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## Evolution of the military project management concept. Introduction to low-code and no-code project management

Original article

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### Abstract

**Objectives:** The overriding research goal is to describe and analyze the evolution of the change in the concept of military project management and the impact of the use of modern low-code and no-code technologies on this area.

**Methods:** The main research method used in the work is desk research, which allowed for searching, collecting and analyzing information from existing sources, and then formulating conclusions on the basis of the researched problem. Subsequently, an empirical method was used - participant observation, which allowed the observation of risk management processes in the implementation of military projects.

**Results:** Currently, there is a noticeable tendency to transfer solutions from the civil to the military sector. This is confirmed by the description and analysis of the most important technical and management solutions used in military projects over the years.

**Conclusions:** The author argues that currently there is a noticeable tendency to transfer solutions from the civil to the military sector. This is confirmed by the description and analysis of the most important technical and management solutions used in military projects over the years. Research points to LCNC solutions as a technology with significant potential to be used to develop digital solutions faster with minimal risk and time. The LCNC project management methodology was presented along with key roles that can be used in military projects.

## Introduction

Technology has always influenced security by being used to wage wars. In the 1980s, Paul Forman noted that we are witnessing a shift from the primacy of science over technology to the primacy of technology over science (Forman, 2007). In the literature on the subject it can be find such terms as: revolution in military matters, scientific-military revolution or scientific-technical revolution. Unfortunately, there is currently no single clear definition of the term technology-induced revolution in military matters. It should be pointed out that the key elements leading to understanding the issue are: changes in the way of warfare and organization of the armed services (Lekowski, 2019, pp. 265-283) and the importance of technology on the battlefield, the harbinger of which was the introduction in 1988 of GPS global positioning system for soldier equipment (Kruszyński, 2011, pp. 76-77.).

Among the leading researchers dealing with the issues of revolution in military affairs include, among others, John Baylis, Eliot A. Cohen, Colin S. Gray, John Arquill, Jacob W. Kippa and Michael Rask. As the latter noted, the issue of changes in military matters is one of the most dynamic debates in the area of security and defence. In the article entitled *The Five Waves of RMA Theory: Processes and Debate* published in 2011 distinguished five debates on revolution in military matters (Raska, 2011, p. 1.). The first concerned the beginnings of changes in military affairs. The second took place in the early 1990s and involved its use in the USA. The third, in the late 1990s, concerned the future of using new technologies in security. The fourth at the turn of the 21st century was associated with a shift of interest towards the transformation of defense ( Raska, 2011, p. 3). At that time, researchers tried to answer questions about the issues of transformation in the military area. Including, among others changes in the security environment after 1991 and 2001, the importance of new technologies for national security, the need for risk management in the case of commanding the armed forces, organizing a military operation, managing institutions and finally planning risk. The fifth and last debate started in 2005, in which efforts to deepen the process of robotization, automation and network-centricity are emphasized (Wójtowicz, 2015, pp. 77-80). It is the recent debate on the use of technology to deepen the automation and robotization process that points to an important direction in the development of technology and management methods.

The development of technology, which has accelerated especially during the Covid-19 pandemic, has a significant impact on the security sector. The analysis of the issue of the influence of technology on security can be considered, on the one hand, in terms of threats, and on the other hand, the opportunities they bring. The author undertakes an analysis of the use of technology in favor of management in military projects. Thus, the subject of this work is the evolution of the concept of management methods in the military sector. The purpose of this article is to introduce the subject of project management using low-code and no-code technologies (hereinafter: LCNC), which can be used to automate and robotize repeated processes in military projects and accelerate the development of project products. The current level of advancement of LCNC technologies allows to hypothesize that their maturity can effectively accelerate and, above all, eliminate unnecessary, repetitive activities in projects of strategic importance in the security sector. This hypothesis is supported by scientific research

conducted by the Department of Innovation at the Ministry of Defence, the results of which are described in the monograph entitled *Priority directions of scientific research in the Ministry of National Defence in the years 2021-2035*, the aim of which was to "(...) indicating the directions of development of defence technologies, which, when implemented into military technology, will allow the Polish Armed Forces to achieve operational capabilities corresponding to the needs of the future battlefield." (MON, 2023, p. 5). The paper identifies 15 technological areas of particular importance. It should be noted that among them the first places were: (1) Artificial intelligence, (2) Autonomy and autonomisation, (3) Analysis, processing and management of large data sets (MON, 2023). Each of the above technological solutions benefits from the support of LCNC (especially in the area of: (2) Autonomy and autonomisation), which facilitate and accelerate the process of product production through, among others production management. This is evidenced by a significant increase in publications dealing with the use of LCNC solutions. On Google Scholar, the results for a no-code query are: 6,760,000, while for low-code: 7,800,000 (Data from 11.11.2023). It is also worth mentioning the most important IT solutions in the area of building machine learning algorithms using LCNC: Amazon SageMaker (a solution enabling the construction and implementation of machine learning models, which also provides a selection of templates for the most popular types of ML applications), Akkio (implementation of artificial intelligence, as the creators of the solution assure, is possible within 10 minutes without the need for coding or analysis skills data. The solution enables the creation of artificial intelligence-based workflows with an emphasis on enabling their rapid implementation and evaluation. It also offers an extensive integration suite), Apple CreateML (the solution offers a drag-and-drop functionality that makes it easy to create iOS applications that include recommendations, classification, image recognition and text processing. Data can be collected using the iPhone's camera and microphone), DataRobot (a cloud-based platform offers tools for automating data preparation, as well as creating and implementing algorithms, with dedicated models for industrial applications, from banking and retail to healthcare, manufacturing and public sector bodies).

It is also worth pointing out the actions taken by the United States Army Office of Enterprise Management (OEM), which is responsible for effectively developing data-driven management practices throughout the armed services to improve efficiency in the delivery of trained and ready forces. As part of its activities, the OEM annually announces a competition titled: *Deep Green Data Science and Artificial Intelligence (AI)*, which aims to prepare employees to use and operationalize artificial intelligence, machine learning and deep learning. This year (2023), the OEM office recommended the No-Code Deep Learning tool developed by H2O.ai. The solution allows DoD data workers with limited or no coding experience to participate in the competition and better understand deep learning and artificial intelligence best practices. The program allows users, without advanced programming knowledge, to build semantic segmentation models with an easy-to-use user interface. As Dr. Millar emphasizes, "One of Deep Green's goals is to train members of the Department of Defense in best practices in data analytics, artificial intelligence and computer science. "No-code tool lowers the bar for entry, enabling everyone to participate and learn best practices in deep learning. The Deep Green Initiative helps drive innovation, knowledge and

increase technology adoption at all levels of leadership and across all domains.” (U.S. Army, 2023).

In the first part, the specific area of military project management will be presented. The trend will be indicated from the transition from strictly military project methods to civil ones, and from civil management solutions to military ones. In the second part, the area of LCNC technology will be described, the development of which allows for the construction of advanced IT solutions with relatively organic technical competence. The LCNC project management methodology will be described, the application of which is independent of the LCNC platform. The article ends with conclusions related to the possibilities of using technology in the area of security.

Bearing in mind due diligence in definitions, the definition and differences between technology and technique should be clarified here, because both concepts are often confused, which can lead to definition problems. Within the framework of this article, technology is considered to be a method of preparing and conducting the process of producing or processing some good or information. Technique, on the other hand, is a field of activity involving the production of phenomena and objects that do not occur naturally in nature. In simpler terms, technique means, ways and activities related to the production of goods, and technology is the science of methods, e.g. processing and tooling of information, which is the result of the work of a device created as part of technical activity (Kopaliński, 2000). Research in the field of technology is most often carried out by engineering and technical sciences. It should be noted that the development of technology is most influenced by the evolution of society, the requirements of which determine the work on inventing all kinds of new inventions to ultimately meet the given needs.

### **1. The specifics of military project management**

In order to analyze the area of military project management, one can observe changes in the approach to conducting research and development works, management culture, changing environment and project risks. The above changes are the result of globalization processes, new categories of threats, the need to modernize the armed forces adapted to new threats and the growing costs of developing defense solutions.

At the turn of the years, in the management process in the defense sector, there have been many changes in the approach to methods, techniques, etc., management. Undoubtedly, it can be said that in the past, defense needs were the driving force behind many classic management approaches, which were then applied in the civil sector.

The most important approaches developed strictly for military purposes include: Integrated Computer Aided Manufacturing Definition (ICAM) a US Air Force program that develops tools, techniques and processes to support manufacturing integration. The ICAM program was established in 1976 and was administered by the United States Air Force at Wright-Patterson as part of their technology modernization efforts. The program initiated the development of a series of standards for modeling and analysis in business management and improvement, called Integrated Definitions (IDEF) (Savage, 1996, p.184). IDEF stands for a family of modeling languages that cover a wide range of applications from functional

modeling to data, simulation, analysis, and object-oriented design and knowledge acquisition. Eventually, IDEF methods were defined up to IDEF14 (IEEE, 1998, pp. 1-199). Particularly noteworthy is IDEF 0, i.e. a modeling methodology for describing production functions through a modeling language for analysis, development and integration of IT systems, business processes and software engineering analysis (Lightsey, 2001). Its effectiveness in the implementation of military programs and projects gave rise to the implementation of strategic armaments programs financed by the US Department of Defense.

In the years 1950-1970, many classic management methods and techniques were developed, which found civilian applications. This gave rise to modern concepts of strategic management as well as many other detailed methods and techniques of management, including in particular forecasting and planning methods such as: the Delphi method, the PATTERN goal tree method and the pioneering Planning, Programming and Budgeting System (PPBS) method, which enabled the Air Force to manage the huge costs of modern, for those times, military technologies and weapons systems. This three-stage process involved planning and reviewing requirements, formulating and reviewing multi-annual programs, and developing annual budget estimates (Czajkowski, 2012, p.114). A special role at that time was played by such think tanks as the RAND Corporation (currently, the RAND Corporation is an American non-profit organization with a global reach, operating as a think tank) (Medvetz, 2012, p. 26) and the Defense Advanced Research Projects Agency (DARPA ), which is thought to account for three quarters of world innovation (Jacobsen, 2015, pp. 46-50), (RAND, 2023). Selected organizations make it possible to indicate the evolution of security-oriented research programs towards the perception of threats, starting from the so-called hard threats related to war, to those based on, for example, bioterrorism (pandemics of infectious diseases).

## **2. Civil management concepts**

Even a cursory analysis of the evolution of management methods puts forward the thesis that nowadays we are more and more often dealing with a reverse process than before, i.e. management methods and techniques for civilian needs are used in the military sector. The attractiveness of civilian solutions for the armed forces increases with a clear improvement in the technical and operational parameters of the products, an increase in the capabilities of the technologies used, the speed of production of the project product, as well as new directions of research, the results of which may potentially be of great use in the armed services.

An example of civil concepts can be solutions initiated in such enterprises as: Toyota, where the Toyota Production System concepts were developed (Ohno, 1988, pp. 1-17). Within which the fundamental element is to reduce waste. This was manifested, for example, in the pursuit of a lack of stocks (Just-In-Time) by appropriate modification of the process. Another element was solving problems at the source and when they occur. In practice, every worker in the factory could stop the entire production line when he saw a problem (Jidoka). It's also a great way to highlight problems. Toyota also recognized that continuous

improvement couldn't happen without getting your hands dirty right where the problem occurred (which, in Toyota's case, meant the factory). The principle of Genchi genbutsu was "go and see for yourself". Toyota also put a lot of emphasis on "visual management". One of the more interesting "inventions" was the kanban system (the progenitor of the currently known Kanban system), which transferred information within and between processes on "command cards". The Toyota Production System described above is often referred to as "Lean Production", emphasizing that it is about industry. Thus, Lean Management means "lean management", i.e. it is the transfer of the Toyota Production System concept from production (industry) to management (Liker, 2004, pp. 19-45). A breakthrough event for the popularization of lean management was the publication in 1990 by a group of researchers associated with the Massachusetts Institute of Technology (MIT) James Womack, Daniel Jones and Daniel Roos of the book *The Machine That Changed the World*. It was created on the basis of thorough research conducted by MIT entitled International Motor Vehicle Program since 1980 (Holweg, 2007, pp. 420-437). IMVP is the largest car market research in history (Womack, Jones, Roos, 2007, pp. 3-9). In the 1960s and 1970s, solutions developed by Toyota began to be copied by other Japanese car manufacturers such as Hino Motors, Daihatsu, Mazda and Nissan.

In 1986, the Harvard Business Review published an article entitled *The New New Product Development Game* by two Japanese professors Hirotaka Takeuchi and Ikujiro Nonaka. They analyzed the work of several teams and projects from the most efficient global companies such as Honda, Fuji-Xerox, 3M, Hawlett-Packard and others. They put forward a thesis that the old (classic cascade) way of creating new products was created for the needs of NASA's space programs (collecting the best practices and experience of IT projects implemented in the agency since 1976) (Nasa, 1992), is a defective system. From the research, it turned out that the most efficient teams used a process of overlapping activities, which was faster and more flexible. In addition, the teams were autonomous, complemented each other and made decisions on their own. Japanese professors likened these teams to a rugby team and found that the best of them worked like rugby players in a mill (Takeuchi & Nonaka, 1986, pp. 137-146).

Seven years later, the 1986 article *The New New Product Development Game* was noticed by Jeff Sutherland, who was working at Easel at the time, looking for a way to organize his team. Even though the article was about production, not software development, Jeff and his team decided to use a new method. It turned out to be so fascinating that he devoted himself entirely to improving it. This is how the Scrum method was formally born. Scrum was formalized as a software development method by Ken Schwaber in 1995. Jeff Sutherland and Ken Schwaber at the Association for Computing Machinery (ACM) conference presented the article "SCRUM Development Process" in which they described a new way of building software (Schwaber, 1995).

In 2001, at the Snowbird resort in the US (Utah), a group of supporters of a new approach to software development, which is an alternative to the traditional approach based on the waterfall model, gathers. As a result, the so-called *Manifesto for Agile Software Development*, which is a declaration of the core values and principles of the so-called agile. The first part of the manifesto consists of four short statements that simply and clearly reflect

the philosophy of agility. The whole thing is very closely related to the principles adopted in the Toyota Production System concept (History: The Agile Manifesto, 2001). In 2001, Ken Schwaber and Mike Beedle publish the first and now cult book entitled *Agile Software Development with Scrum*. In 2003, the position titled *Lean Software Development: An Agile Toolkit*, which presents lean software development based on adaptations of the Toyota Production System for the IT environment (Poppendieck, Poppendieck, 2003). Also in 2003, the concept of Customer Development is developed and published by Steven Blank in the book entitled *The Four Steps to the Epiphany: Successful Strategies for Products that Win*. It marks the beginning of the later concept of Lean Startup, an approach where MVP product concepts are produced before building the final product. The approach is basically to check whether the MVP of the product will find buyers on the market. It also allows to test functionalities before entering the significant production costs of the product. In 2011, the concept of Lean Startup is developed by Eric Ries in the book entitled *The lean startup*, according to which a startup is an organization created to form a new product or service in an environment of great uncertainty. This uncertainty means that until a profitable business model is found, the most important process in the company is the learning process (i.e. going through the cycles of building, measuring results, learning as quickly as possible). However, this learning cannot take place in isolation from customers, i.e. without customer development. However, the learning process is based on scientific methods, e.g. on measuring appropriate indicators so as to constantly reduce this uncertainty.

### **3. Introduction to LCNC and Citizen Development**

Changes caused by globalization processes, growing competition, the emergence of new players on the market, pressure to improve quality, reduce costs, delivery times, the rapid pace of scientific and technical progress, and cyber threats have created new demand and requirements for management methods and techniques. What used to "work" is now becoming useless. The earlier, above, analysis of management processes in the civil sector indicates that currently special emphasis is placed on: increasing the intellectual capital of the organization, emphasis on quality and customer needs, quick change management, flexibility, innovation and technological progress.

The current, most innovative, management methods and technological solutions meet the above criteria. They allow to design mock-ups of the project product, automate work faster than ever before. Unfortunately, they are still less known in the military sector due to their primary civilian character, but this does not mean that they are not attractive to this sector. These technologies are low-code and no-code and the management solutions in accordance with the Project Management Institute (PMI) publication: *Citizen Development: The Handbook for Creators and Changemakers* (PMI, 2021).

The result of the development of the LCNC project management methodology is the emergence of technology, which is the result of the natural evolution of programming

languages. Most IT-savvy people know that in the beginning there was a binary system that replaced mechanical programming.

The development of the assembly language gave rise to a family of low-level programming languages where one instruction essentially corresponds to one processor instruction. The use of assembly language languages has eliminated a significant part of the error-prone, time-consuming first-generation programming that was required for early computers. They freed professional programmers from memorizing numerical codes and manually calculating addresses. They were widely used until the 1980s and 1990s, where their use was supplanted by higher-level languages that allow to increase the efficiency of programming. The prototype of the first assembler is considered to be the electromechanical system for the preparation of a perforated tape constructed by Konrad Zuse in 1945 with a program for the Z4 machine in the form of the Planfertigungsteil module, which made it possible to enter and read commands and addresses in a human-understandable way (Dasgupta, 2014, pp. 191- 192). However, the author of the first actual assembler is considered to be Kathleen Booth (David Cassel: Kathleen Booth, Creator of the First Assembly Language. 2022-11-06. [accessed 2023-01-28].), who in 1947, in cooperation with John von Neumann and Herman Goldstine at the Princeton Institute for Advanced Studies developed the first assembly language (Birkbeck school of Computing, 2023). Today, assembly language languages are still used to manipulate hardware directly, to access special CPU instructions, or to address critical optimization problems.

Over time, programming changed, and the languages developed began to reach higher and higher levels of abstraction. The available languages vary depending on e.g. from the system level, functional or object-oriented. The real revolution turned out to be functional programming.

In 1987, the Functional Programming Languages and Computer Architecture FPCA'87 conference was held in Portland, Oregon. During the conference, a decision was made to create a committee to design a new functional language. This is how the Haskell functional programming language was born. The name of this language comes from the name of the famous logician Haskell Brooks. Haskell is a functional programming language, just like Erlang or Lisp. Compared to other technologies of this type, it is a purely functional language. This means that programmers using this language have the ability to write with pure functions, so they can focus on the result of the operation, not on the steps that lead to it (Thompson, 1999) In this regard, Haskell is considered a pioneer because it offered an even higher level of abstraction, avoiding many of the lower-level programming details characteristic of previous languages. Thus, it can be assumed that functional programming was the precursor of LCNC.

The current pace of development requires the maximum use of technology. Automation, Machine Learning and Artificial Intelligence (AI) have eliminated a lot of complexity, thanks to which advanced technologies can be used by people without the need to know how it works. Citizen Development, i.e. the emerging movement of Low-Code (low-code platforms) and No-Code (no-code platforms) - LCNC - is one of the most important factors accelerating the current digital transformation. They allow to create applications



without the need and skills of coding (or with little coding on Low-Code platforms). This is evidenced by the trend indicating the rapid penetration of LCNC platforms in enterprise environments (Sanchis et al., 2019).

In short, it can be said that No-code is a rapidly developing trend in technology. It consists in the fact that more and more tools are being created that allow to create advanced IT solutions without the need to use the services of a programmer and without programming skills. There is a huge shortage of experienced developers on the market today, and many apps work similarly. Enterprise resource management (ERP) applications (task and project management applications) are becoming particularly popular. Therefore, ideas were born to fill this gap. Tools have begun to be developed that can be used by people who are not advanced programmers to build their own applications, e.g. to automate boring work. Low-code, on the other hand, is nothing more than low-code platforms. Using them requires knowledge of a given programming language in order to modify ready-made scripts. In this case it have access to the source code, which can be freely - manually - modified. Low-code solutions are already widely known and used by developers.

The use of LCNC makes it possible to minimize bottlenecks in the process of creating solutions. Services and products are delivered faster and at a lower cost. This is especially important for industries characterized by a lower level of digitization, where the implementation of advanced solutions, i.e. digital transformation, is associated with high costs and time-consuming stages. Digitization of processes at low costs and high flexibility using LCNC allows to reduce costs, risks and accelerate the implementation of changes (Cai et al., 2022, pp. 1840-1845).

This creates new opportunities for the development of new competencies, democratizes access to technology for non-IT people. The Gartner organization predicts that already in 2023 the number of Citizen Developers, i.e. specialists who design professional programs and applications without the need for programming, will be four times higher than in the case of professional programmers (Gartner report, 2023).

What can be developed with no-code solutions? It all depends on expectations. From websites, e-commerce solutions, applications for various operating systems and web (for most operating systems: Windows 10, Android and iOS). The developed applications can automate background work, serve clients to arrange meetings, employees to automate repetitive work or eliminate errors, etc. It is worth mentioning about building prototypes. Having an idea for a solution, first, before entering into high costs it should be verified the idea by creating the MVP of the project product by examining the interest of potential interested parties. In this area, no-code meets expectations, because creating prototypes is much simpler, but also cheaper (Table 1).

**Table 1. Comparison of No-Code solutions with traditional approaches to product development**

Comparison area	Traditional (present) approach	No-code solution
Implementation team	A team of professionals	One person
Required competencies	Extensive programming experience (Windows 10, Android, iOS, macOS)	No programming skills required (e.g. business analyst)
Time (MVP prototype)	2-3 months	2-5 days
Cost (MVP prototype)	>> 200 man-days	2-5 man-days
Time (ready solution for Windows 10, Android, iOS, macOS)	Couple months	Several days
Costs (ready solution for Windows 10, Android, iOS, macOS)	>> 1000 man-days	person-days/-weeks
Modifications	Difficult, Time-consuming, Costly	Minutes-hours, Designed for easy changes
Investment risk	Very high (among others due to prototype costs)	Minimal (ad-hoc generated prototypes)

Source: Own study

It is estimated that by 2030, 500 million applications will be designed, of which 400 million in LCNC technology. The above data on the popularity of LCNC platforms with the simultaneous lack of standards and methods that would allow for safe development and scaling of applications clearly indicated the need to develop them. That is why the leading decision makers of the IT and business world created the methodology and framework of procedures that can be used to create applications tailored to the needs of the organization, regardless of the LCNC supplier. Tips and good practices are included in *Citizen Development: The Handbook for Creators and Changemakers*, developed are designed for anyone who wants to turn ideas into reality. Especially for organizations and people who see opportunities to change and improve their own work, where the speed and time to market of products are key. The methodology distinguishes three main groups that enable the development of Citizen Development: practitioners, architects and strategists:

- *practitioners* - Citizen Developers who use modern LCNC platforms to create applications, are responsible for operational work.
- *business architects* - manage teams of Citizen Developers, the management process and cooperation between stakeholders in IT and the environment. They facilitate access to the right tools and methods. They can come from the IT department, be Agile Coaches, Product Owners, Project Managers.
- *strategists* - manage and lead the creation of an operational environment that enables Citizen Development to grow, introduce cultural practices that foster scaling development and drive organizational transformation through the use of LCNC. They are usually members of senior management.

The speed at which applications can be developed requires the right framework and workflows to help securely deliver projects. The discussed methodology consists of five elements forming the so-called Citizen Development Canvas, the use of which allows to build, manage and scale Citizen Development for the entire organization. The Project Delivery and Capability Development components contain guidelines to equip Citizen Developers with competencies that will allow them to successfully design and create advanced applications. The Operating Model and Organization Alignment components, on the other hand, concern the management and scaling of Citizen Development in the organization by Business Architects and Strategists.

Project Delivery explains what Hyper-Agile SDLC is: the life cycle of software delivery based on the principles of agile management, its use allows to design, build and implement applications tailored to Citizen Development initiatives. Ideation 2.0 is used to generate ideas, i.e. a method that combines brainstorming with real-time application development. Depending on the risk and complexity of the project, applications can be created independently by Citizen Developers or with the support of the IT department, which is defined in the Suitability Assessment.

Capability Development includes the following elements: Business Analysis and Design (how to design applications), Enterprise Risk Requirements (focuses on functional and non-functional requirements of applications), Application Development (covers steps related to gathering all information in previous modules and using them to design and develop applications and then successfully implement them).

The third component is the Operating Model. Its purpose is to present the organizational structure, roles and responsibilities in teams, as the introduction of Citizen Development will undoubtedly affect the way the organization operates. The Competency Center, Community of Practice and hybrid models of operational work will be presented. As part of the methodology, tips are provided on how Business Architects are to: manage Citizen Developer teams, change, introduce an organizational culture that allows teams to operate and further scaling.

The fourth component is Organization Alignment. It explains how to manage change, stakeholders, create a culture focused on scaling, create IT cooperation with the Citizen Developer community in order to mutually understand needs and responsibilities, and how to measure the value created by Citizen Developer projects.

The last, fifth component is the Citizen Development Maturity Model. It describes the ways of working, organizational processes and structures characterizing the various stages of maturity. The Discovery stage is the first contact with Citizen Development, its further development in the organization depends on the experience related to it. At the Experimentation stage, Citizen Development develops to reach the so-called critical mass, which is the point at which it is formally approved by the organization. The key role here is played by Citizen Developers who, through the delivered applications, create their potential at the operational level. In the third stage - Adoption - Citizen Development is already formally embedded in the organization and begins to be perceived as a key factor of digital transformation. At the Scaling stage, an environment that is conducive and creates a culture of

continuous innovation is co-created. Full maturity is reached in the Innovation phase, where Citizen Development is at the center of the organizational culture and fully integrated with the business strategy. At this stage, innovation and digital transformation has reached a large scale. The use of the above phases allows to assess what stage of maturity organizations are at, which enables further diagnosis and removal of potential obstacles.

## Conclusions

The aim of the article was to indicate the changes taking place in the field of military project management and the impact of LCNC technology. The author put forward a hypothesis that currently there is a noticeable tendency to transfer solutions from the civil to the military sector. The above is confirmed by the description and analysis of the most important technical and management solutions used in military projects over the years. From solutions of the Integrated Computer Aided Manufacturing Definition class, through PATTERN or processes developed by Toyota, to the latest Scrum solutions and, above all, hyper-agile, which is a response to LCNC.

The growing market of low-code and no-code platforms shows a tendency that they are the future in terms of: the speed of developing IT solutions; automation and robotization of repetitive tasks; competence gaps (possibility of developing solutions by people without programming competence). The area of military projects is particularly receptive to such solutions. With the development of new types of threats, there is a growing need for key competencies, which are currently deficient. Knowledge in the field of handling selected LCNC solutions already today allows to develop solutions that facilitate more advanced work on connected projects. The organization dealing with the analysis of LCNC issues is Gartner. In the published data, it directly indicates that 60% of applications are already created outside IT departments, and in addition half of them (i.e. 30%) are already developed by employees with little or very limited programming skills (Gartner, 2023). According to Gartner, "by 2024, at least 65% of all new applications will be built with high-productivity toolkits, such as low-code and no-code development platforms (Gartner, 2023)." In practice, it looks like one team can create a product from an idea without contact with the IT department in a few days instead of months or come up with a solution that will allow to speed up the current project by automating some tasks in LCNC. An example is the Power Automate Desktop program, which is a free tool available in Windows 10 and 11 (in the latter it is also installed by default). Able to perform tedious and repetitive tasks. Filling out forms, generating invoices, reports and other files, sending e-mails, collecting data from websites. All these tasks can and even need to be automated! It doesn't need to have any special skills to use this simple tool. Most activities are literally just a click away! The use of this program is a perfect example of how the use of LCNC solutions allows to speed up design work, minimize the risk of errors at minimal costs. What used to take dozens of hours or days can be done in 5 minutes.

It is also important to indicate the development of management solutions under the influence of LCNC. Methodology *Citizen Development: The Handbook for Creators and Changemakers* allowed for structured management of all LCNC class projects, regardless of the technology used. The implementation of the best practices allows for the maximum use of the potential of the latest technologies.

## References

- Cai, Z. (2022) “A Case Study: Digitalization of Business Processes of SMEs with Low-Code Method”, IFAC-PapersOnLine, Volume 55, Issue 10. doi: 10.1016/j.ifacol.2022.09.666.
- Czajkowski, M. (2013) Obrona przeciwrakietowa w stosunkach międzynarodowych, Wydawnictwo Uniwersytetu Jagiellońskiego.
- Dasgupta, S. (2014) It Began with Babbage: The Genesis of Computer Science, Oxford University Press.
- Forman, P. (2007) “The Primacy of Science in Modernity, of Technology in Postmodernity, and of Ideology in the History of Technology”, History and Technology, nr 23. doi: 10.1080/07341510601092191.
- Hirota T., Nonaka, I. (1986) “The New New Product Development Game”, Harvard Business Review 64, no. 1. 1986. Available at: <http://damiantgordon.com/Methodologies/Papers/The%20New%20Product%20Development%20Game.pdf>.
- Holweg, M. (2007) “The genealogy of lean production”, Journal of Operations Management. 25 (2): 420–437. doi: 10.1016/j.jom.2006.04.001.
- Jacobsen, A. (2015) The Pentagon's Brain: An Uncensored History of DARPA, America's Top-Secret Military Research Agency Little, Brown and Company.
- Kopaliński, W. (2000), Słownik wyrazów obcych, Świat Książki.
- Kruszyński B. (2011) Udział sił zbrojnych USA w konfliktach w Iraku i Afganistanie – największych wojnach przełomu XX/XXI wieku, Wydawnictwo Naukowe UAM.
- Lekowski M. (2011) Współczesna rewolucja w dziedzinie wojskowości. Analiza wybranych aspektów i cech charakterystycznych, Bezpieczeństwo Narodowe, nr 19.
- Lightsey, B. (2001) Systems Engineering Fundamentals, Defense Acquisition University Press.
- Liker, J. (2004) The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer, McGraw Hill.
- Medvetz, T. (2012) Think Tanks in America, University of Chicago Press.
- Poppendieck, M., Poppendieck, T. (2003) Lean Software Development: An Agile Toolkit, Addison-Wesley Professional.
- Raska, M (2011) “The Five Waves of RMA Theory: Processes and Debate”, Pointer, vol. 36, no. 3.
- Ries, E. (2011) The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Currency.
- Sanchis, R. et al. (2019) “Low-code as enabler of digital transformation in manufacturing industry”, Applied Sciences. 2020; 10(1):12, doi: doi.org/10.3390/app10010012.
- Savage, C. M. (1996) Fifth Generation Management: Co-creating Through Virtual Enterprising, Dynamic Teaming, and Knowledge Networking, Butterworth-Heinemann.

- Schwaber, K. (1995) "SCRUM Development Process". Available at: <http://www.jeffsutherland.org/oops/schwapub.pdf>.
- Schwaber, K., Beedle, M. (2001) Agile Software Development with Scrum, Pearson.
- Taiichi, O. (1988) Toyota Production System. New York Productivity Press.
- Thompson, S. (1999) Haskell: The Craft of Functional Programming, Pearson Education.
- Womack, J., Jones, D., Roos, D. (2007) The Machine That Changed the World: The Story of Lean Production - Toyota's Secret Weapon in the Global Car Wars That Is Now Revolutionizing World Industry, Free Press; Reprint edition.

### **Other sources**

- A Brief History of RAND (2023). Available at: <https://www.rand.org/about/history/a-brief-history-of-rand.html>.
- Birkbeck school of Computing (2023) History of the Department. Available at: <https://www.dcs.bbk.ac.uk/about/history/>.
- Gartner report (2023). Available at: <https://www.gartner.com/en/newsroom/press-releases/2022-12-13-gartner-forecasts-worldwide-low-code-development-technologies-market-to-grow-20-percent-in-2023>.
- History: The Agile Manifesto (2001). Available at: <https://agilemanifesto.org/history.html>.
- IEEE (1998) "IEEE Standard for Functional Modeling Language - Syntax and Semantics for IDEF0", IEEE Std 1320.1-1998, vol., no., pp.1-116, doi: 10.1109/IEEESTD.1998.89198.
- Ministerstwo Obrony Narodowej, Departament Informacji (2023) Priorytetowe kierunki badań naukowych w resorcie obrony narodowej w latach 2021-2035, Warszawa.
- NASA (1992), Recommended Approach to Software Development SEL-81-305. Available at: <https://ntrs.nasa.gov/api/citations/19930009672/downloads/19930009672.pdf>.
- U.S. Army, Office of Business Transformation (2023), Phase II of the Army's Deep Green Competition has Started, Available at: [https://www.army.mil/article/264210/phase\\_ii\\_of\\_the\\_armys\\_deep\\_green\\_competition\\_has\\_started](https://www.army.mil/article/264210/phase_ii_of_the_armys_deep_green_competition_has_started).
- Project Management Institute (2021) Citizen Development: The Handbook for Creators and Changemakers, Project Management Institute.
- Wójtowicz, T. (2015) Wykorzystywanie nowych technologii w zapewnieniu bezpieczeństwa militarnego Stanów Zjednoczonych, Federacji Rosyjskiej i Chińskiej Republiki Ludowej, rozprawa doktorska, Warszawa: Akademia Obrony Narodowej.