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Innovative Culture: A Predictor of Digital Transformation in Technical Manufacturing Companies

Marin Grčić, Ljerka Luić*

Abstract: The innovative culture and the implementation of new digital technologies in the overall operation of enterprises are predictors of their digital transformation process. This paper, based on a study conducted on a convenient sample of 42 technical manufacturing companies in Croatia, examines their awareness and determines their readiness for digital transformation, with particular emphasis on the manufacturing process itself. Accepting the results of related international studies, according to which the Republic of Croatia is placed in the lower part of the readiness scale for business operations in the digital age, the hypothesis was set that Croatian enterprises are insufficiently familiar with the benefits of digital transformation achieved through the development of a digital innovative culture. Based on the analysis of the results, the reasons for the effective semi/unpreparedness of technical manufacturing companies to enter the process of digital transformation are determined, inductive conclusions are drawn, and suggestions for ways to encourage innovative culture are given.

Keywords: awareness; digital transformation; innovative culture; technical manufacturing company

1 INTRODUCTION

The exceptionally rapid progress and development of digital technologies require employees to adapt to changes quickly, learn new skills, and work in teams, as jobs become more specialized, making it challenging for one person to perform and be familiar with all work segments (or at least most of them). Furthermore, the magnitude of changes we witness daily has led to various work concepts and hours, the disappearance of certain jobs and the emergence of new ones. Computer systems have become the backbone of our lives, both private and business. It is no surprise, therefore, that companies wishing to survive and advance on the market invest significant human, material and financial resources in developing their operations and IT solutions. This trend has already been well established and is constantly increasing in the developed countries. In Croatia, however, signs of movement in this direction are observed, especially among some more technologically aware, younger and innovative business environments, and yet there is an impression that an insufficient number of companies understand the importance of changing business and production methods. It is possible that the reasons for this also lie in the socio-economic context in which companies operate, at both local and national levels, and the administrative burden that hinders or suffocates the possibility of change. The research described in this paper seeks to argumentatively determine the attitudes of Croatian technical manufacturing companies, specifically those engaged in production within the field of mechanical engineering (domestic or foreign-owned), regarding digital transformation, i.e., the need to reshape the existing business-production models. [1]

The paper analyzes the awareness of Croatian technical manufacturing companies regarding the application of digital technologies in business, i.e., their readiness for digital transformation, with special emphasis on the digital transformation of the manufacturing process. In this context, it is tentatively possible to estimate how the results presented in this paper will contribute, in an applicative sense, to a better understanding of the Croatian economy in the domain of the manufacturing industry regarding readiness to face new challenges brought by the modern era marked by the rapid development of high technologies.

2 DIGITAL TRANSFORMATION, INNOVATIVE CULTURE

At the beginning of the paper, it is important to define the concepts of digital transformation and innovative culture, which are often used as synonyms in the context of introducing digital technologies and solutions into modern business in business practice, as well as in professional and scientific publications. For this reason, theoretically grounded explanations are provided below, while their practical application is explained in the introductory part of the survey questionnaire.

2.1 Digital Transformation

According to Grčić [1], digitization is basically the conversion of analog into digital information, which can be stored, processed, and transmitted further using computers, without substantial changes in the business process itself. It is, therefore, a simple conversion of data into a digital format, a conversion that does not imply the digital transformation of business processes. This aspect is defined by the term digitalization, which the same author describes as a process that means "...enabling, improving, and/or transforming business activities, roles, models, activities using digital technologies. It mainly refers to management systems and their implementation through digital data and processes, i.e., the use of digital technologies to change business models and create new revenues and values." [1]

The term digital transformation denotes the process within which business organizations, in the context of this paper, technical manufacturing companies, completely change their business processes and the way of doing

business. Thus, according to Von Leipzig et al. [2], digital business transformation is currently one of the most frequently used terms in business publications, on business portals, and in business meetings. According to Tekic and Koroteev [3], there is probably no successful manager who does not know what digital transformation means for the operation of their organization. According to Spremić [4], digital transformation refers to the intensive application of digital technology and resources to convert these resources into new revenues, business models, and ways of doing business. Transformation occurs when a company decides to fundamentally change its business processes, strategies, activities, hierarchical and organizational structure in a relatively short period of time, all in order to better connect these processes and strategies and ultimately provide a better competitive advantage for the company on the market. Although Schallmo et al. [5] present arguments from which it is evident that the term digital transformation is still not clearly defined, for the purposes of this paper, the definition of the authors Verhoef et al. has been accepted, according to which "Digital transformation is defined as a change in the way a company uses digital technologies to develop a new digital business model that helps create and provide greater value for the company" [6]. Furthermore, the term digital transformation can be described as "a thorough change in the organization and the traditional way of doing business using digital technologies and applying new business models with the aim of improving the performance of the organization and faster adaptation in an environment that is constantly and rapidly changing" [7]. According to the European Commission, "digital transformation today is no longer a matter of choice - it is inevitable, necessary, and unavoidable" [8], and implies a complete transformation of business, but also attitudes, i.e. business culture, and the need for continuous learning and improvement of both employees and persons in leading positions. It also implies changes in relationships with (potential) customers, advertising methods, and the production of products themselves. In essence, "it encompasses much more than just technologies and relates to radical changes in the way of thinking and perceiving the business of the organization" [9].

Many business entities, their directors, and managers are still not fully or sufficiently familiar with the comprehensiveness of the term digital transformation and "equate it with the digitalization of existing business models and/or analog processes and solutions of information and communication technology" and are often not aware of the necessity of the active role of "the management structure of the company for the implementation of the transformation at all levels" [10]. If companies understand the strategic role of new digital technologies "they can create new values, improve user experiences, simplify operations or create completely new business models and sources of income. But more than the technology itself, the success of digital transformation is based on people" [11]. Namely, "educating employees on digital topics is measure no. 1 when it comes to planning digital transformation" [9]. In addition to this, many other measures are available to companies in terms of improving their digital competitiveness, such as: "prioritizing digital transformation"; "creating a digital transformation strategy, i.e. a vision of the desired future"; "engaging experts"; "creating a digital culture"; "implementing an appropriate digital transformation management structure"; "quality human resource management"; "developing collaborations and partnerships"; "greater agility and better preparedness for the unexpected" [9].

2.2 Digital Transformation of Production

Today, almost all initiatives aimed at digital transformation are built on technologies and solutions of the so-called Third Platform [12], which includes mobile technology, cloud data storage, big data set analysis, and the use of social media. More recently, the term Industry 4.0 is increasingly used, which implies the introduction of digital technologies into (almost) all production processes and is based on "automated technology networked through sensors and communication elements [...] thus connecting the real and virtual world in the form of the so-called cyber-physical systems, such as autonomous robots" [13]. In such industrial systems, machines are not viewed as independent units, but are connected "into a kind of community that is in mutual interaction and cooperation, autonomously and "intelligently" [13]. They imply the use of technologies "that lead to the automation of certain processes in production and/or provision of services" [13]. The most important among these technologies are the following: artificial intelligence, "big data", robots, simulations, horizontal and vertical integrations of systems, the Internet of Things, cybersecurity, cloud technology, three-dimensional printing, augmented reality [13]. The use of digital technologies and the networking of different sectors enable technical manufacturing companies to obtain information about the production process more efficiently and optimize it due to the availability of external and internal data, which ultimately gives them a competitive advantage on the market. Furthermore, they enable the development of individualized production based on customer requirements and better connectivity with the latter.

"Industry 4.0 has been in place for the last 10 years, benefiting the industry but also highlighting its shortcomings. Now, the time for Industry 5.0 has arrived. Smart factories have increased business productivity; however, Industry 4.0 has its limitations. [...] Industry 5.0 is changing the paradigm and offers a solution by reducing the emphasis on technology and focusing on collaboration between humans and machines. [...] In modern business, with advanced technological developments, Industry 5.0 is necessary for gaining competitive advantages as well as fostering economic growth for factories." [14]

2.3 Digital Transformation Strategies

Digital transformation strategies in each company take on a different perspective and are aimed at achieving different goals. In any case, it is necessary to "predict the costs of the process as concretely as possible and set measurable performance indicators for implementation in the

short and long term" [9]. If the company's digital strategy is designed in a quality way, based on detailed analyses of all business elements and indicators of positive and negative characteristics of the business and taking into account existing trends on global markets, it will ensure "a transparent and organized system within a successful [sic] company or organization. Such a system includes the management of technologies, a structured process of collecting ideas, selecting adequate technologies, preparing a concept, commercialization, and monitoring performance on the market or within the company" [9]. In order for the digital strategy to ultimately be successful, "a clear, concrete, and measurable implementation plan is needed that will include a series of measures, steps, and activities with success indicators and a time frame, but also tools that will be applied" [9]. Certainly, digital transformation is a journey, not a destination. Even when a company reaches a level of digital maturity, continuous investment, innovation and quick response to market changes are required. Continuous investment allows new generations to be agile from the very beginning [15]. This means that they know how to adapt quickly and flexibly to changes, unforeseen elements and situations, and the needs of their customers and users.

2.4 Preconditions for Digital Transformation

According to Gurbaxani and Dunkle [16] and Warner and Wager [17], successful digital transformation of business requires a change in organizational thinking and corporate culture, which is considered one of the key dimensions of the digital transformation process. Furthermore, Meske and Junglas [18] note that although some managers believe that transformation always results in the cannibalization of existing products and services, this is not the case. Digital transformation provides companies and their employees with a long-term perspective of sustainable business and is necessary for achieving and maintaining the competitiveness of companies. Organizing and implementing good business transformation is not the responsibility of employees, but it provides them with the opportunity to better focus on business priorities, be ready to respond to environmental changes (agility), and better long-term career development opportunities, knowledge, and skills. According to Haffke et al. [19], for successful digital transformation, it is important to have someone for whom it is the primary job. For this reason, more and more companies are adding functions of digital transformation directors or board members for managing digital transformation to the management structure, who should be at the highest level of management, and who will take responsibility for implementing digital transformation. Thus, Burilović [10] notes that when planning a digital transformation strategy, it is important to know that in most cases it will not bring quick and short-term results, and it is important to define the long-term interests of the company. It is also very important to predict the costs from the very beginning. Of course, it is impossible to fully predict the costs associated with changing the business culture or organizational structure, but with good planning, unnecessary resistance in project implementation can be avoided. Furthermore, at the beginning of implementation, it is necessary to set measurable performance indicators. Only in this way can the results of digital transformation be evaluated after implementation. It is important to accept the fact that investing in digital transformation is not a cost, but an investment that will specifically pay off in the future.

From the analysis of recent sources, it is evident that most authors who have researched the success of digital transformation implementation in companies highlight the following key elements: change in the organizational way of thinking and corporate culture, personal commitment and responsibility of the most influential stakeholder in the organization, commitment of top management to digital transformation, defining and updating the strategy, developing a business plan that should contain components of digital transformation, the function of the director of digital transformation who will take responsibility for implementing digital transformation, defining the long-term interests of the company, predicting costs from the very beginning, setting measurable performance indicators, and educating employees.

2.5 Advantages and Barriers to Digital Transformation

The advantages of digital transformation can be seen through the following elements: the possibility of storing and quickly accessing a large amount of data and its more efficient linking into sets based on certain characteristics or parameters, for the purpose of planning the production and business, as well as developing short-term and long-term strategies; connectivity of production and administration and all other sectors and departments; networking of headquarters, all production plants, departments, and branches, which enables better communication among employees and synchronization of daily activities; higher quality and more direct communication with clients and the possibility of creating personalized product and service offers; networking of all processes that enables the creation of a more efficient monitoring and control system, as well as timely elimination of defects, breakdowns, problems in stock supplies, etc.; acceleration of production; reduction of material costs; better management of working hours; higher quality of making products and service offers. [1]

The main obstacle to digital transformation is the insufficient number of experts in companies who would be able to technically design, organize and implement digital transformation in a quality way, which significantly hinders, slows down or completely postpones the process itself. For this reason, companies must employ a new person or more of them or, alternatively, hire external consultants, which requires additional costs, which are already high due to technical needs, creating a new or more suitable infrastructure, purchasing new IT tools, training employees. Furthermore, due to the high concentration and huge amount of information, and their constant "movement" in the digital world, it is necessary to further strengthen security systems and ensure the impregnability of virtual storage spaces. In Croatia, according to research [7, 9], the biggest obstacles to the implementation of digital transformation are: "financial

reasons (costs)"; "too much focus on existing business priorities" leading to the postponement of "all new strategic directions"; "lack of time for digital transformation implementation", i.e. lack of time primarily for training and adequate preparation of employees for changes that inevitably come with digital transformation, changes that affect the organizational and innovative culture of companies.

2.6 Innovative Culture

Knowledge and skills necessary for effective job performance in the modern environment are changing and developing at an unprecedented speed. Accepting and encouraging innovation, with special emphasis on curiosity, agility, and experimentation [20], is key to developing competencies necessary for functioning in such an environment. Innovation also requires not only new ideas, but also employees and management who possess the knowledge and skills to recognize and implement innovation [21]. Given that innovativeness is recognized as a "driver of competitive advantage, companies go beyond their own borders to find and generate new knowledge" [22]. In this regard, creativity contributes to innovation through creative breakthroughs and strategic connections of seemingly unrelated elements [23]. One of the drivers and sources of innovativeness is certainly digitalization, considering that digital technologies enable greater collaboration between science and innovation, internationalization, and openness to the public [24].

As Tohidi and Jabbari pointed out, "innovation is a process that begins with the introduction of an idea that will become a new function and this makes it distinguished from creation" [25], while digital and information and communication technologies provide new technical and business opportunities that significantly change the structure of traditional technical and business systems [26] creating preconditions and the necessary infrastructure for managing large amounts of data, which are converted into specific knowledge in the process of digital transformation, into innovative ideas which are the first step in creating and establishing an innovative culture of companies.

3 MATERIALS AND METHODES

Awareness of the importance of implementing a comprehensive digital transformation of business, with an emphasis on the production process, and the readiness of companies for the same, was investigated using the survey method. For this purpose, a survey questionnaire was created that contained 35 research questions for whose conceptual framework the source was used [27], 5 general questions about the company, and 4 general questions about the respondent (1. Your current position in the company is; 2. Your level of education is; 3. The email address where you would like to receive the research results; 4. Your comments and suggestions related to the research topic). The questionnaire in digital form was sent to publicly available e-mail addresses of 200 technical manufacturing companies based in the Republic of Croatia. The following sources were used to determine the research sample: the business search engine of the website www.tvrtke.hr, court and crafts registers, and data from the Croatian Chamber of Economy. Furthermore, publicly available materials on similar research were studied with the aim of more precisely formulating the research hypothesis, which is as follows,

H1: The majority of technical manufacturing companies in Croatia are not sufficiently aware of the impact of digital transformation of production on creating an innovative culture and the overall business success of companies.

42 companies (21% of the total number of 200 technical manufacturing companies in Croatia) responded to the questionnaire. The results of the research are presented below, grouped according to subtopics. Namely, after the introductory questions, companies were asked to select the stage in which they are in terms of implementing digital transformation (1. They do not plan to implement it, 2. They plan to implement it, 3. They are in the implementation phase, 4. They have implemented digital transformation). Depending on the selected stage, the questionnaire was directed to questions specific to the selected (chosen) stage of digital transformation implementation.

To summarize the information contained in the collected data and to determine the main facts about the researched issue, to analyse the obtained results, their graphical and tabular presentation, to determine the distribution of results, and to compare and position individual results within the group, descriptive statistics were used. The methods, both numerical and graphical, are presented in the following chapter.

4 RESULTS

The results of the research, processed using the method of descriptive statistics, are presented below.

4.1 Company Data

Companies that completed the questionnaire are mostly engaged exclusively in production or, alternatively, in production and sales, as shown in Fig. 1, and the majority of them have between 10 and 50 employees, as evident from Fig. 2.

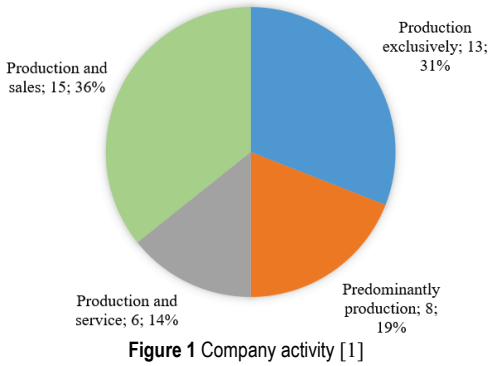


Figure 1 Company activity [1]

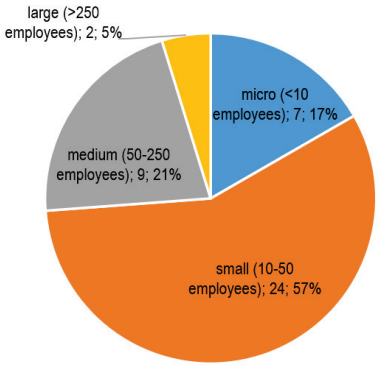


Figure 2 Company size [1]

Furthermore, in terms of ownership type, a large majority of responses came from private companies with domestic ownership, as evident from Fig. 3, all of which fall into the category of small companies. Only two companies have more than 250 employees: one of them is from the public sector, and the other is private with foreign ownership. They operate exclusively (the first) or predominantly (the second) on the foreign market.

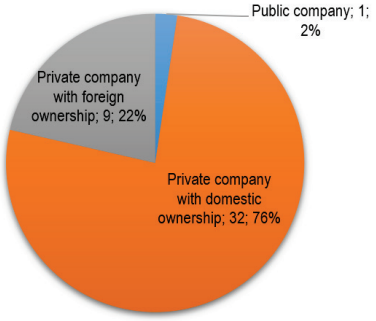


Figure 3 Type of ownership [1]

Companies participating in the research generally operate mostly on the domestic market, but about a quarter of them mainly do business with foreign countries, and 17% operate exclusively on the foreign market, as evident from Fig. 4. No company operates exclusively on the Croatian market. In line with expectations, all companies that operate exclusively (3 responses) or predominantly (6 responses) on the foreign market are in foreign ownership. One company (in domestic private ownership, engaged exclusively in production) responded that it operates both on the domestic and foreign markets.

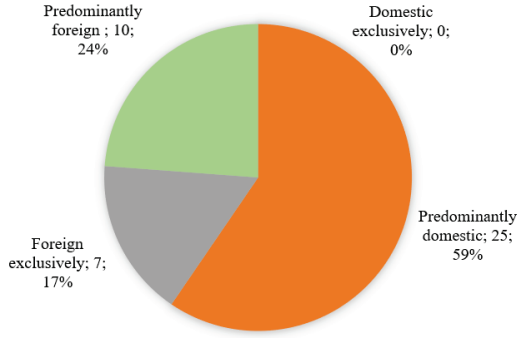
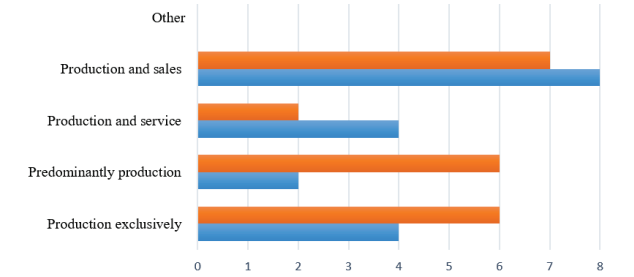


Figure 4 Market of operation [1]

All companies which stated that they mainly operate on the domestic market are private companies with domestic ownership, while those that operate only in the foreign market are exclusively engaged in production.

4.2 Analysis of the Status of Digital Transformation Implementation

The comparison of company activities with the stage in which the companies are in terms of digital transformation, considering those companies that plan to implement it or are in the implementation phase, is shown in Fig. 5.

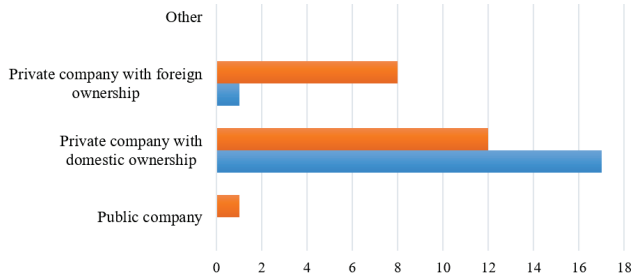


	Production exclusively	Predominantly production	Production and service	Production and sales	Other
Implementing digital transformation stage	6	6	2	7	0
Planning to implement digital transformation	4	2	4	8	0

Figure 5 Comparison of activities with the implementation stage of digital transformation [1]

No particular differences are observed among the types of activities of companies which are in the implementation stage of digital transformation, while among those that only plan to implement it, prevail companies which are engaged in production and sales.

If, on the other hand, we compare the ownership type with the stage of digital transformation in which the companies are, we observe that the majority of companies that implement it or plan to implement it are privately owned with domestic ownership, as evident from Fig. 6.

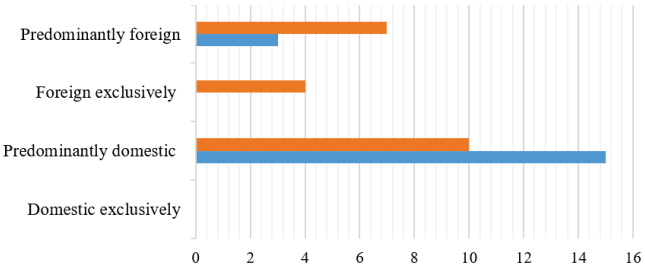


	Public company	Private company with domestic ownership	Private company with foreign ownership	Other
Implementing digital transformation stage	1	12	8	0
Planning to implement digital transformation	0	17	1	0

Figure 6 Comparison of ownership type and digital transformation implementation stage [1]

This data can be interpreted as an increasing awareness of private entrepreneurs in Croatia regarding innovations recommended by the modern era, and in some segments,

even required both on the production and general business level. However, a greater willingness to change is noticed in companies with foreign ownership, which may also depend on the "traditional" business culture of Croatia, which is quite oriented towards retaining the existing models and expressing less willingness to take risks and step out of the "comfort zone".

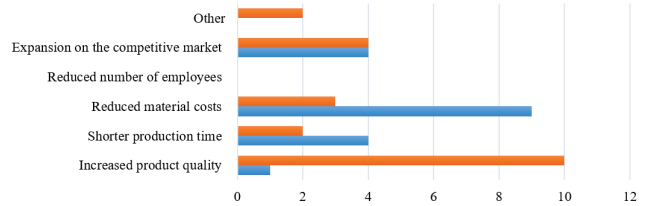


	Domestic exclusively	Predominantly domestic	Foreign exclusively	Predominantly foreign
Digital transformation implementation stage	0	10	4	7
Planning to implement digital transformation	0	15	0	3

Figure 7 Comparison of market type and digital transformation implementation stage [1]

Compared with the type of market in which they operate, shown in Fig. 7, it is possible to observe that the majority of companies operate mostly on the domestic market, which particularly applies to companies which only plan to implement digital transformation.

The comparison of expectations from the implementation of digital transformation depending on the stage of digital transformation implementation is shown in Fig. 8.



	Increased product quality	Shorter production time	Reduced material costs	Reduced number of employees	Expansion on the competitive market	Other
Digital transformation implementation stage	10	2	3	0	4	2
Planning to implement digital transformation	1	4	9	0	4	0

Figure 8 Comparison of expectations from implementation and the implementation stage of digital [1]

It is evident in Fig. 8 that companies that have initiated the digital transformation process expect an increase in product quality after its implementation. Companies that plan digital transformation primarily expect a reduction in material costs.

4.3 Priorities and Effects of Digital Transformation of Production

From Fig. 9, it is evident that as a priority of digital transformation of production, respondents primarily place product manufacturing (62% of them), followed by technology (24% of them), while product design (7% of them) and material procurement (7% of them) are at the end of priorities (according to 14% of respondents).

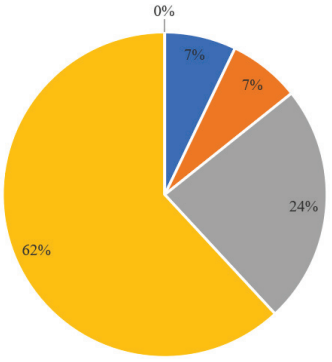


Figure 9 Priorities in the process of digital transformation of production [1]

As a result of the implementation of the digital transformation process of production, the majority of respondents expect primarily higher product quality, expansion in the competitive market and lower material costs, as evident from Fig. 10.

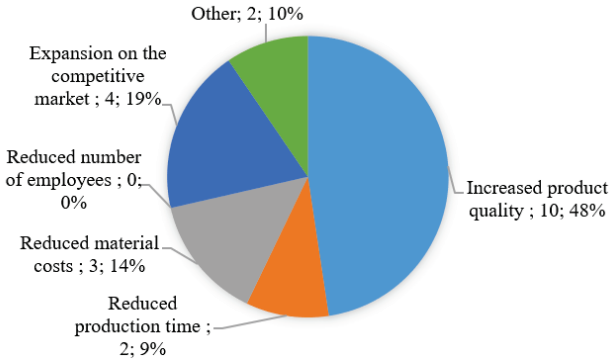


Figure 10 Expected results of digital transformation of the production process [1]

In the category "Other", the following responses were obtained: "it is difficult to single out one benefit", "better insight and monitoring of efficiency and profitability". It can be interpreted as positive data that no company stated that it expects a reduction in the number of employees, which is often mentioned as a potential disadvantage in the implementation of digital transformation of business.

5 DISCUSSION

The subject research, conducted on a sample of 21% of technical manufacturing companies in Croatia, yielded results whose analysis makes it possible to determine the degree of awareness of manufacturing companies from the technical sector. Based on the analysis of the results, it is evident that technical manufacturing companies, especially those with foreign ownership, are significantly aware of the role of digital transformation and the radical transformation of business it brings about. However, still an insufficient number of them (21 out of 42 companies, 50% of the

companies that participated in the research) dared to take this step and fully implement digital transformation. In terms of the production process itself, the majority of companies believe that product manufacturing should be the priority in digital transformation, followed by technology development. These are areas that require the greatest additional investments, in term of both material and time. These responses are consistent with expectations because this sector is most susceptible to human errors, so it is important for the company to create a system in which product defects and rejects are minimized, and the consumption of materials and energy is optimized. Since technology is still prone to errors and malfunctions, it is important that people who will manage and/or supervise machines, robots, and software programs used in the production itself are adequately and well-trained and ready to recognize potential problems and react to them in a timely manner. The entire transformation process should be overseen and led by the company's management structures to ensure that digital transformation is carried out in a holistic manner, taking into account all potential business goals and executive functions. "Croatia should accelerate its efforts in the area of digitalisation of businesses. In particular, it should raise awareness about the benefits of business digitalisation, provide public support for workshops and trainings, increase participation in existing (funding) schemes, especially among SMEs. Croatia should intensify its efforts to support the development and deployment of trustworthy, secure, sovereign advanced technologies and solutions, especially for AI, cloud, big data, including through the availability of legal and technical support and procurement procedures." [27]

6 CONCLUSION

Based on all of the above, it can be concluded that technical manufacturing companies in Croatia are predominantly aware of the importance of investing in digital technologies and the need for implementing digital transformation of the entire business, especially the production process. Namely, a larger part of the surveyed companies is in the stage of implementing or planning the implementation of the same. Therefore, the obtained results only partially support the initial research hypothesis, which claimed that the majority of technical manufacturing companies in Croatia are not sufficiently aware of the impact of digital transformation of production on creating an innovative culture and the overall business success of companies. It is possible that this is the case because technical manufacturing companies must "fight" more with strong global competition that regularly follows and adopts trends in business and production and continuously improves its work performance. Since these companies are aware of the need for digital transformation, they are on the right path to achieving it. The time period in which they will succeed and the results they will achieve largely depend on the availability of experts necessary for the implementation, financial resources, as well as national strategies, infrastructures, potential administrative limitations, and willingness to invest in entrepreneurship.

Furthermore, the research showed that technical manufacturing companies in Croatia are in principle ready for digital transformation, but it can be assumed that they lack external support and a thorough development of the strategy, and possibly material resources, for relatively rapid implementation. Therefore, it would be useful, through further research, to determine ways to effectively implement digital transformation of production. Furthermore, in order to increase the number of quality workforce and experts in the field of digital technologies applied to production and the mechanical engineering sector in general (without which it is not possible to fully successfully implement digital transformation of production), it would be necessary to modernize the education system at all levels, especially higher education, and bring it closer to the real sector and the labour market, i.e., systematically work on developing practical digital competencies of students and their active involvement in the processes of innovative culture.

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Authors' contacts:

Marin Grčić, mag. ing. mech.
Karlovac University of Applied Sciences,
Trg J. J. Strossmayera 9, 47000 Karlovac, Croatia
E-mail: grcicmarin92@gmail.com

Ljerka Luić, Full Professor
(Corresponding author)
University North,
Jurja Križanića 31b, 42000 Varaždin, Croatia
E-mail: ljluic@unin.hr