

# BUSINESS AND TECHNOLOGICAL ASPECT OF PROCESS INFORMATIZATION AND AUTOMATION IN INDUSTRIAL PRACTICE

Mitja Cerovšek

## Abstract:

Digital transformation brings great technological and business challenges to organizations. It helps to change the patterns of business operations and has the effect of increasing innovation and competitiveness. At the same time, this is a great opportunity to develop and introduce many positive changes to the existing business and process model. Understanding of process informatization and automation, meaningful integration of technology with business processes, and control and implementation of strategic directions of the organization are the three topics that need to be simultaneously managed in order to achieve an implementation of all the necessary changes.

In product development, companies use the approach of informatization and automation of business processes in managing changes, which is mainly focused on achieving technological changes. Such an approach is no longer appropriate and has become insufficient. We propose an approach that, in addition to the technological ones, also takes into account the business aspects of the necessary changes. Such an approach enables significantly better interaction between all stakeholders involved in change processes. As it arises from business motives, it also leads to significantly better results in industrial practice. We propose a model of strategic and comprehensive approach to the necessary changes in the digital transformation of the organization, which takes into account 5 different areas of necessary change: strategy, business processes, technology, employees and organizational culture. Proposed model has been tested and implemented in industrial practice of the automotive industry and in manufacturing of industrial equipment.

## Key words:

Industry 4.0, digital transformation, business process, business and technological aspects of change, business renewal and informatization, process automation

## 1 Introduction

Numerous studies find that digital transformation projects fail in 70% of cases [1]. The reasons can be found in the fact that organizations generally use only the approach of informatization and automation of business processes in managing change. They are interested in technological changes and new solutions that they fully trust. They install new solutions on old (existing) business processes. The approach does not work in practice because it focuses mainly on introducing technological change. Such an approach is therefore no longer appropriate and does not meet the expectations of the time. Therefore, it is necessary to find and apply an approach that, in addition to technological, also

takes into account the business aspects of the necessary changes. Existing business practices need to be supplemented by including the business aspect as a building block of the model of necessary changes in the process of digital transformation. If the introduction of changes is based on business motives, this leads to significantly better results in industrial practice.

Today, we pay special attention to digital transformation, mainly due to the great impact of advanced digital strategies on ensuring excellent cooperation with customers and increasing the efficiency of business processes [2]. With the development of new technologies, dynamic markets and customers, the economic environment is taking initiatives to discover business model innovations and renovate products, processes and organizational structures [3]. It is the philosophy and technology of the future that connects devices, products and services to the global internet.

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Figure 1 : Digital transformation framework [4]

The foundations of digital transformation are laid on the foundations of business renewal and informatization, e-commerce and business process management. However, the model will not work in the long term if it is not placed on renewed business processes. Organizations and employees need to make a professional, technological, personnel and sociological shift in thinking and acting. It's mostly about business change. These need to be established on a changed business and process model of the organization, which can take us from digitalization to digital transformation (Figure 1).

## 2 Concepts and backgrounds of digital transformation

Although the potential benefits of digital transformation of production are remarkable (increasing efficiency, sustainability and adaptability), only a limited number of organizations have already developed their strategy to achieve top performance in this field [5]. The digital transformation of manufacturing (Industry 4.0 or 'smart manufacturing') is a common term for technologies and concepts in an organization's value chain. It is based on technological concepts of using and recognizing cyber and physical systems, the Internet of Things (IoT), the Internet of Services (IoS) and data mining. These allows us to implement new forms of individualization

of customer needs. Direct customer input enables organizations to produce increasingly flexible products, shorten production cycles and reduce costs. Newly created value is shared between the manufacturer and the customer. The Industry 4.0 concept bridges the gap between flexible mass production on the one hand and individual-oriented production on the other [6]. Given the absence and incomplete definition of the current framework (rules, guidelines, boundary conditions) of the Industry 4.0 concept, four perspectives need to be emphasized [7]: (1) production processes, (2) machinery, tools and devices, (3) software and (4) engineering.

The basic components of the Industry 4.0 model [8] are (1) mobility (number of IP devices exceeds population, more than a billion smartphones, the impact of mobile devices on daily life), (2) cloud computing (67% of adult Internet users in the USA use cloud services, cloud will replace computers), (3) cooperation (transformation of cooperation using cyber-physical systems, connecting virtual and real world, use of RFID, NFC and QR technologies, shift from centralized to decentralized production control system, challenges in the field of systems security, gradual introduction of new technologies, use of cooperation and knowledge exchange networks, participation of employees in the process model of the organization) and (4) large amount of data (data is generated everywhere, huge growth in data last two years). Hyoung et al. [9] similarly

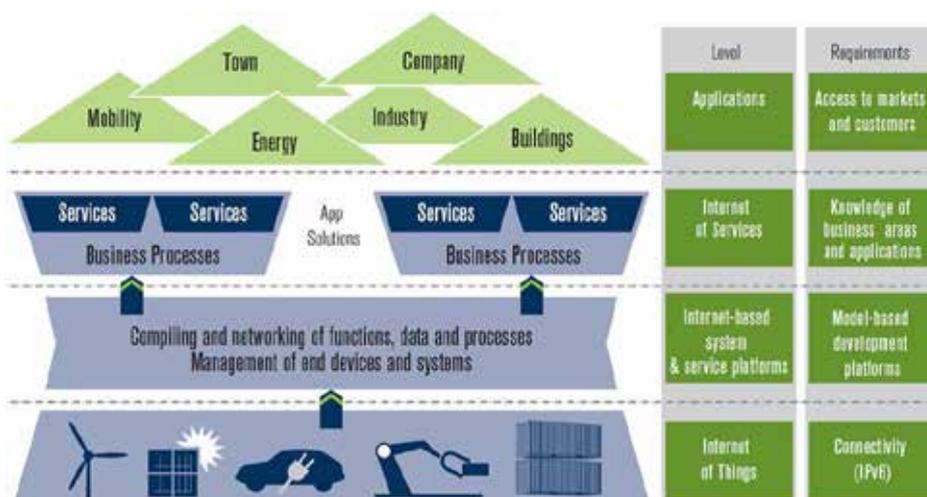


Figure 2 : Architecture of the Industry 4.0 concept [9]

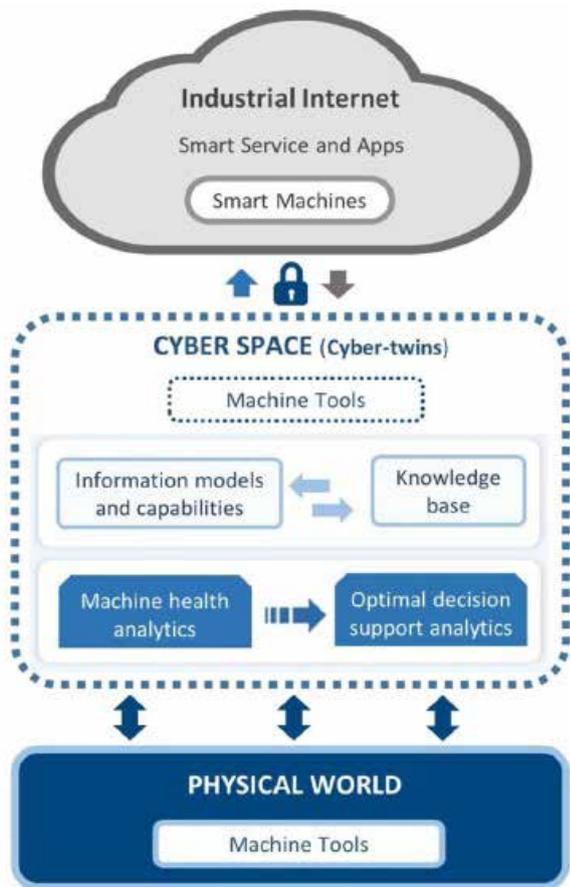


Figure 3 : Conceptual framework of smart machines and tools [11]

note that cyber-physical systems, cloud manufacturing, big data analytics, internet of things, smart sensors and energy saving will play an important role in the development of smart factories in technological terms. The development of smart production will not only take place at the level of individual processes and individual factories, but comprehensively (along the entire supply chain) also between different production units and between different entities (Figure 2).

Digital integration between products and information systems enables the use of more complex business scenarios in the areas of production and mobility. Smart products enable the design of smart services and smart service systems. These are

based on monitoring, optimization, remote control and autonomous product customization. Smart products retrieve and analyze aggregated data and include smart services based on meaningful data context [10].

Continuous improvement of machines and tools has a significant impact on productivity in production. Key features of Machinery 4.0 (Figure 3) include vertically and horizontally integrated cyber-physical systems and increasingly intelligent, autonomous and secure machines and tools [11].

The development of new key technologies in the field of artificial intelligence is proceeding rapidly. This triggers many changes in models, assets and ecosystems in industrial production systems, as well as changes in the development of artificial intelligence itself. New models, forms and architecture of intelligent product and technology system (Figure 4) are based on [12] integration of artificial intelligence technology with information, communication and manufacturing technology (intelligent robots, intelligent manufacturing services in cloud, intelligent services and design, data and knowledge services, intelligent financial services).

With the development of Industry 4.0, the maintenance of machines and tools is becoming an important area for achieving competitive advantage. Predictive maintenance in particular is becoming a criterion for assessing the maturity of Industry 4.0 (Figure 5). Artificial intelligence offers methods and approaches based on the capture and processing of large amounts of industrial data in order to ensure long-term performance without failures. With the integration and support of cyber-physical systems, an appropriate approach can provide integrated maintenance planning of production facilities, which leads to the calculation of the Remaining useful life of machines and devices and to the calculation of expected loss of profit (Profit loss indicator) [13].

Industrial production is most often advanced by increasing its competitiveness. It achieves this largely through the use of state-of-the-art information technology and automation, which can provide new starting points and opportunities for growth. However, not without prior implementation of business process changes using business process management methods.

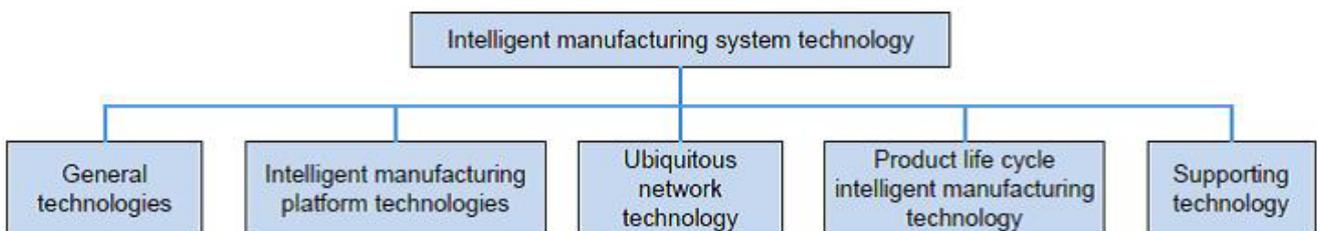


Figure 4 : Intelligent product and technology system [12]

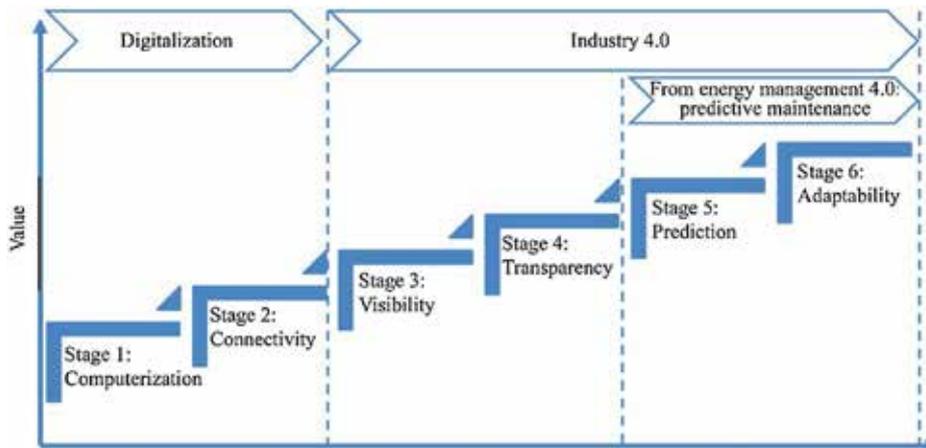


Figure 5 : Industry 4.0 maturity model [13]

### 3 An approach to introducing digital transformation into industrial practice

High expectations in the field of business digitalization and Industry 4.0 need to be meaningfully, selectively and gradually incorporated into existing industrial practices. The available resources of the organization are limited, so the correct choice of activities (actions) is extremely important. The reasons for the reasonableness and selectivity of all activities for the transfer of Industry 4.0 concepts into business practice (Figure 6) must therefore be directly linked to increasing competitiveness and business performance. This means introducing new business models, new or different products, new or different services, capturing and using data in products and services, increasing innovation, increasing productivity, creating added value for the customer and managing costs more efficiently.

Integrating Industry 4.0 concepts into industrial practice is not just about the connectivity, utilization and efficiency of machines and tools. We want

to achieve connectivity, efficiency and effectiveness of the entire production chain from suppliers through manufacturers to end customers (B2C or B2B). We connect processes, products, equipment, services, people and management. We are establishing inter-company integration that extends beyond the borders of individual organizations. It is a high level of automation and informatization of production (machines, devices and tools) and its integration with business and production applications, software tools and knowledge of employees.

Industry 4.0 brings mostly business challenges. Albukhitan [14] lists 8 key challenges facing production organizations in the field of digital transformation: (1) traditional business processes, (2) resistance to change, (3) inherited (existing) ways of doing business, (4) limited process automation, (5) budget constraints, (6) lack of relevant skills, (7) inflexible organizational structure and (8) cyber security. Vogelsang [15] among the main obstacles to the successful implementation of digital transformation in manufacturing organizations includes the

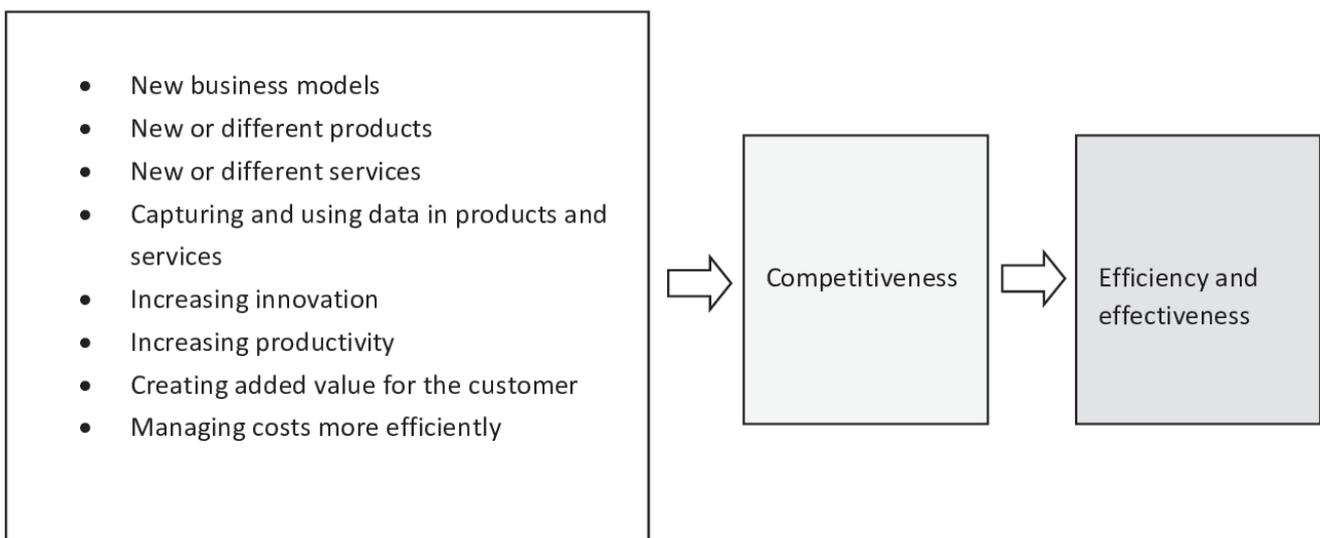


Figure 6 : Reasons for integrating Industry 4.0 concepts into industrial practice

lack of relevant information skills (IT knowledge, information for decision-making in the field of technology, process knowledge), technological barriers (dependence on individual or existing technologies, data security, existing infrastructure), personal barriers (fear of losing control of the data and losing the job), organizational and cultural barriers (maintaining traditional roles, lack of vision and strategy, rejecting cultural change, attitude towards culture of mistake, risk aversion, lack of financial resources, lack of time) and environmental barriers (lack of standards and laws).

Business reform and informatization must be based on a clearly defined strategy of the organization and on renewed business processes. When introducing the digital transformation of the organization, the following contents should be thoroughly considered:

- ▶ digital strategy of the organization,
- ▶ process changes,
- ▶ technological changes,
- ▶ employees,
- ▶ organizational culture.

### 3.1 Digital strategy of the organization

Based on a systematic study of the definitions, aspects, perspectives, dimensions and models found in the literature, four key areas (*Figure 7*) of the organization's digital strategy can be identified [16]: market entry, collaboration, performance factors and organizational factors. Regardless of the model or strategy that an organization uses to carry out its digital transformation, it must focus on addressing its ten content dimensions. Along with the ten dimensions of digital transformation, organizations need to integrate and monitor dig-

ital agility in their work. This includes three continuous and interconnected capabilities: conscious action, data-based decision-making, and rapid execution.

An important task of top management is to create an environment for the implementation of digital transformation. Without a business map (digital strategy), what changes need to be addressed in order to be competitive, successful and efficient in the future, it is not possible to set the right goals for digital transformation. Digital strategy must become an integral part of an organization's business strategy. The action plan should be concrete, the contents precisely defined, the contractors competent and committed, and the deadlines for implementation ambitious and realistic. A study of the state and trends of digital transformation in Slovenia [17] found the following: in 44% of cases, the digital transformation strategy is included in the business strategy, and in 14% it is prepared independently. However, a large part of the surveyed organizations (33%) do not have a digital strategy.

### 3.2 Business Process Management

The availability of digital technologies and solutions enables the digital transformation of business processes. At the same time, this means [18] that digital processes and products need to be created with a deep understanding of the (hidden) needs of consumers and their behavioral patterns. The development of intelligent factories based on the recognition of 'digital' opportunities leads to custom manufacturing. However, the essence of this process is not digital technology. The key is changes in our way of thinking and acting. Here, business processes are the second

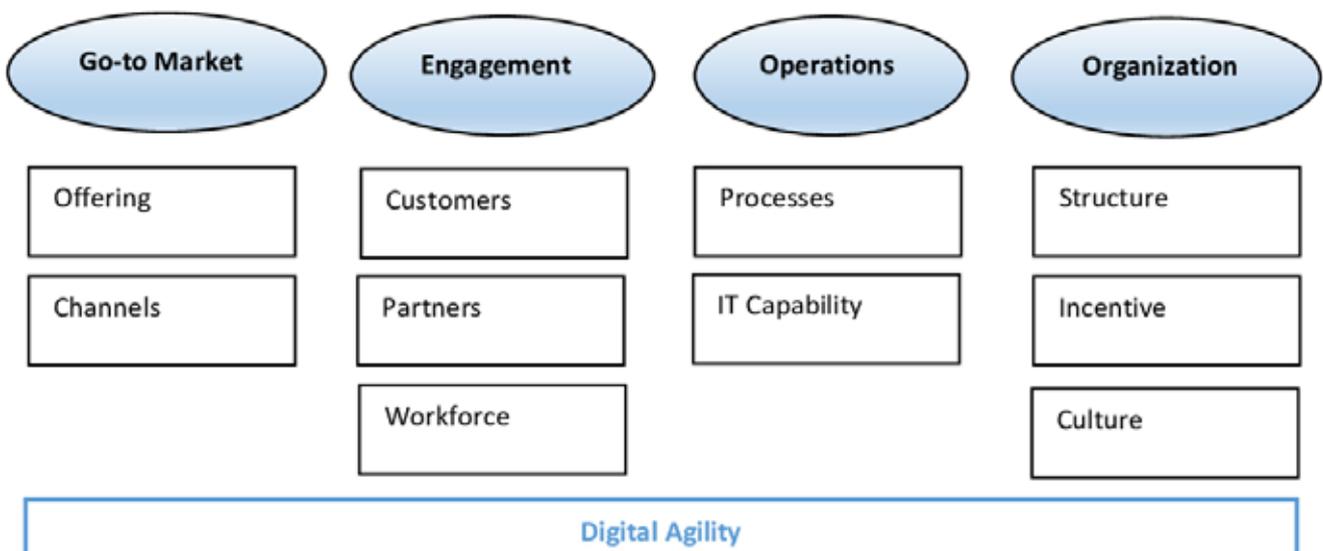
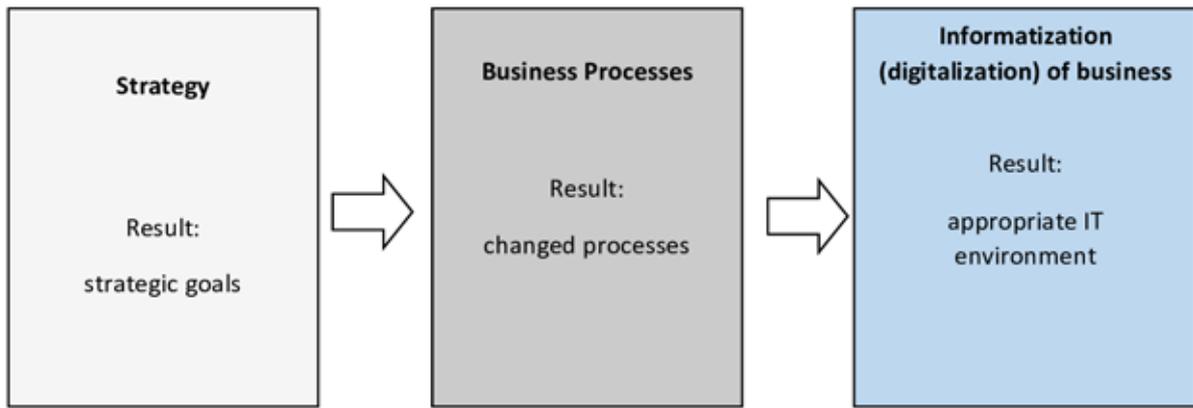


Figure 7 : Dimensions of Digital Transformation [16]



**Figure 8 :** Role and position of business processes in the introduction of Industry 4.0 in industrial practice

pillar of the chain, which enables the successful implementation of the renovation and informatization of business (Figure 8). If the organization's strategy represents the key orientations and goals of the operation, the business processes are the 'performers' of the instructions represented by the organization's strategy. Therefore, if business processes do not pursue the goals of the organization or are not optimally managed, then we cannot expect to be able to properly automate, computerize and integrate them into a lean whole. So: successful digital transformation is only possible with the simultaneous renewal of business processes.

The authors of the research on the state and trends of digital transformation in Slovenia [17] come to the same conclusions. When it comes to digital transformation, we are thinking mainly of business changes. Only the introduction of technology does not increase an organization's digital maturity. It is a business transformation, so the digital transformation must be primarily a business initiative.

### 3.3 Technology change management

In order to achieve their strategic goals and maintain a competitive advantage in the digital era, organizations must periodically renew their digital platforms and infrastructures. However, knowledge about such technology change is limited and dispersed in the organization. Technology renewal is [19] a kind of paradoxical process by which organizations remove their current technological bases on which they depend. At the same time, they are establishing uncertain practices on new technological bases, which they do not know enough about. Technology renewal is a critical process of digital transformation in this sense. It requires management to make decisions in new and extremely complex situations.

Technological change is happening rapidly, constantly and partly unpredictably (introduction of mobility, use of social networks and collaboration

tools, cloud computing, analytics and business intelligence tools, Internet of Things (IoT), Internet of Everything (IoE), artificial intelligence, smart robots, Blockchain Technology). Changes are faster than we are able to understand and meaningfully incorporate them into our daily work. Organizations often approach them without proper critical (temporal and substantive) judgment and the necessary professional, philosophical and sociological distance. Technologically leading organizations in the field of information, communication and automation technologies are the initiators of creating new needs and requirements. The head (technology and technological development) is therefore faster and not necessarily smarter than the feet (business processes and employees), which can cause many challenges in the business environment.

An important area of integrating Industry 4.0 concepts into industrial practice is the introduction and use of Manufacturing Execution Systems (MES). These systems are the direct interface between the business (ERP) and process (Scada, PLC, regulators) level of operation. They enable tracking of all production parameters. Users have access to all relevant information and production data in real time. These systems increase the added value of products and services. Using them we can also increase efficiency and productivity. Good results in improvement can be achieved if the changes are driven by concrete business reasons.

Information has always existed everywhere but has often been found in an isolated, incomplete and unintelligible form. In the future, the device mesh (combination of devices, including mobile devices, wearable devices, consumer and home electronic devices, automotive devices and environmental devices, which are connected with each other through network) and IoT can make these interconnected devices more secure, intelligent and responsive [20].

### 3.4 Human Resource Management

Employees are internal customers and often also end users of the organization's processes. In establishing the process of digital transformation, we face the culture of the organization, aligning the goals of employees with the goals of the organization and improving internal communication. Industry 4.0 and Digital Transformation boost the organization awareness about positive Digital Employee Experience (DEX) [21]. Technological knowledge and digital mindset of employees influence decisions to 'participate' or 'escape' from their organization's digital transformation initiatives [22]. Their beliefs about the adaptability of personal abilities and the availability of resources affect their perception of new technologies, which represent (1) an opportunity for professional growth and (2) interference with the ability to demonstrate the necessary personal competencies. The authors of the research on the state and trends of digital transformation in Slovenia [17] find that successful digital transformation is based not only on the introduction of new technologies, but also on the organization's ability to use their capabilities. The research identifies a deficit in the skills and willingness of employees to introduce the principles of digital transformation into industrial practice.

Employees enter the field of digital transformation with their abilities, characteristics, limitations and priorities. At the same time, the traditional reluctance to change is confronted with fear, ignorance and excessive expectations, which can largely stop the creative unrest and innovative forces of the or-

ganization. It is therefore important that we establish a respectful, well-meaning and honest dialogue with our employees. Realistic, timely and quality information is part of the process of making good changes.

### 3.5 Development of organizational culture

The basic starting point for the successful implementation of digital transformation is the existing culture of the organization. As decision-makers, we are extremely interested in organizational culture. The state of organizational culture mobilizes our efforts for change or makes it difficult. It is the key to adopting technology and creating an innovation environment. Therefore, caring for the culture of the organization plays a crucial role in the digital transformation [23].

The innovation of an organization is a powerful trigger for new ideas, products, services, concepts and approaches. We want to encourage the development of new business models. Organizational culture is stronger than any strategy. It can be understood [24] as a crucial element in supporting a comprehensive organizational orientation towards innovation. Organizational culture is a determinant of innovation strategy. Open organizational cultures encourage the development of innovation environments. In contrast, closed (hierarchical) cultures develop a tendency to imitate or follow others. If we want to be successful in implementing our innovation strategy, we need to influence positive changes and the gradual development of organi-

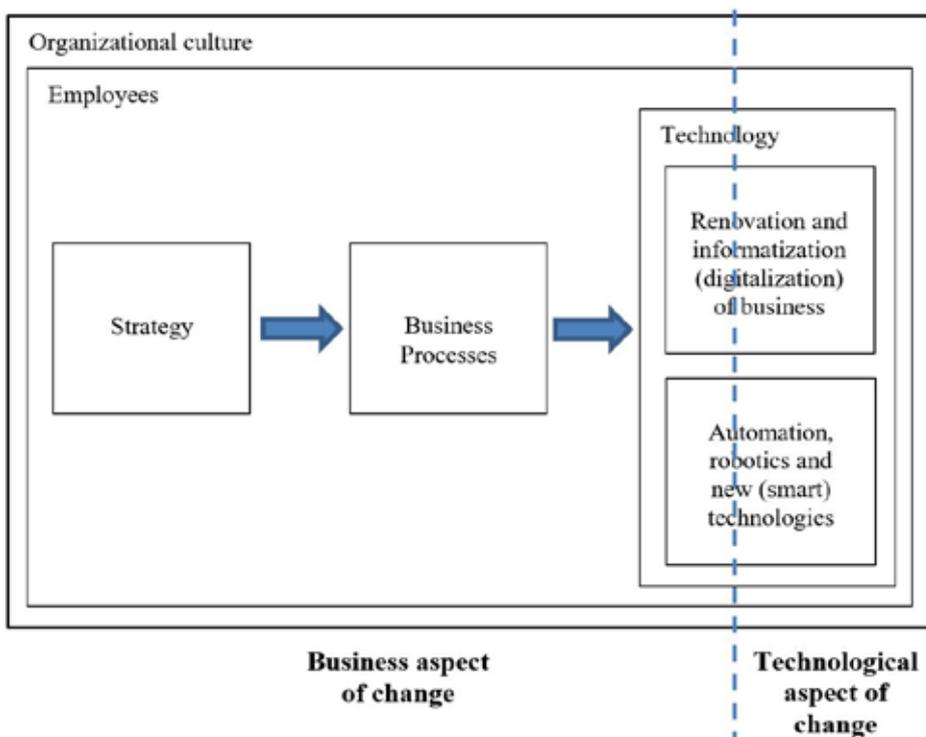


Figure 9 : Model of business and technological aspects of digital transformation

zational culture. We need to develop a dynamic business environment in which risk-taking is allowed. The entire business environment is not only defined by efficiency, delivery times, costs, formal rules, policies, hierarchy and control. The results of the research [25] show that organizational culture has a positive and significant effect (direct and in the form of silent knowledge exchange) on the innovative abilities of employees.

Our goal is to improve existing performance patterns while maintaining only those that promote organizational growth, develop innovation, and create added value. Today, organizations are fundamentally changing their business models and entering in completely new areas of their operations. New companies are creating new products and new services. With intellectually young and fresh staff, they create a whole new perspective on customer needs. As customer requirements change, it is necessary to find an appropriate response to these challenges within the organization.

### 3.6 Model of business and technological aspects of digital transformation

Any investment in digital technologies should be directed and guided by business strategy. The challenges posed by the digital transformation are business and technological nature. With the help of technology, operating patterns change and innovation and competitiveness increase, which is an important task of the entire management structure of the organization. However, only taking into account the business aspects of these changes can we expect appropriate positive effects on the results of the organization.

Model of business and technological aspects of digital transformation (*Figure 9*) is an extended model of business renewal and informatization, which consisted of elements of (1) strategy, (2) business processes and (3) business informatization. In business practice, we have successfully tested it on projects in the automotive industry. Taking into account the new guidelines in the field of Industry 4.0, digital transformations and good business practices, we expanded the model with the building blocks 'Employees' and 'Organizational Culture'. Based on business practice, we find that these two building blocks are crucial and necessary for the successful implementation of changes in the organization. Technology adds a special boost to activities. For this reason, the model therefore extends the existing 'business informatization' building block. It divides this element into two meaningful content sets: business informatization (ICT tools and solutions) and business automation (robotics and new smart technologies).

## 4 Conclusion

Digital transformation helps to change the patterns of our operations and has the effect of increasing innovation and competitiveness. It offers us a great opportunity to develop and introduce many positive changes to the existing business and process model. Upgrading strategic, process and information content and awareness of the importance of employees and the role of organizational culture can establish a starting point for the overall progress of the organization. This is also an extremely important task and responsibility of top management, information systems management and employee development. It is sensible and necessary to fully involve employees (internal sources and information) who know best their own business and production environment.

The way of approaching change and the way of integrating the potentials of digitalization into the industrial environment have a decisive influence on the achieved results and consequences. The proposed model of integrated approach takes into account various aspects of the necessary changes when introducing the digital transformation. We find that their implementation can be ensured by understanding, connecting and simultaneously managing the five contents of the Business and Technological Aspects of Digital Transformation Model: (1) digital strategies, (2) business processes, (3) technology, (4) employees and (5) organizational culture.

The proposed model upgrades on the existing approach to business renewal and informatization. It takes into account theoretical findings and at the same time experience from successfully implemented more than 20 projects in industrial practice of the Slovenian automotive industry and in manufacturing of industrial equipment in the fields of Enterprise Resource Planning (ERP), Enterprise Content Management (ECM) and Manufacturing Execution System (MES). Based on the presented model, we can conclude that the technological aspect of the necessary changes today is exposed and extremely penetrating, but it is definitely necessary to place it in the context of the expected business effects. We believe that the contribution of the proposed model to the successful and efficient implementation of the necessary changes is very important. It provides a substantive and methodological framework for the implementation of the digital transformation of the organization, which has been thoroughly tested in industrial practice of the automotive industry and in manufacturing of industrial equipment. In future research, it would be sensible to upgrade the proposed model in all its five dimensions, and at the same time to develop and test it in different and additional branches of industrial practice.

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**Poslovni in tehnološki vidik informatizacije in avtomatizacije procesov v industrijski praksi****Razširjeni povzetek:**

Digitalna preobrazba prinaša organizacijam velike tehnološke in poslovne izzive. Pomaga spreminjati vzorce delovanja organizacij in vpliva na povečevanje inovativnosti in konkurenčnosti. Hkrati predstavlja sijajno priložnost za razvoj in uvedbo številnih pozitivnih sprememb obstoječega poslovnega in procesnega modela. Ključno vlogo izvedbe potrebnih sprememb pri tem lahko odigra sočasnost upravljanja treh vsebin: definiranja in izvajanja strateških usmeritev podjetja, obvladovanja poslovnih procesov ter razvoja informatizacije in avtomatizacije.

Organizacije pri obvladovanju sprememb praviloma uporabljajo pristop informatizacije in avtomatizacije poslovnih procesov, ki je osredotočen predvsem na doseganje tehnoloških sprememb. Tak pristop ni več ustrezen in je postal nezadosten. Predlagamo pristop, ki poleg tehnoloških upošteva tudi poslovne vidike potrebnih sprememb. Tak pristop omogoča bistveno boljšo interakcijo med vsemi deležniki, ki so vključeni v procese sprememb, hkrati pa namenja pozornost tudi vsebinam, ki jih tehnologija ne zaznava v zadostni meri. Ker izhaja iz poslovnih vzgibov, pa hkrati vodi tudi do bistveno boljših rezultatov v industrijski praksi. Predlagamo model strateškega in celovitega pristopa k potrebnim spremembam v okviru digitalne preobrazbe organizacije, ki upošteva 5 različnih področij potrebnih sprememb: strategijo, poslovne procese, tehnologijo, zaposlene in organizacijsko kulturo. Predlagani model je bil preizkušen in uspešno implementiran v industrijski praksi avtomobilske industrije in proizvodnje industrijske opreme.

**Ključne besede:**

industrija 4.0, digitalna preobrazba, poslovni procesi, poslovni in tehnološki vidik sprememb, prenova in informatizacija poslovanja, avtomatizacija procesa



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