

HOW DIGITAL MATURITY AFFECTS THE STRIVE FOR INNOVATIONS IN SMES IN THE CZECH REPUBLIC

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Abstract:

I: Innovative approach of SMEs is one of core drivers of their business. It intertwines across their business models, internal and organisational transformation processes all the way up to product and service innovation. But in what manner is this approach affected by the digital maturity of the organisation? The aim of this paper was to evaluate the impact of digital maturity on the SMEs journey to innovative company in the Czech Republic. M: Literature review was carried out, then the closed questionnaire containing the data of 73 respondents representing SMEs in the Czech Republic was conducted. Number of participants was verified through power sample analysis using G power. Collected data was statistically tested using test of given proportion via R programme. R: Results imply, that SMEs with higher level of digital maturity perceive its direct influence on innovation activities, on the contrary to enterprises classified with lower level of digital maturity. The influence on innovation processes and innovations ratio is measured, leading to the conclusion that more digitally mature SMEs report higher number of innovations. D: This paper contributes to prior literature by practical implementation of modified digital maturity model and addressing the correlation between the level of digital maturity and innovation processes in SMEs in the Czech Republic. Limitations naturally occur, springing from included sample size and impossibility to control the environment in which the data was collected. Author proposes a conclusion, that digital maturity can be perceived as a driver of innovations, emphasizing the need for future research and both scholarly and practical discussion.

Key words:

Innovation, digital maturity, digital readiness, SME, innovation process

JEL: M.15, O.15, O.33

1 Introduction & literature review

Innovation is one of the key attributes in business administration and other substantial fields and can be seen as one of the primary elements of entrepreneurship (Schumpeter & Backhaus, 2003; Davidsson, 2016).

As globalized market is a competitive environment, we can perceive high pressure on process efficiency (Nawanir et al., 2016). As companies need to achieve higher performance to attract new customers and retain current customers by achieving long-term customer satisfaction (Aguwa et al., 2012), they ought to continuously improve and innovate mainly by improving their production quality, costs, and flexibility (Singh & Singh, 2015). Fitzgerald et al. (2014) define the digital transformation as an enabler of major business improvements such as creating new business models, raising performance, and enhancing customer experience. Therefore, digital transformation leads to gaining advantage in competitive environment. As digital transformation is clearly an imperative to innovation,

and innovation is a solution for firms to survive a thrive in nowadays competitive markets (Kim & Mauborgne, 2015), it is vital to search for the best ways of harnessing the innovation potential. Entrepreneurial success can be derived from identification of innovative products or service, processes, and business models.

The digital innovation perspective changes the nature of business models and firm management, as we can draw from information system literature (Yoo et al., 2010; Yoo et al., 2012; Nambisan et al., 2017; Tilson et al., 2010). The role of digital technology on firms' strategies was examined during past years (Hess et al., 2016; Bharadwaj et al., 2013), regarding the possible disruptive impact on business models and organizations. As Sing & Hess (2020) imply, the holistic approach must be projected in connection to the strategic management, overall strategy, and digital transformation to compensate for disruptive impact of digital innovation of organizations (El Sawy and Pereira, 2013.)

In order to innovate, companies are ought to take up digital transformation to open new paths to gaining competitive edge. Although there are many different approaches to digital transformation, digital maturity is one of the cornerstones of its success.

As we can draw on (Sommer, 2015) the research regarding the SMEs in Germany, digital transformation, and industry 4.0 approach can be perceived as a challenge, mainly from the point of view of knowledge, readiness, and capability to face unexpected challenges. It can be established that the capability and adaptability depend on either size or revenue, but also on deriving factors such as strategic management, financial and human capital, and internal compatibility of embracing change, which originates from digital maturity and level of necessary competencies (Werner & Wäger, 2019). Motivation, capability of adaptation to change and level of digital maturity is vital in for reaching success in complicated and costly process of digital transformation (Ghobakhloo & Iranmanesh, 2021).

Maturity refers to a state of readiness and perfection (Simpson & Weiner, 1989) and provides an insight to the level of development of a system. Maturity can be measured quantitatively and qualitatively in different manners (Kohlegger et al., 2009) by using different models. Maturity models dealing with the digital maturity are used to evaluate the starting point of a company and help to set up the pace and plan of digital transformation and innovation process, e.g., PriceWaterhouseCoopers Digital Operations Self-Assessment or Deloitte maturity model (2018). Yet, how do the SMEs perceive their level of digital maturity and its impact on innovative actions? Can the digital maturity be coherent with the number of innovations?

Nearly two-thirds of manufacturing CEOs claim that agility, in hand with innovation is the new currency of business. Being slow leads to the bankruptcy. Yet, one third points out that their organisation is struggling to keep the pace with technological and digital innovation (KPMG, 2018).

Drawn from the Tech Pro survey (The Tech Pro Research, 2019), 70% of business leaders claim to be investing more time and resources into digital strategy and digital transformation. It can be stated that businesses seek digital transformation to harness innovative potential and achieve sustainable growth and competitive advantage.

General public opinion sees greater promise in smaller firms investing heavily in innovations rather than large incumbents (Lee & Chen, 2009). It can be stated that SMEs are prone to conclusion that innovation is a means to achieve success, and new normal is to make the most of digital transformation. Without digital maturity, transformation is more likely to fail or to be rather costly experiment. So how does the digital maturity impact the number of innovations?

More than a hundred different maturity models have been created (de Bruin et al., 2005), and new ones are constantly being published. But the authors rarely reveal the development of their model and the results of evaluation, as it is usually contained in their knowhow and a part of a business product. For the purpose of this research, modified maturity model was drawn from the pivots of Deloitte maturity model to assess the SMEs participating in the survey.

Aim of this paper is to find out if there is a correlation between the level of SME's digital maturity and the innovations including business model innovations, internal and process innovations and

product/service innovation and to explore and measure the influence of digital maturity on innovation process in SMEs in the Czech Republic.

2 Methods

As a member of digital transformation projects, first author observed the strive for innovation in companies focusing also on digital transformation. Therefore, the author used quantitative methods to collect and analyse data to address the main aim of this study. In terms of the aim stated above, following research questions were proposed:

RQ1: Does the level of digital maturity affect the number of innovations in SME's?

RQ2: Do the SMEs managers perceive the influence of digital maturity on their innovation activities?

Following zero hypothesis were formulated:

H0_A: Level of digital maturity does not affect the number of innovations.

H0_B: 50% of SME's managers think that level of digital maturity influences their innovation activities.

Following alternative hypothesis were formulated:

HA_A: Level of digital maturity does affect the number of innovations.

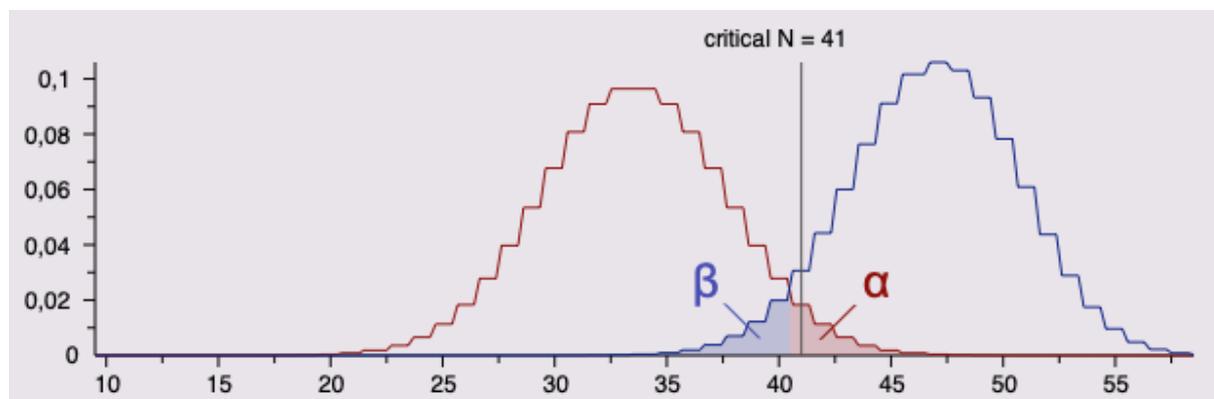
HA_B: More than 50% of SME's managers think that level of digital maturity influences their innovation activities.

To address the research problem and answer the research questions, a research project based on conducting a quantitative study was carried out in selected SMEs in the Czech Republic. To obtain the necessary data, a structured survey was performed. Closed question survey contained basic questions regarding the company stats as revenue, number of employees and revenue growth trend. Auto evaluation assessing the level of digital maturity followed, closing with the questions regarding the number of innovations and perceived influence of digital maturity on innovation activities.

2.1 Structure of the survey sample

Research survey contained 73 responses. The number of respondents was evaluated using the G-power programme through power sample analysis proportion sign binomial test with effect size 0,2 (deriving from 70% expected result minus 50% zero hypothesis starting point) on with error probability 0,05, with the result of 67 total sample size, as can be seen in Fig. 1.

Figure 1 - Power analysis



Source figure: authors own.

In terms of stated above, the number of participants was deemed sufficient.

SMEs respondents structure was identified followingly:

- As for the size of companies included:
 - 0 – 9 employees – 21 % of the research sample.
 - 10 – 49 employees – 34 % of the research sample
 - 50 – 249 employees – 45% of the research sample.

- As for the revenue value proportion:
 - < 2 mil. Euro – 30 % of the research sample.
 - 2 – 10 mil. Euro – 60 % of the research sample.
 - 10 – 50 mil. Euro – 10 % of the research sample.

- As for the trend of the revenue growth:
 - Declining – 34 % of the research sample.
 - Stable – 38 % of the research sample.
 - Rising – 28 % of the research sample.

2.2 Evaluation of digital maturity

As for the digital maturity evaluation, author drew on the Deloitte maturity model (2018), and prepared modified version of the assessment. Following pivots were evaluated:

- Flexible, secure infrastructure – implementing technology that balance security and privacy.
- Data mastery – aggregating and activating of data embedded into products, services, and operations to increase efficiency and revenue growth
- Digital savvy, talent networks – training programs and empowering talents with focus on digital competencies.
- Ecosystem engagement – external business partners, universities, tech incubators.
- Intelligent workflows – continuous improvement and calibration of processes to produce positive outcomes
- Customer experience – digital coordination and interaction with customers to deliver fast and transparent experience.
- Business model adaptability – change and expansion of business models and revenue streams through optimization and agility in changing markets.

Evaluation was based on 1-10 scale, where value 1 stood for minimum level, and value 10 for maximum level. Pivots were marked ad variable x_i , ($i= <1;7>$). Results were collected from top-management of SME's. To ensure the reliability of data collected, the same set of questionnaires was used. Addressing the ethical rules of research, full anonymity was guaranteed to each participant and organization.

For the purpose of categorizing the respondents, digital maturity index (DMI) was used. Digital maturity index (DMI) was calculated thusly:

$$DMI = \frac{\sum x_i}{n} * 100 \quad (1),$$

Where x_i represents variable, whereas n represents the value of maximum sum of variables ($n=7*10$).

The classification of the results was based on summary score of the responses:

Intervals	Evaluations
LDMI (0; 0.3)	Low digital maturity index
MDMI (0.3;0.7)	Medium digital maturity index
HDMI (0.7; 1)	High digital maturity index

Following intervals were used:

- LDMI = low digital maturity index
- MDMI = medium digital maturity index
- HDMI = high digital maturity index

2.3 Evaluation of influence of digital maturity on innovations amount and process

The amount of innovation was analysed using following formulas:

- Product/service innovation ratio (%) (PIR)

$$\text{Product innovation ratio} = \frac{\text{Number of innovations}}{\text{Number of products total}} * 100 \quad (2),$$

- Business model (BM) innovation ratio (%) (BMIR)

$$\text{BM innovation ratio} = \frac{\text{Number of BM innovations}}{\text{Number of BM total}} * 100 \quad (3),$$

- Internal process innovation ratio (%) (IPIR)

$$\text{Internal process innovation ratio} = \frac{\text{Number of internal innovations}}{\text{Number of internal processes}} * 100 \quad (4).$$

Innovation ratio spans in interval (0;1) calculated via the comparison of monitored variable to total number. Average innovation ratio (avg.IR) was calculated followingly:

$$\text{avg. IR} = \frac{\text{PIR} + \text{BMIR} + \text{IPIR}}{n} \quad (5).$$

Average innovation ratio was examined in context of the level of digital maturity to evaluate the correlation between digital maturity and number of innovations.

The influence of level of digital maturity on innovation activities was measured using Likert 3-point scale with 0/+2 range based on personal evaluation of the respondents, where:

- 0 = not at all
- +1 = slight influence
- +2 = strong influence

Following questions were used:

- Does the level of digital maturity affect your business model innovations?
- Does the level of digital maturity affect your internal process and operations innovations?
- Does the level of digital maturity affect your product/service innovations?

Responses were sorted to categories using DMI as main criterion with aim to analyse possible difference in responses from different DMI categories. For the purpose of hypothesis evaluation, average numbers of responses representing value +1/+2 were calculated. Relative frequency was used to express the portion of respondents opinion evaluating the influence of digital maturity on innovation process.

The data acquired was analysed using 1-sample proportion test with continuity correction using following formula in the R statistical programme:

$$\text{prop.test}(n, x, p = 0.5, \text{alternative} = \text{greater}) (6),$$

Where n (number of responses total), x (variable), p (zero hypothesis probability). Zero hypothesis was tested on three different categories divided by DMI criterion.

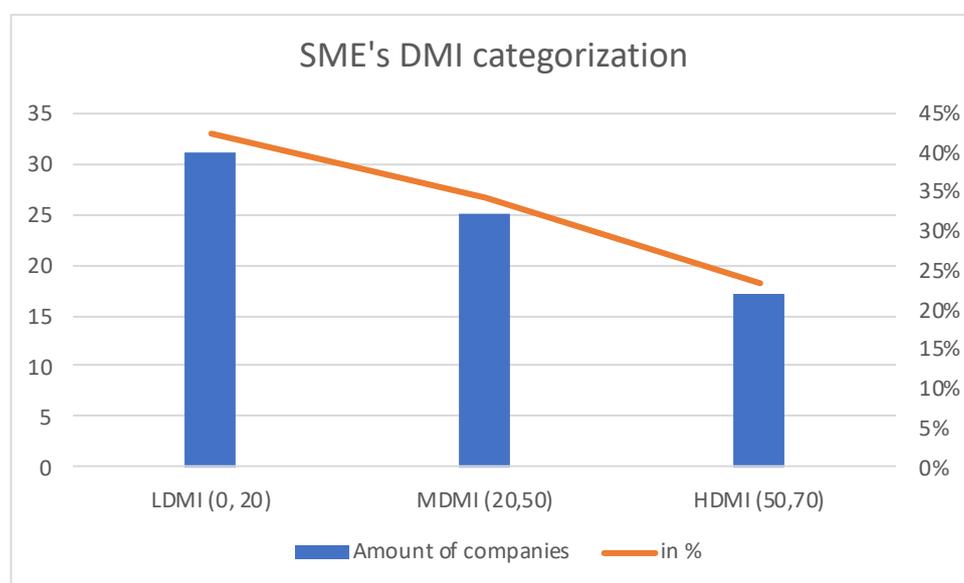
3 Results and discussion

During the data evaluation phase, it became clear that level of digital maturity depends strongly on respondents' capability to evaluate its organisation position accordingly. After initial collection, the data was cleared and prepared for statistical processing. Firstly, SMEs were sorted out to categories using the digital maturity index using formula (1), as stated in chapter 2.2.

3.1 Level of digital maturity

As can be seen in Fig. 2, lesser portion of the sample is represented by SME's identified with high digital maturity index. Overall number of companies was 73, from which 31 were identified with LDM index, 25 with MDM index and 17 with HDM index. Respondents evaluated their level of digital maturity in 7 categories, as stated chapter 2.2.

Figure 2 - Categorization through DMI criterion



Source figure: authors own.

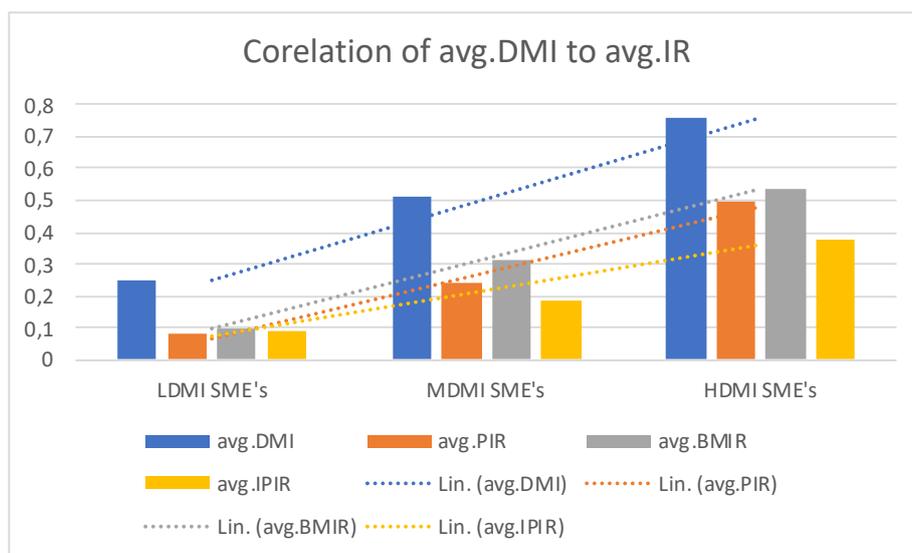
Fig. 2. shows declining tendency of digital maturity index in our research sample, revealing that state of digital maturity amongst SMEs is a matter of importance, that is to be addressed in future years in terms of rising the companies' level of digital maturity in order to reach competitive edge and to maximize the potential of digital transformation. As the digital transformation is an actual and important

topic, SMEs are ought to continuously measure their level of digital maturity, as it is one of the key markers interlacing the journey to maximum digital readiness and successful digital transformation. Based on the processed data, it can be stated that there is still vast space for SMEs to improve and develop their digital position in internal and external environment.

3.2 Influence of digital maturity on number of innovations

In Fig. 3., we represent a model that shows the correlation of average digital maturity index to innovation ratio. It can be stated that higher digital maturity index is projected in higher innovation ratio.

Figure 3 - Correlation of average digital maturity index to average innovation ratio



Source figure: authors own.

Partial innovation ratio was measured according to formulas (2,3,4) and average innovation ratio was calculated using formula (5), as stated in chapter 2.3. As an organisation progresses and develops higher digital maturity level, the influence pattern on average number of innovations can be perceived clearly. It can be stated that although there are many factors influencing the innovations amount and thus innovation ratio, in terms of our research sample, the relationship between the level of digital maturity and amount of innovation leads to consideration of the fact, that more developed and digitally advanced organisation implements higher number of innovations. Thus, can be recommended that SMEs should nurture digital talents and improve their employees' competencies as well as invest in appropriate technological background to rise their level of digital maturity, which can lead to rising the number of innovations supporting the organisations growth and revenue.

Based on basic frequency analysis, we can imply that zero hypothesis is rejected in favour of alternative, resulting in a fact that the number of innovations is influenced by the level of digital maturity.

3.3 Influence of digital maturity on innovation process

Influence of digital maturity on overall innovation processes was measured according to the methods stated in chapter 2.3. For the purpose of distinction of categories with different digital maturity index, data was divided into three different groups. Results were statistically tested using the formula (6) with focus on the responses marked as b and c, as it is represented in Fig. 4., standing for the slight or strong influence of digital maturity on the innovation process.

Figure 4 - LDMI SMEs evaluation of influence of digital maturity on innovation process

LDMI responses overview						
Question	Variable meaning	variable marker	variable value x	relative frequency	relative frequency x(b+c)	p value
Does the level of digital maturity affect your business model innovations?	not at all	1a	18	58,06%		
	slight influence	1b	9	29,03%		
	strong influence	1c	4	12,90%		
	x(b+c)		13		41,94%	
Does the level of digital maturity affect your internal process and operations innovations?	not at all	2a	20	64,52%		
	slight influence	2b	7	22,58%		
	strong influence	2c	4	12,90%		
	x(b+c)		11		35,48%	
Does the level of digital maturity affect your product/service innovations?	not at all	3a	21	67,74%		
	slight influence	3b	6	19,35%		
	strong influence	3c	4	12,90%		
	x(b+c)		10		32,26%	
	avg.value x(b+c)		34			
	n.total		93			
	avg.relative frequency x(b+c)		34		36,56%	0,3655

Source figure: authors own.

As can be seen in Fig. 4., companies categorized with low digital maturity index don't perceive significant influence of digital maturity on their innovation processes. It can be stated that those companies are on the brink of implementation of digital environment, struggling with many pitfalls on the way to reach at least an average level of digitalization. Thusly, the space for innovations or the ability to see the connection between digitalized environment, evolved digital competencies can be diminished.

On the contrary, data in Fig. 5 shows that with rising level of digital maturity, the influence rises and companies are prawn to see the pattern between innovation and digital readiness.

Figure 5 - MDMI SMEs evaluation of influence of digital maturity on innovation process

MDMI responses overview						
Question	Variable meaning	variable marker	variable value x	relative frequency	relative frequency x(b+c)	p value
Does the level of digital maturity affect your business model innovations?	not at all	1a	11	35,48%		
	slight influence	1b	8	25,81%		
	strong influence	1c	6	19,35%		
	x(b+c)		14		56,00%	
Does the level of digital maturity affect your internal process and operations innovations?	not at all	2a	12	38,71%		
	slight influence	2b	5	16,13%		
	strong influence	2c	8	25,81%		
	x(b+c)		13		52,00%	
Does the level of digital maturity affect your product/service innovations?	not at all	3a	9	29,03%		
	slight influence	3b	11	35,48%		
	strong influence	3c	5	16,13%		
	x(b+c)		16		64,00%	
	avg.value x(b+c)		43			
	n.total		75			
	avg.relative frequency x(b+c)		43		57,33%	0,5733

Source figure: authors own.

As for the companies listed in category with high digital maturity index, as represented in Fig. 6., the results are clear and can lead to confirmation of the assumption, that companies with developed digital infrastructure, high level of digital competencies and in the state of advanced development are much likely to connect their position with harnessing the innovation potential, thus leading to conclusion that digital maturity strongly affects the innovation processes.

Figure 6 - HDMI SMEs evaluation of influence of digital maturity on innovation process

HDMI responses overview						
Question	Variable meaning	variable marker	variable value x	relative frequency	relative frequency x(b+c)	p value
Does the level of digital maturity affect your business model innovations?	not at all	1a	3	9,68%		
	slight influence	1b	7	22,58%		
	strong influence	1c	7	22,58%		
	x(b+c)		14		82,35%	
Does the level of digital maturity affect your internal process and operations innovations?	not at all	2a	5	16,13%		
	slight influence	2b	8	25,81%		
	strong influence	2c	4	12,90%		
	x(b+c)		12		70,59%	
Does the level of digital maturity affect your product/service innovations?	not at all	3a	2	6,45%		
	slight influence	3b	10	32,26%		
	strong influence	3c	5	16,13%		
	x(b+c)		15		88,24%	
	avg.value x(b+c)		41			
	n.total		51			
	avg.relative frequency		41		80,39%	0,8039

Source figure: authors own.

The zero hypothesis was tested secluded for each category, using formula (6). As can be seen in Fig. 7., the zero hypothesis can be accepted in low digital maturity index SMEs. On the contrary, in categories MDMI and HDMI the zero hypothesis is rejected in favour of alternative hypothesis.

Figure 72 - Results of zero hypothesis prop.test

SME category	p H0	p-value	confidence interval	evaluation
LDMI SME's	0.5	0.9936	> 0.2883	H0 accepted
MDMI SME's	0.5	0.1241	> 0.4718	H0 rejected
HDMI SME's	0.5	1.33e-05	> 0.6873	H0 rejected

Source figure: authors own.

From the data presented in Fig. 7., we can draw a conclusion, that alternative hypothesis stating that more than 50% of SMEs perceive that digital maturity has an influence on their innovation processes, is only viable in more evolved and advanced enterprises, that already reached the necessary breakpoint of digital maturity to be able to assess its influence on innovation processes.

4 Conclusion

This paper was aimed to examine how SMEs level of digital maturity influences the innovation process and number of innovations implemented in order to conceptualize the approach to innovation and digital maturity as a process of gaining a competitive edge for ongoing thrive for sustainability and competitiveness. According to the obtained data and discussed results, number of conclusions can be drawn regarding the research questions.

It has been found that digital maturity and its influence on innovations is a matter of importance for included SMEs, and the effect can be perceived as measurable. Digital maturity serves as an accelerator of innovation processes and contributes to a higher number of innovations. As last years were somewhat turbulent and SMEs had to deal with perplexity caused by covid19 pandemic, innovations could have been a means to evolve and gain competitive advantage.

SMEs with lower digital maturity index do not perceive the influence equally as more advanced enterprises. As for the number of SMEs and its division into categories according to the digital maturity index, higher number of respondents was categorized as lowly digitally mature. It opens space for both scholarly and practical discussion about SMEs journey to digital maturity. It can be stated that there are still future goals to reach in terms of digital maturity and digital transformation process for SMEs in the Czech Republic.

Through raising the level of digital competencies and building up viable technological environment, SMEs can maximise the effect of digital transformation process, and with higher level of digital maturity, a larger number of innovations can spring, helping the enterprises to reach sustainable revenue growth and competitive edge.

As one of the limitations of this research we can state that digital maturity is not the sole factor affecting the innovations ratio, although this fact opens space for future research on the topic of factors influencing the innovations ratio and describing the position of digital maturity among them.

It can be stated that innovations ratio rose, as the SMEs reported higher digital maturity index, as well as the perception of influence of digital maturity on overall innovations. Thus, results of the study recommend that SMEs build up their level of digital maturity if they strive for more innovative company. As the digital maturity evaluation can vary depending on the point of view of respondents, the author aims to develop more detailed evaluation protocols for digital maturity in future research.

This research contributes to prior literature and practical digital maturity models via application of modified digital maturity model used to measure level of digital maturity and linking its impact to the amount of innovation ratio and innovation processes.

As this study has an exploratory character with limited sample, there are natural limitations. Yet, those limitations provide impulses a create possibility for future research.

As responses often depend on time and conditions (Baxter & Jack, 2008), it can be stated that one limitation is the impossibility to control the environment. By executing multiple studies with larger samples, this limitation could be addressed by future researchers. Future research could also explore the position of digital maturity among other factors with impact on innovation ratio and innovation processes, and the means of building up the digital maturity and training necessary competencies needed to successful digital transformation (Zhou et al., 2021). Another research gap can be seen in comparison between various SME divided by fields of business, size, revenue, and other performance indicators, concerning their role and purpose in building dynamic capabilities for digital transformation (Barreto, 2010).

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