the necessary time and funds have been spent, virtual reality would predominantly give enterprises advantages that would put them a rung above their competitors.

The successful implementation of smart solutions and the development of Industry 4.0 in the conditions of SMEs will further depend in particular on the approach of SMEs, which would [11]:

- should emphasize training their employees, supporting their lifelong learning, ensuring that they develop learning habits, and preparing them for the new technological changes that automation and robotics will bring,
- to implement better scouting for talented employees who will meet the new labor market requirements of the future,
- prepare for the change in the structure of the workforce, which will be linked to the loss of permanent employees working directly in factories and the replacement of permanent employees with more flexible working hours working outside factories,
- rigorously analyze current processes (not just manufacturing) and focus on streamlining and innovating them (improve the use of Community programmes, in particular, Horizon 2020 and FP9 and the European Strategy Forum's system of programmes and projects on research infrastructures),

- strive to increase their competitiveness, especially vis-à-vis foreign competitors, as the development of smart industries is closely linked to globalization and the breaking down of barriers between countries (the best local companies in each country are starting to expand into global markets),
- increase the speed of implementation of new ICT in enterprises,
- increase the involvement of enterprises in primary research and development of new technologies, either on their own or by deepening cooperation with secondary or higher education institutions,
- make more use of big data analysis, which will allow enterprises to better understand internal processes, analyze the current situation and then use it to plan further activities,
- to prepare for building "Smart Factories" based on the implementation of smart solutions that monitor all activities from production, through logistics, distribution, and administration,
- to create financial reserves for the need to co-finance or fully finance innovation in production.

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