

DOCTORAL CONSORTIUM

THE MULTI-CRITERIA DIGITAL AND SUSTAINABLE MATURITY ASSESSMENT MODEL

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European Union (EU) recognized the strong need for digital and sustainable transition of enterprises and societies. Although digital technologies can contribute to achieving sustainable goals, many of enterprises still struggle with challenges of digitalization and digital transformation, especially SMEs, which due to limited resources often lag behind larger enterprises. In the paper, we focus on SMEs, since they represent majority of EU economy, and are strong contributor to the number jobs and GDP. To achieve goals for successful digital and sustainable transition, which are adopted by European Commission, it is important to use proper strategies. This is not possible without understanding the current state and predict the impact of given measures and develop new business models that can be derived from digital transformation, sustainability, and circular economy. There are several available tools for digital maturity assessment available and SMEs can estimate their position in digital journey. However, to our knowledge, no tool, which would enable assessment of digital maturity and its impact on achieving sustainability goals, is currently available. Such a model could help SMEs to assess current state and plan for proper strategy to achieve digital transformation towards sustainability goals.

Keywords:

SMEs,
regulation,
sustainability,
digital
transformation,
twin
transition,
maturity
assessment
model

1 Introduction

Many crises in Europe and worldwide, caused by Covid-19, war in Ukraine, population growth and environmental exploitation, resulting shortage of natural sources and natural disasters, have led the European Commission to prepare the strategy for twin green and transition. Both strategies- EU digital strategy and green deal, are heading to the same goal- to make digital strategy work for people, while helping to achieve a target of a climate-neutral Europe by 2050 (European Commission, 2020c). Digital regulatory framework is combined under EU digital strategy and consists of several regulations and directives (European Commission, 2020c).

Twin transition is one of the most important paradigms in the current time. Irreversible changes and further damage on the planet Earth can only be avoided with greater responsibility from each individual, adjustments in business with the changes in business models and adopted legislative (Vidmar, 2021).

EU framework for the twin transition aims to achieve sustainability, combat climate change and environmental degradation with harnessing digital technologies for sustainability and prosperity, and to empower citizens and business (Muench et al., 2022). Green transition, addressing environmental performance (planet) is only one of the elements in the triple bottom line of sustainability, besides economic performance (profitability) and social performance (people), (Dao et al., 2011) which all need to be addressed in the forthcoming economy. The transformation from pure economic success in linear economy to shared value which is including not only individual (economic) success, but the success of the society is the basis for the sustainable or circular economy (Brenner, 2018).

The area is currently regulated by the Directive as regards disclosure of non-financial and diversity information by certain large undertakings and groups (NFRD directive) from 2014, which only affects large enterprises from 2018 and anticipates reporting in the annual reports on five dimensions and four sub-dimensions in pdf format with low reliability of reporting (European Commission, 2014).

Under the EU Green Deal (European Commission, 2019) new directives and new standards are under preparation, also obliging SMEs for preparation of standardized reports, including financial taxonomy.

In the paper, we will focus on SMEs, which represent 99 % of European economy. Unfortunately they are lagging in adopting new development principles both in the digital transformation and consequently sustainability (Gorgels et al., 2022).

2 Problem definition

The problem addressed in our research is focused to the twin transition of SMEs. SMEs represent 99% of the European economy; they provide 100 million of jobs and contribute 50% of Europe's GDP. (Gorgels et al., 2022). At the same time, only 25% of EU SMEs work on green products or services and only 17% have successfully integrated digital technology. SMEs contribute about 65% of overall employment in the economy, but they are also responsible for around 60% of all greenhouse gas emissions by enterprises (European Commission, 2020a). New regulatory framework is setting rules for SMEs for mandatory reporting and taking actions towards the twin transition. The digital and sustainable maturity assessment model can help them with easier adopting to the regulations but also help them design new strategies for future development of their enterprises.

We can observe that many enterprises are facing challenges with establishing digital capabilities, competences, and changes of the organizational culture (Pucihar, 2020). With the emerged need for sustainable transformation of the world around us, and the simultaneous ongoing digital transformation, it is necessary for enterprises to find parallels in development of their business models. Digitalization is giving us the possibility to re-create the environment we live in, even though the population is rising, especially in the cities. In the cities, the impact of digital technologies is already recognized through the sharing economy business models (Hildebrandt et al., 2018). Dealing with the twin transition, digital transformation, and the innovation of digital business models already guided entrepreneurs towards pro-growth mentality and openness to changes (Ferreira et al., 2022). Recent research shows that sustainability and digitalization can integrate principles and strategies (Vidmar, 2021). The research investigated which information technology, organizational and business environment factors influence changes in business models, with the focus on its

digitalization. The research also focused on the impact of business model changes on the three components of sustainable performance: economic, environmental, and social.

European Commission can influence European market by setting rules, that is why the twin transition (Muench et al., 2022) with the digital strategy (European Commission, 2020c) and European green deal (European Commission, 2019) targeted the same outcome – to create a climate neutral Europe by 2050 with including various factors of everyday life (Muench et al., 2022).

EU Green deal includes different goals and therefore reporting standards about achieving those goals. Main goals are dedicated to environment, Europe to be the first climate-neutral continent by 2050, with at least 55% less net greenhouse gas emissions by 2030, compared to 1990 levels and planting additional 3 billion of trees in EU. EU green deal will represent a series of benefits, fresh air, clean water, healthy soil, and biodiversity, renovated, energy efficient buildings, healthy and affordable food, more public transport, cleaner energy and cutting edge clean technological innovation, longer lasting products that can be repaired, recycled, and reused, future-proof jobs and skills training for the transition with globally competitive and resilient industry (European Commission, 2019). Goals and expected results are affecting the economy, which will have to transform to comply with the demands and to ensure the sustainable products. At the same time, the directives CSRD (European Commission, 2023), EU Taxonomy (European Commission, 2020b), ESRS standards (EFRAG, 2021) and CSDD directive (European Commission, 2022), will significantly influence the operations of the enterprises.

Some of the key characteristics of SMEs are limited financial and human resources, operation in economic or geographic niches and in uncertain markets and policy environments, which all represent challenges for the sustainable transition (Gorgels et al., 2022). SMEs also meets difficulties in influencing wider business environment and they are often owned and managed by the same person, on whom depend on all the values and beliefs (Kljajić et al., 2021a). SMEs were forced to proceed with the digital transformation in the last years, because of their competition, but also Covid-19 pandemic push. Both transformations, digital and sustainable, need to start from the current state of the individual enterprise, which we can also state as maturity. From there, enterprises can plan strategies and further development.

The maturity can be defined as “the state of being complete, perfect or ready” (Lasrado et al., 2015), the assessing the maturity of digitalization reflects the degree of digital transformation in the company (Alsufyani & Gill, 2021), which represents long and uninterrupted process, covering technology, culture, company strategies, staff, and end user needs (Nasiri et al., 2022).

Our research emerges from the limited abilities of SMEs to design their own strategies for twin transition. In Slovenia, national digital maturity assessment model was developed in 2020 and it is under constant improvements. This assessment model enables individual SME to assess its current state in the digital transformation journey and compares themselves with its competition. In addition, the tool also provides automatically generated report with recommendations for further development (Kljajić Borštnar & Pucihar, 2021). National digital maturity assessment model is a result of many studies and expert group involvement, and it gains from outcomes of already existing digital maturity models in other countries. The aim of our research is to extend the existing tool with sustainability criteria and adjusting existing digital and organizational readiness assessment criteria will provide multi-criteria digital and sustainable maturity assessment tool. SMEs will use the measured score for orientation on their position on the market as well for the planning of future investments to gain compliance and benefits from twin transition to create future strategies connected to their needs for digitalization and green transition goals. The national level of collecting data enables policy makers to customize proper instruments to help SMEs, based on aggregated and analysed data.

3 Methodology

As the umbrella methodology for the proposed research, we follow the design science research methodology (DSR) , with the main goal the development of organization- informatics artefact to solve the relevant business needs, based on the existing knowledge (Hevner et al., 2004). The proposed solution – artefact- will be multi-criteria model for the assessment of the digital and sustainability maturity.

Based on the scientific and expert literature review, existing models, policy literature and research, we will conduct the conceptual research model and determine the initial set of criteria for the assessment of digitalization and sustainability maturity. In the next step we will determine value ranges and validate the criteria set through

the semi-structured interviews with experts on the digitalization and sustainability fields. Semi-structured interview provides the additional questions, which were not planned, but they can significantly contribute to the model development and understanding of the problem (Kallio et al., 2016).

The model we will develop will be the multi attribute decision model, which are considered as useful decision-making tools in the complex situations with evaluation process with including all the relevant factors, which can affect the decision (Kljajič et al., 2021b).

We will develop multi-criteria assessment model and will test it on the 6-10 SMEs to confirm its sensibility for differences among enterprises.

In the development phase of multi-attribute decision making model, we will use the DEXi program – a software which is freely available. DEXi method requires the decomposition of the decision problem into smaller problems with lower complexity and easier to solve (Bohanec, 2020).

In the last step we will evaluate the model and analyse the data from SMEs, with which we will confirm the suitability of the further usage of the model in practice. One of the goals is test of the model in practice to achieve opinions and recommendations for the improvements of the model.

3.1 Literature review

Initially we wanted to establish the time when the topics of digitalization and sustainability became of more importance, regarding the number of published sources. Through the knowledge bases Web of Science, Scopus and ProQuest Dissertations and Thesis we've searched for the key words "digitalization" and "sustainability", collected the results, and presented the median through the Figures 1 and 2, presenting the number of articles with included keyword digitalization (Figure 1) and sustainability (Figure 2). Because we assume that some of the articles are the same, published in different knowledge base, we did not calculate the sum, but took the median.

We assume that the number of articles as well represent the importance of the topics. In the Figure 1 and Figure 2 we can see that both topics became relevant in early 19th Century, but raising relevance in the last 10-15 years, while now they represent one of the most important topics.

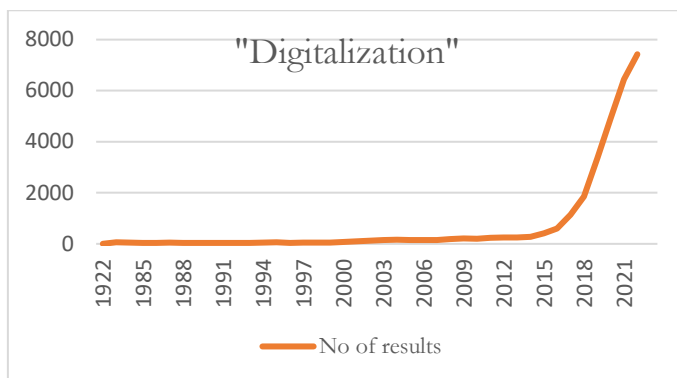


Figure 1: Number of articles on the keyword "digitalization"

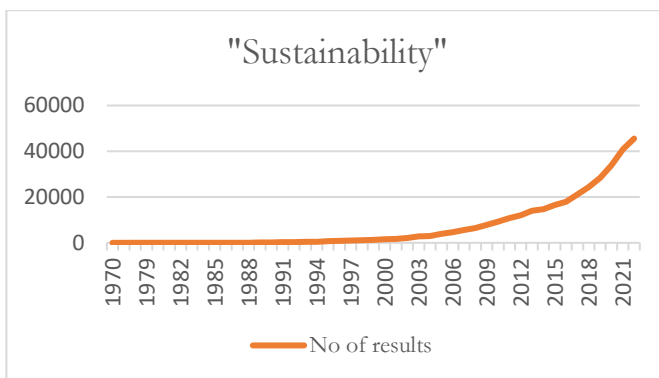


Figure 2: Number of articles on the keyword "sustainability"

In the next step, we used three knowledge bases: Scopus, Web of Science and ProQuest Dissertations and Thesis, to search by the key words listed below. We were adding the concepts, applied to the research problem, to narrow the selection. In this process, we concluded that for the research problem – the design of multi-criteria model for digital and sustainable maturity assessment in SMEs - there is no articles in knowledge bases, we searched. In the Scopus and Web of Science there is

only one article, which is dealing with twin transition model for SME as well digital and sustainable maturity, but it is strictly focused on the manufacturing enterprises.

The key words, which were used in the search, are:

- Digitalization
- Sustainability
- Digitalization AND sustainability
- Digital AND maturity AND assessment
- Sustainable AND maturity AND assessment
- Digital AND maturity AND maturity AND assessment AND SME
- Digital AND Sustainable AND maturity AND Assessment AND SME AND model
- Digital AND Sustainable AND maturity AND Assessment AND SME AND multi-criteria AND model
- Twin transition AND sustainability AND digital AND model AND SME

Table 1: Inquires in the ProQuest Dissertations and Theses Global database

Database	Key word (the combination of key words)	Number of results in the database
ProQuest Dissertations and Theses Global	Digitalization	8919
	Sustainability	227448
	Digitalization AND sustainability	2727
	Digital AND maturity AND assessment	576
	Sustainability AND maturity AND assessment	409
	Digital AND sustainability AND maturity AND assessment	157
	Digital AND Sustainable AND maturity AND Assessment AND SME	564
	Digital AND Sustainable AND maturity AND Assessment AND SME AND model	564
	Digital AND Sustainable AND maturity AND Assessment AND SME AND model AND multi-criteria	54
	"Twin transition" AND sustainability AND "digital maturity assessment" AND model AND SME	0
	"digital maturity assessment" AND "sustainability" AND "multi criteria model"	0

Table 2: Inquiries in the Web of Science database

Database	Key word (the combination of key words)	Number of results in the database
Web of Science	Digitalization	21.112
	Sustainability	375.239
	Digitalization AND sustainability	1712
	Digital AND maturity AND assessment	449
	Sustainability AND maturity AND assessment	403
	Digital AND Sustainable AND maturity AND Assessment	23
	Digital AND Sustainable AND maturity AND Assessment AND SME	3
	Digital AND Sustainable AND maturity AND Assessment AND SME AND model	2
	Digital AND Sustainable AND maturity AND Assessment AND SME AND multi-criteria AND model	0
	Twin transition AND sustainability AND digital AND model AND SME	1

Table 3: Inquiries in the Scopus database

Database	Key word (the combination of key words)	Number of results in the database
Scopus	Digitalization	32136
	Sustainability	348195
	Digitalization AND sustainability	1749
	Digital AND maturity AND assessment	730
	Sustainability AND maturity AND assessment	407
	Digital AND Sustainability AND maturity AND Assessment	45
	Digital AND Sustainable AND maturity AND Assessment AND SME	6
	Digital AND Sustainable AND maturity AND Assessment AND SME AND model	5
	Digital AND Sustainable AND maturity AND Assessment AND SME AND multi-criteria AND model	0
	Twin transition AND sustainability AND digital AND model AND SME	1

Besides the sources, which we will study and sort in the following process, we have found approximately 50 other sources, including directives, regulations, guidelines, and recommendations, used to regulate the field from the European Commission. Literature review will give us the basis for preparation of the list of criteria, which will be the base for multi-criteria model for digital and sustainable maturity assessment of SME in Slovenia.

4 Expected results

Main expected result is the developed and validated multi-criteria model for assessment of digital and sustainability maturity of SMEs. With our model, SMEs will be able to assess their current situation on the market, the position towards the competitors and strategize the future steps for successful digital and sustainable transition. At the same time and on the larger, aggregated scale, the model will enable the decision makers to design proper politics and programs to support the development, resilience and market respond of SMEs. The model must distinguish between different levels of both, digitalization and sustainability stage separately, and on the other hand measure impact of digitalization on achieving sustainability goals. The assessment sensibility can be reached with the setting of proper rules of the decision-making model - tool.

5 Future developments

Further systematic literature review is the first step in the designing of the multi-criteria model. In the preparation of systematic literature review, we are about to research the existing literature review on related areas. We are not going to timely limit the overview of the related literature, since both fields are developing for many years, even though the intersection of both fields just recently began. That is why we need an interdisciplinary approach to understand and combine both fields. Main areas of review will be digital maturity assessment, sustainability maturity assessment and both assessments combined, especially into the model.

Through the literature review, we will search for theoretical papers and already used methodologies and principles and the basis and knowledge to identify the criteria for the model. Once, when criteria will be defined, we will validate them through the interviews with experts on the fields of sustainability and digitalization. We are planning 6 interviews, 3 with the sustainability experts and 3 with experts in the field of digitalization.

When the criteria are determined and validated through the interviews, we will combine them into the multi-criteria decision support model, and once again validate it with the expert focus group.

After the model is validated through the expert focus group, we will test and validate it again with 15 SMEs.

References

- Alsufyani, N., & Gill, A. Q. (2021). A Review of Digital Maturity Models from Adaptive Enterprise Architecture Perspective: Digital by Design. *Proceedings - 2021 IEEE 23rd Conference on Business Informatics, CBI 2021 - Main Papers*, 1, 121–130. <https://doi.org/10.1109/CBI52690.2021.00023>
- Bohanec, M. (2020). IJS delovno poročilo DEXi: Program for Multi-Attribute Decision Making User's Manual.
- Brenner, B. (2018). Transformative sustainable business models in the light of the digital imperative—a global business economics perspective. In *Sustainability (Switzerland)* (Vol. 10, Issue 12). MDPI. <https://doi.org/10.3390/su10124428>
- Dao, V., Langella, I., & Carbo, J. (2011). From green to sustainability: Information Technology and an integrated sustainability framework. *Journal of Strategic Information Systems*, 20(1), 63–79. <https://doi.org/10.1016/j.jsis.2011.01.002>
- EFRAG. (2021, April). ESRS standards. <https://www.efrag.org/lab6?AspxAutoDetectCookieSupport=1>
- European Commission. (2014). DIRECTIVE 2014/95/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - of 22 October 2014 - amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014L0095>
- European Commission. (2019). A European Green Deal. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
- European Commission. (2020a). Unleashing the full potential of European SMEs. <https://doi.org/10.2775/218854>
- European Commission. (2020b). EU taxonomy for sustainable activities. https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en
- European Commission. (2020c, February 19). A Europe fit for the digital age. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age_en
- European Commission. (2022). Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) no 537/2014, Directive 2004/109/EC and Directive 2013/34/EU, as regards corporate sustainability reporting. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022L2464>
- European Commission. (2023, January). Corporate sustainability reporting. https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en
- Gorgels, Stefan., Priem, Maximilian., Blagoeva, Tsvetelina., Martinelle, A., Milanese, Giulio., European Commission. Directorate-General for Internal Market, I., DIW econ., & PwC. (n.d.). Annual report on European SMEs 2021/2022 : SMEs and environmental sustainability : background document.
- Hevner, March, Park, & Ram. (2004). Design Science in Information Systems Research. *MIS Quarterly*, 28(1), 75. <https://doi.org/10.2307/25148625>
- Hildebrandt, B., Hanelt, A., & Firk, S. (2018). Sharing Yet Caring: Mitigating Moral Hazard in Access-Based Consumption through IS-Enabled Value Co-Capturing with Consumers. *Business and*

- Information Systems Engineering, 60(3), 227–241. <https://doi.org/10.1007/s12599-018-0532-6>
- Kallio, H., Pietilä, A.-M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, 72(12), 2954–2965. <https://doi.org/10.1111/jan.13031>
- Kljajić, M., Borštnar, K., & Pucihar, A. (2021a). *electronics* Article. <https://doi.org/10.3390/electronics>
- Kljajić, M., Borštnar, K., & Pucihar, A. (2021b). *electronics* Article. <https://doi.org/10.3390/electronics>
- Kljajić Borštnar, M., & Pucihar, A. (2021). Multi-Attribute Assessment of Digital Maturity of SMEs. *Electronics*, 10(885). <https://doi.org/10.3390/electronics>
- Lasrado, L., Vatrappu, R. K., Andersen, K. N., Lasrado, L. A., & Vatrappu, R. (2015). MATURITY MODELS DEVELOPMENT IN IS RESEARCH: A LITERATURE REVIEW Democratic and technological innovation: An inquiry into the relations of power, technology and democracy in Greenlandic e-democracy View project Collaborative Representations View project MATURITY MODELS DEVELOPMENT IN IS RESEARCH: A LITERATURE REVIEW. <https://doi.org/10.13140/RG.2.1.3046.3209>
- Muench, Stefan., Stoermer, Eckhard., Jensen, Kathrine., Asikainen, Tommi., Salvi, Maurizio., Scapolo, Fabiana., & European Commission. Joint Research Centre. (2022). Towards a green & digital future: key requirements for successful twin transitions in the European Union.
- Nasiri, M., Saunila, M., & Ukko, J. (2022). Digital orientation, digital maturity, and digital intensity: determinants of financial success in digital transformation settings. *International Journal of Operations and Production Management*, 42(13), 274–298. <https://doi.org/10.1108/IJOPM-09-2021-0616>
- Pucihar, A. (2020). The digital transformation journey: content analysis of *Electronic Markets* articles and Bled eConference proceedings from 2012 to 2019. *Electronic Markets*, 30(1), 29–37. <https://doi.org/10.1007/s12525-020-00406-7>
- Vidmar, D. (2021). VPLIV INFORMACIJSKIH TEHNOLOGIJ NA TRAJNOSTNO USPEŠNOST ORGANIZACIJ.