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The Use of Technological Bricks in Agile: Conclusions Based on Analysis of the Literature and on Empirical Research

Rozwiązania technologiczne w metodyce Agile – wyniki analizy literatury oraz badań empirycznych

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ABSTRACT

Objective: The main objective of the study was to assess the level of Agile implementation in organisations in Poland and to determine the most commonly used Agile methods. The intention of this paper is to present the results of empirical research on technological tools supporting agile organisations in Poland and consider which digital competencies may favour their use.

Research Design & Methods: This paper presents a review of the literature and the results of empirical research on the use of information technology in enterprises which follow Agile practices

and approaches. Empirical research is based on an interview questionnaire, which contained questions about the level of Agile implementation in the organisation, Agile implementation and support areas, support factors, barriers to implementation, and implementation results.
Findings: The paper presents the main IT tools used in agile enterprises and the results of research conducted in this field. The study shows that in 2019 companies mainly used the Agile approach for the creation of innovative services and (or) products. Research also indicates that, when it comes to Agile Good Practices, respondents most often use Scrum and Kanban. Practices such as DevOps, TDD, or SAFe were much less frequently used by the companies surveyed.
Implications/Recommendations: The results of the research provide valuable information on three issues: implementation of the Agile approach in Polish enterprises, assessment of the use of technological bricks in Polish enterprises, and an analysis of good practices in Polish enterprises. The research also indicates directions for further research. Among others, it is recommended to repeat the research on the level of agility of the organisation in Poland, primarily to check whether the level of implementation has changed and whether the implementation has taken place in other key areas of the company.
Contribution: Literature review and economic practice indicate that there is increasing popularity of the use of information technologies, not only in agile organisations but in general, requiring employees and managers to improve their digital competencies. This paper addresses the need to evaluate the current state of Agile implementation in the organisation and examines the use of technological bricks in Agile in both theoretical and empirical ways.

Article type: original article.

Keywords: Agile, Agile Good Practices, competencies, technology.

JEL Classification: M15, M19.

STRESZCZENIE

Cel: Głównym celem artykułu jest przedstawienie wyników badań empirycznych nad narzędziami technologicznymi wspierającymi zwinne organizacje w Polsce oraz rozważenie, jakie kompetencje cyfrowe mogą sprzyjać ich wykorzystaniu.
Metodyka badań: W artykule zaprezentowano przegląd literatury oraz wyniki badań empirycznych dotyczących wykorzystania technologii informatycznych w przedsiębiorstwach stosujących zwinne praktyki zarządzania projektami. Badania empiryczne opierały się na kwestionariuszu wywiadu, który zawierał pytania dotyczące poziomu wdrożenia Agile w organizacji, obszarów implementacji i obszarów wsparcia Agile, czynników wsparcia oraz barier we wdrożeniu, a także wyników wdrożenia Agile.
Wyniki badań: Przedstawiono główne narzędzia informatyczne wykorzystywane w zwinnych przedsiębiorstwach oraz wyniki badań prowadzonych w tym zakresie. Ze zrealizowanych badań wynika, że w 2019 r. firmy stosowały głównie podejście Agile do tworzenia innowacyjnych usług i (lub) produktów. Wyniki badań wskazują również, że jeśli chodzi o Agile Good Practices, respondenci najczęściej wykorzystują Scrum i Kanban. Zainteresowanie badanych przedsiębiorstw praktykami, takimi jak DevOps, TDD czy SAFe było znacznie mniejsze.
Wnioski: Wyniki badań dostarczają cennych informacji na temat trzech zagadnień: oceny zwinnego podejścia w polskich przedsiębiorstwach, oceny wykorzystywanych rozwiązań tech-

nologicznych oraz oceny dobrych praktyk w polskich przedsiębiorstwach. W artykule wskazano kierunki dalszych analiz. Zaleca się m.in. powtórzenie badań dotyczących poziomu zwinności organizacji w Polsce, przede wszystkim w celu sprawdzenia, czy poziom wdrożenia uległ zmianie i czy wdrożenie miało miejsce w innych kluczowych obszarach firmy.

Wkład w rozwój dyscypliny: Przegląd literatury i praktyka gospodarcza wskazują, że rośnie popularność wykorzystania technologii informatycznych nie tylko w organizacjach zwinnych, ale w ogóle, wymagając od pracowników i menedżerów poprawy ich kompetencji cyfrowych. Niniejszy artykuł wypełnia lukę badawczą związaną z potrzebą oceny obecnego stanu wdrożenia Agile w organizacji oraz zbadania wykorzystania narzędzi technologicznych w Agile na dwa sposoby: teoretyczny i empiryczny.

Typ artykułu: oryginalny artykuł naukowy.

Słowa kluczowe: Agile, dobre praktyki Agile, kompetencje, technologia.

1. Introduction

The development of modern technology is largely the result of the yet unfinished Fourth Industrial Revolution, which demands changes in, among others, managing organisations, creating new business models, and developing the competencies of employees and management.

Jarosz, Sołtysik and Zakrzewska (2020) believe the Fourth Industrial Revolution directly relates to the development of the following technologies: the Internet of Things (IoT), the industrial Internet, factories of the future, the Physical Internet, and Cyber-physical Systems. A good example of a phenomenon that has been triggered by the Fourth Industrial Revolution is the attitude of people to using the telephone. Bencsik, Machová and Zsigmond (2018) claim that the introduction of Internet access on smart devices has created new opportunities for both ordinary users and for companies. Additionally, the authors confirm that there is a growing demand for software and other virtual content (Bencsik, Machová & Zsigmond 2018).

Internet tools and work automation tools have completely changed the way people work and business management models. Such a phenomenon is related not only to the broadly understood digitalisation but also has its consequences in the economic and social sphere. This is expected to lead to major social transformations in the future (Kurt 2019), which are due to strong links between the digital society that is being born before our eyes, digital culture, and those technologies that stand behind the Fourth Industrial Revolution (Mazali 2018). It should be emphasised that the development of the digital society has a very large impact on the labour market, types of jobs, and competencies of people employed in enterprises that adopt new management practices (Susskind & Susskind 2015).

As Herceg *et al*. (2020) demonstrate, the Fourth Industrial Revolution is the key challenge for contemporary businesses, this challenge requires the commitment of people who will be able to cope with technological challenges.

Tyrańska *et al*. (2020) state "the concept of competences is considered from the perspective of an employee or workplace". Eberhard *et al*. (2017) claim that a decline in employment will occur because of new technologies such as computerisation, robotisation, and digitalisation. Jarosz, Sołtysik and Zakrzewska (2020) conducted a literature review that showed that the process of development of competencies is still changing and assert that there is a need to develop digital competencies which have value on the labour market.

Kosała, Małkowska and Urbaniec (2019) claim that digital transformation is determined by technological development. In the authors' opinion, the transformation generates an "ecosystem" for improving digital competencies in the contemporary labour market.

What motivated the authors to take up the topic of digital competencies and IT tools are the problems in the labour market resulting from the low level of digital skills among employees and employers. The primary goal of this paper is to present the results of empirical research concerning technological tools supporting agile organisations in Poland and consider which digital competencies may favour their use. The paper presents the research results of a study conducted in 50 Polish enterprises. The results reflect Agile implementation in enterprises, but they also refer to IT tools used in organisations. The main research question is what competencies should be developed among employees and managers in agile enterprises to enable them to use information technology effectively in their work. This issue is of particular importance due to the growing popularity of Agile methodologies in the business world (Zakrzewska *et al*. 2022). It should also be noted that the forementioned assumptions of digitalisation behind the Fourth Industrial Revolution bring a pressing need to study digital tools in Agile methodologies.

The article is structured as follows: the literature review presents the characteristics of the Agile approach, key IT support tools, and discusses the issue of digital competencies. The next part of the article presents the methodology of the empirical research and the results of the authors' research carried out in Polish enterprises.

2. Literature Review

2.1. Agile Approach

Over the past decade, the term "Agile" has grown in popularity. The topic of Agile management is a regular at the largest IT conferences both in Poland and around the world, and the number of successful transformations only increases the enthusiasm of management. Following contemporary trends, more and more organ-

isations have decided to abandon the traditional cascade model and to implement the Agile approach.

Until now, Agile has only been associated with the software development sector. Agile software development practices were not entirely new, but the fact that they were formulated and integrated into one ground-breaking Agile Manifesto theory led customers to appreciate improvements in many areas, such as speed of delivery and reduction of software development costs (Highsmith 2002, Williams & Cockburn 2003, Zakrzewska, Jarosz & Sołtysik 2020). In general, Agile methods are processes that are short and iterative, actively engaging team members in development, prioritising, and analysing requirements (Boehm & Turner 2005).

Zakrzewska, Jarosz and Sołtysik (2020) list the achievements of the authors of the Agile Manifesto (Beck *et al*. 2001). They emphasise that the principles which reflect the idea of Agile are: people and interactions over processes and tools, working software over detailed documentation, cooperation with the client over negotiating contracts, and reacting to changes over the implementation of the assumed plan.

An important benefit of the Agile concept is that it removes the separation between the project team and customers and *vice versa*. Customers are constantly involved in product or service development, which increases the level of innovation and the value of the information system (Beck 1999, Schwaber & Beedle 2002, Conboy & Morgan 2011). Other benefits of Agile implementation are as follows: better software quality, greater customer satisfaction, and a faster return on investment (Sołtysik *et al*. 2021). Further advantages of the Agile approach are the opportunity to make changes in projects when the planning phase ends, engagement of the stakeholder, the ability to change the requirements, opportunities to test new solutions and avoid errors, and scope to increase motivation and cooperation (Whitworth 2006, Koi-Akrofi, Koi-Akrofi & Henry Matey 2019).

Agile is still being developed, but some good practices in the Agile approach have been defined. In the literature they are described as Agile methods. Hamed and Abushama (2013) claim that the two most popular Agile methods are Scrum and Extreme Programming. Other Agile methods include: Kanban, DevOps, Test-driven Development, Scaled Agile Framework, and Large-scale Scrum.

Scrum – a set of guidelines for the software development process, set in a strictly defined environment working by the guidelines of the Agile Manifesto (Sienkiewicz 2013). Wyrozębski (2011) states that the Scrum method is based on three roles (Product Owner, Scrum Master, Scrum Team), three ceremonies (sprint planning meeting, sprint review meeting, and daily Scrum meeting), and three artefacts (product backlog, sprint backlog, and burndown chart).

Extreme Programming – the method was inspired by K. Beck in the community of IT specialists from the Smalltalk language and programming environment (Kos 2019). In project management, Extreme Project Management is also known as

a method of managing projects in extreme conditions and complex environments (Olszak & Kisielnicki 2015).

Kanban – the method was created to enable the adaptation of the Japanese production control system for IT project management (Krasiński 2013). According to Wawak (2011), thanks to the Kanban method processing time was reduced to a minimum, stock was reduced, production volume was adjusted to the number of orders, quality-control was enhanced, and operating costs were kept to a minimum at every stage of the process.

DevOps – this approach aims to minimise the time between deciding on a change in a system and implementing the change in the production environment, while, at the same time, ensuring a high level of quality (Zhu, Bass & Champlin-Scharff 2016).

Test-driven Development – an approach that consists of developing test cases and then preparing code that will make the tests run correctly (Shull *et al*. 2010). This approach allows a reduction in the defect rate of about 50% compared to other systems of unit testing (Maximilien & Williams 2003).

Scaled Agile Framework – a solution for organisations that need an approach to scaled Agile development. As a method, it makes it possible to accelerate time to market, increase quality and productivity, and reduce risks and costs (Turetken, Stojanov & Trienekens 2017).

Large Scale Scrum – development of this method "requires a release planning process that supports the agile way of working and planning" (Heikkilä *et al*. 2013). It is a guide for scaling scrum for teams that work on a single product (Schwaber & Sutherland 2020).

Methods from the Agile family do not usually constitute a complete alternative to traditional methods of managing the software development process. However, their skilful use permits replacement of the traditional approach in software development (Bławucki, Ramanovich & Skublewska-Paszkowska 2020).

2.2. Key IT Tools Supporting Agile

Both the Revolution 4.0, and other factors, such as the COVID-19 pandemic, have significantly influenced the growing need to use information technologies to manage organisations and direct people's work. Among the key technological solutions supporting Agile in modern organisations, the following are prominent:

– collaboration and communication development tools,
– tools supporting the automation of tasks,
– technology platforms.

When it comes to collaboration and communication tools, how do they change jobs? Marion and Fixson (2021) summarised how the impact of digital tools on indi-

viduals, project teams, and organisations has changed. They highlighted the main changes: broader process integration, higher performance, lower barriers to entry, and new types of tools for collaboration and workflow.

Lim (2017) points to the advantages of using collaboration and communication tools synchronously and asynchronously. The main utility of synchronous communication tools (video conferencing, web conferencing, audio conferencing, live chat, whiteboarding, application sharing) is real-time interaction, demonstration, and co-development of documents, involving a certain number of people, etc. On the other hand, asynchronous communication tools, such as, discussion forum, e-mail, weblogs enable cooperation and sharing of ideas, greater reflection on the topic under discussion, sharing of training materials, privacy of communication, group communication, etc.

The second category of technological tools supporting agile organisations is those supporting the automation of tasks. The need to use and develop these tools comes directly from the assumptions of Revolution 4.0, the concept of which provides for the automation of work. Automation of tasks is possible thanks to, among others, internet services and mobile applications. There is no doubt that it facilitates and improves everyday work. The main advantage of task automation tools is that "non-technical workers" can easily manage devices via, for example, an application on a smartphone or tablet (Coronado & Iglesias 2016). The authors confirm that with time there are more and more new solutions that allow work to be automated. Sampson (2021) claims that automation of tasks provides certain advantages: focusing on improvement, considering a variety of solutions, and an increase in the availability of highly qualified positions.

Another group of tools that support agile organisations is technology platforms. They are considered to be "a valuable policy instrument to assist a multi-stakeholder formulation and implementation of long-term research and development (R&D) programs in specific technology areas" (Proskuryakova, Meissner & Rudnik 2017). Among technology platforms, there are cloud platforms, Open Data platforms, API platforms. All the platforms are used in IT projects where the required production capacity is unknown (Szyjewski & Niemcewicz 2016), and this is particularly important from the point of view of agile organisations.

2.3. Digital Competencies

The dominant presence of information and communication technologies (ICTs) in advanced societies, the incorporation of a cultural vision of education, and the application of psychological theories based mainly on constructivist perspectives make it possible to consider new approaches to education and preparing employees to enter the labour market. Revolution 4.0 is bound to increase demand for workers

with high competencies. Furthermore, employees should also be aware of the necessity to develop skills and competencies through the lifelong learning paradigm (Susskind 2020).

A review of the literature indicates that among the most desirable competencies in the era of digitalisation are:

– advanced cognitive skills for problem-solving,

– skills supporting teamwork,

– combinations of skills which allow employees to be flexible and to adapt rapidly,

– advanced reasoning skills.

In addition, more and more researchers are highlighting the need to develop digital competencies as key not only to the success of workers in the labour market but also as a key aspect of the successful implementation of Industry 4.0 (Flores, Xu & Lu 2020). Soon, skills that go well beyond the iterative skills needed in the age of computerisation will be necessary – developing digital competencies is bound to be a proper response.

So far, there is no universally agreed definition of digital competencies. Digital competencies are a collection of "knowledge, skills, and attitudes" which are crucial for people to function in a highly digitised world (Głomb *et al*. 2019), or a set of basic knowledge, skills, abilities, and other characteristics that enable people at work to efficiently carry out their tasks involving digital media at work (Oberländer, Beinicke & Bipp 2020).

In other words, digital competencies give employees opportunities to actively participate in creating, consuming, and critiquing our contemporary digital workplace. Swan (2015) points out that in an age when information noise surrounds everyone through the media or the Internet, the key skill of the 21st century is the ability to study content and evaluate its quality.

3. Methodology

In this work the research tool used was a questionnaire. Surveys are one of the basic research tools in management sciences. They consist of a series of questions addressed to a specific group of respondents who answer them by choosing one of several available options or by entering their own answers. Surveys are particularly useful in management research because they allow for quick and effective acquisition of large amounts of data from a range of respondents.

The study used an interview questionnaire, which generally contained questions about the level of Agile implementation in the organisation, Agile implementation and support areas, issues that require support, barriers to implementation, and

implementation results. Some of the questions in the form focused on examining the use of digital tools in Agile methodology. Among these questions were:

1. What is the level of adoption of Agile in your company/organisation today?
2. What are your main application areas?
3. Do the following roles exist in your company/organisation?
4. What essential technological bricks have you implemented to apply the Agile approach – Collaborative Tools?
5. What essential technological bricks have you implemented to apply the Agile approach – Task Automation Tools?
6. What essential technological bricks have you implemented to apply the Agile approach (Technology Platforms)?
7. What Agile Good Practices do you currently apply?
8. How do you primarily measure the success and benefits of your Agile efforts?

In 2019, a survey was conducted among Polish companies to assess the level of Agile implementation.

In order to reach as many respondents as possible, the test data was obtained by publishing the survey form in selected:

– business social media,
– groups for project managers,
– newsletters addressed to project managers.

This method allowed us to reach and submit a survey request to about 200 employees of various organisations operating in many different sectors of the economy throughout Poland. These companies were characterised by the fact that they use or are introducing Agile project management methodology. With regard to the replies received, 50 usable questionnaires from respondents were received, indicating a 25% response rate.

Concerning the size of the organisation and the sector, 30% of the respondents represented small and medium-sized enterprises and 70% were large enterprises. 10% of the surveyed companies were related to administration and investments, 34% to the research and development industry, 38% to consulting, and 18% to media and telecommunications services.

4. Results

4.1. Assessment of Agile Approach in Polish Enterprises

The main objective of the study was to assess the level of Agile implementation in Polish enterprises. The first part of the results relates to the evaluation of the Agile approach.

Table 1 presents the level of adoption of Agile in Polish companies, when the survey was conducted.

Table 1. Level of Adoption of Agile

Responses	%
Experimental	32
Used in project management	30
Used for all business activities	4
Standardly used in all IT operations, scaled up	6
Extended to IT operations	10
Extended to support all departments and areas of the company	6
Others	12

Source: the authors.

The study showed that, in 2019, 32% of the surveyed companies were at an experimental level of adoption of Agile. 30% of the surveyed companies were using Agile in project management and 10% extended it to IT operations. Among the surveyed companies, 6% used Agile in all IT operations, 6% extended the Agile approach to support all departments in a company and only 4% used it for all business activities. 12% of respondents assessed their level of Agile adoption as "different" to those included in the questionnaire.

Table 2 presents the main areas of Agile adoption.

Table 2. Agile Main Adoption Areas

Responses	%
Creation of innovative services/products	34
Important projects with high visibility in the organisation (e.g., mobile applications)	26
Digital projects	24
Piloting – Proof-of-Concept (PoC)	22
Transformation of the way information services are managed	22
Transformation to scale information services	12

Source: the authors.

When asked what the respondent's main application areas of Agile are, respondents could choose the two most significant responses for their organisation. 34% of respondents chose creation of innovative services and (or) products; 26% selected important projects with high visibility in the organisation; 24% indicated digital projects; 22% chose Piloting – Proof-of-Concept; 22% chose transformation of the way information services are managed and 12% chose transformation to scale information services.

Table 3 presents what Agile-related roles existed in the surveyed companies.

Table 3. Roles in the Organisation

Responses	%
Product Owner	54
Scrum Master	36
Agile Coach	14
Release Train Engineer	10
Community Leader	6

Source: the authors.

When asked about the existing roles in the company, the respondents answered as follows: the role of Product Owner existed in more than half of the surveyed companies (54%), 36% of the surveyed companies had the role of Scrum Master, in 14% of the surveyed companies there was an Agile Coach, 10% of the surveyed companies had the role of Release Train Engineer, and in only 6% of the surveyed companies did the role of Community Leader exist.

4.2. Assessment of Technological Bricks in Polish Enterprises

The second part of the results relates to the assessment of technological bricks in Polish enterprises. Table 4 presents the collaborative tools that the surveyed companies have used to apply the Agile approach.

Table 4. Collaborative Tools

Responses	%
Video conferences/chat	56
SharePoint	36
Gates	8

Source: the authors.

The surveyed people indicate three main collaborative tools: 56% have used video conferences and chat for interactive communication, presenting and sharing files, and information exchange; 36% have used SharePoint to manage, publish and disseminate information between users in the corporate network and 8% have used Gates as tools and templates to evaluate stages of development.

Table 5 presents what task automation tools surveyed companies have used when it comes to Agile methodology.

Table 5. Automation Tools

Responses	%
Automatic testing	38
Bug analysis	24
Release automation	18
Self-provisioning	8
Orchestration of services	6

Source: the authors.

In the midst of the current technological revolution, automation is becoming more and more common. 38% of respondents declared the use of tools for automated testing, 24% for bug analysis, 18% for release automation, 8% for self-provisioning, and only 6% for the orchestration of services.

Table 6 presents what technical platforms surveyed companies have used to apply the Agile approach.

Table 6. Technical Platforms

Responses	%
Cloud platforms	54
API platforms	24
Open data platforms	16
Others	6

Source: the authors.

When asked about the use of technology platforms supporting Agile, respondents indicated: cloud platforms (54%), API platforms (24%), and open data platforms (16%). 6% of respondents answered that they use other platforms.

4.3. Assessment of Good Agile Practices in Polish Enterprises

The last part of the research results is related to good practices in Polish enterprises. Table 7 shows which Agile Good Practices the surveyed companies currently apply.

Scrum was implemented in 50% of the surveyed companies, Kanban in 40%, and DevOps in 28%. Test-driven Development was applied by only 12% of the surveyed companies, the same was the case with Scaled Agile Framework. The least frequently used practices were eXtreme Programming (6%) and Large-scale Scrum (2%).

Table 7. Agile Good Practices

Responses	%
Scrum	50
Kanban	40
DevOps	28
TDD	12
SAFe	12
XP	6
The LSS	2

Source: the authors.

Table 8 shows how the surveyed companies primarily measure the success and benefits of their Agile efforts.

Table 8. Success and Benefits of Agile – Measurements

Responses	%
Shortening the time of project implementation	20
Increased customer satisfaction	14
Speed of adoption of solutions by users	12
Reduction in the number of errors (production errors, software bugs)	8
Development of a culture of cooperation within the company	6
Increasing the number of employees trained in Agile techniques and tools	4
Others	10

Source: the authors.

In response to the question about how to measure the success and benefits of their Agile efforts, the answers were as follows: 20% of the surveyed companies have measured their success by a shortening of the time of project implementation, 14% by increase in customer satisfaction, 12% by the speed of adoption of solutions by users, 10% by others (not indicated in the survey), 8% by a reduction in the number of errors, 6% by the development of a culture of cooperation, and finally, 4% by increasing the number of employees trained in Agile techniques and tools.

5. Conclusions

The main purpose of the study was to assess the level of Agile implementation in organisations in Poland. A survey conducted in 2019 among Polish enterprises showed that the level of Agile implementation varies: some companies have

implemented an Agile approach only in selected areas of activity, while others are only experimenting with Agile. On the other hand, the respondents' responses to the questions about the presence of Agile roles in the organisation confirm that the Agile approach has even been implemented for organisational structures. The role of Product Owner is present in more than half of the surveyed companies, and the Scrum Master role in slightly more than 30% of companies. This is consistent with to the implementation of Agile Good Practices. As many as 50% of respondents say that they use Scrum and 40% that they use Kanban. Practices such as DevOps, TDD, or SAFe enjoyed much less interest from the surveyed companies.

In this paper, the results of research on the assessment of technological bricks in Polish enterprises deserve special attention. The results showed that among the collaboration tools, the surveyed companies most often chose videoconferencing and chats. The literature confirms the practical advantages of using such tools, especially in dispersed organisations.

The results of the conducted research confirm that today's economic reality forces innovation, thanks to which it is possible to achieve a competitive advantage. In search of innovation, organisations are leaning towards Agile. The study shows that in 2019 companies mainly used the Agile approach for the creation of innovative services and (or) products.

Additional support for the implementation of Agile in organisations is provided by technological tools that support communication, cooperation, projects, and processes. Additionally, the application of Agile Good Practices plays an important role in agile organisations. The increasing popularity of the use of information technologies, not only in agile organisations but in general, requires employees and managers to improve their digital competencies. This is particularly important in an era of increasingly widespread digitalisation and automation. When it comes to task automation tools, the surveyed companies most often use automated testing tools (this may be because the Agile approach is most often used in software companies whose products need to be tested), bug analysis, and release automation. Technical platforms are another issue. The survey showed that as many as 54% of the surveyed companies used cloud platforms.

6. Discussion

The literature indicates that the success of Industry 4.0 depends, to a large extent, on skills and competencies primarily related to the development and implementation of key advanced technologies, as well as on the development and use of a new business process that proposes a new paradigm for digitalisation and networking.

The extensive use of technologies that automate routine activities and enrich human workplaces impose huge demands on organisations, businesses and business models, the public sector, and employees. It also poses challenges to the educa-

tion and training system, which needs to provide multidisciplinary education in professional and academic institutions, lifelong learning, continuous upskilling and competency development. These institutions must also work with the latest productivity tools in distributed online environments and teams (Leitao *et al*. 2020).

The increasing pace of innovation and technological development, and increased customer demand for bespoke products has led to rapid changes in the business environment. One of the solutions for modern organisations is the Agile approach (Olak 2017). The main determinants of an agile organisation were distinguished by Yusuf, Sarhadi and Gunasekaran (1999). These are:

– speed and flexibility,
– response to changes and uncertainty,
– high quality and highly customised products,
– products and services with high information content and added value,
– launching key competencies,
– response to social and environmental issues,
– synthesis of various technologies,
– integration both within the enterprise and between enterprises.

The results of research in the field of technological bricks evaluation indicate the need to improve digital competencies in accordance with the DigComp model (Vuorikari *et al*. 2016), which distinguishes five areas of competence:

– information,
– communication,
– content creation,
– security,
– problem-solving.

As for the practical implications, this article may provide guidance for management organisations and practitioners in the context of collecting and defining digital competencies and the directions in which the digital competencies of employees should develop. In addition, practitioners planning to implement Agile using digital tools receive tips on what to expect when implementing Agile Good Practices. It can also help with better Agile implementation (Fuchs & Hess 2018).

This work has its limitations. The study group consists solely of Polish companies. Further research should expand to other countries so as to also examine the cultural context of the use of digital tools in Agile. This is one of the most important directions for scientific research in the field of management and Agile methods (Zakrzewska *et al*. 2022). It is also recommended that the research on the level of Agile implementation in Poland is repeated, primarily to check whether the level of implementation has changed and whether the implementation has spread to other key areas of the company. In the future, it is recommended that a larger group of companies be studied so as to be able to analyse the level of Agile implementation,

the use of Agile best practices, and the use of IT tools in companies of different sizes, in different sectors, and with different business models.

In the future, it is also worth examining whether recent years have seen new technological solutions that are tailored to the needs of a changing environment appearing on the market, e.g., the COVID-19 pandemic, which has led to much greater interest in and development of the Agile approach and flexible management models.

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