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Review Article

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Conceptual Aspects of Lean and Agile Philosophies and their Synergy in Improving Production Processes

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ABSTRACT
The article is devoted to the study of the conceptual aspects of examines the conceptual aspects of the Lean and Agile philosophies. The ability of any organisation to function in rapidly changing conditions increases with the combination of Lean production philosophy (Lean) and flexible production philosophy (Agile). The conceptual aspects and practical tools of these philosophies complement each other and enable effective decision-making, taking into account the main factors influencing production processes: Lean philosophy focuses on reducing production waste, and Agile philosophy focuses on the smooth adaptation of production processes to changing environmental requirements. The article pays special attention to the synergy effect of these two production philosophies and its importance in improving the production processes.

Keywords: Lean philosophy, Agile philosophy, Their Synergy, Improvement of Production Processes

Introduction

In today's rapidly changing environment, with the intensive globalisation of all spheres of society and the rapid advancement of technology, the need to increase organisational process efficiency is becoming increasingly obvious and relevant. Environmental dynamism requires a flexible approach that adapts to changes in the competitive environment, ensuring the profitability of production through the introduction of new technologies and compliance with modern market requirements and quality standards. The need to adapt to changing environmental conditions highlights the importance of continuous improvement of the organisation's operational processes; this, in turn, is associated with continuous performance analysis, which allows you to detect problems, identify sources of cost formation, and rationalise directions of activity. Continuous improvement is always relevant for every organisation because it helps develop the organisation's potential and strengthen its competitiveness. Masaaki Imai, the author of the Japanese business philosophy Kaizen, claims that "not a day should go by without some kind of improvement being made somewhere in the company" [1]. However, to make these improvements, it is necessary to clearly understand the situation that needs improvement, be aware of the factors influencing it, the reasons for its occurrence, and the interrelationships and possible consequences of these factors. This approach is possible when any situation or problem is considered within the framework of a single system, in which all elements are interconnected and, accordingly, influence each other, forming a complex whole. Understanding the system and the foundations of its formation allows us to view a specific object or phenomenon from different angles, in various aspects, holistically and comprehensively, taking into account other systems and relationships [2]. Clearly, without knowledge of the system, it is impossible to improve it.

It is reasonable to say that today the dynamism of the environment promotes the rapid exchange of data flows, significantly

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influences the political and economic processes of the country, social behaviour patterns, and transforms social relations, thereby generating new knowledge and processes. All this suggests that within this context, the prior planning of any actions can make organisations rigid, to some extent static, less flexible and unable to quickly and effectively adapt to environmental challenges [3]. Obviously, the complexity and uncertainty of the environment require a different nature of management relations, a different type of interaction of these relations, other approaches to control and management. There are several findings in the scientific literature that today improving the management of production processes and increasing their compliance with environmental requirements is possible with new flexible methodologies that combine the Lean manufacturing approach with the active (flexible) manufacturing approach – Agile this in turn allows the organisation to develop a production system operating strategy that is aimed at eliminating any types of waste, quickly adapting to changing environmental requirements, and optimising the entire production processes [4-6].

The study aims to compare the Lean and Agile philosophies and explore the synergistic effect of their combination on the development of management decisions and the improvement of production processes.

System, systems thinking and its importance in improving processes in organisational management

The modern dynamically developing environment has a significant impact on global processes, contributing to their high variability and complexity. On the one hand, the volatility of the world is characterised by accelerating technological progress, the emergence of new knowledge and methods of work organisation, increased information load, and changes in society's interests and behavioural patterns. On the other hand, the complexity of the world is determined by the close interaction, interconnection, and interdependence of the aforementioned phenomena, which, in turn, creates additional uncertainty and misunderstandings, complicating the prediction and management of any process [7]. To keep up with the changes, today it is essential to be able to work at the same speed with which the world is changing; to quickly adapt to new environmental conditions and quickly learn new things and practices; and to be able to make decisions quickly and anticipate their consequences. Furthermore, it is important to view every process as a system, a set of elements that are in specific relationships with each other and with the environment and which are designed to jointly perform a predetermined function [8,9]. To see a system, it is important to be able to view the process more broadly, from multiple perspectives, taking into account the context, the nature of the interactions between its elements, and tracing cause-and-effect relationships. The ability to view elements as parts of a whole, understanding their interrelations and mutual influences, is the foundation of systems thinking. Rather than viewing elements in isolation, systems thinking focuses on their interactions and impact on the system as a whole: it considers problems and situations as a unified system, taking into account their complexity and nonlinearity [7]. Systems thinking is also associated with the ability to see a system at different scales, from the micro to the macro level [10].

The originator of the term systems thinking, Barry Richmond, defines systems thinking as the art and science of making reliable inferences about the behaviour of a system by developing an ever-deeper understanding of its structure [11]. He emphasises that the development of this "art and science" leads to the formation of mental models that allow us to see the world as a complex system, the behaviour of which is determined by its dynamic structure and the interaction of its links. In addition, the scientist emphasises that individuals who practice systems thinking "can see both the forest and the trees": "structurally, they see both the whole and its parts, behaviourally – both the action pattern and the event and its consequences".

Another system thinking researcher, Peter Senge, defines systems thinking as a discipline that sees the whole, its structure, the relationships between its parts, and the regularities of change [12]. This definition describes critical elements of systems thinking. However, it does not reveal its goal: to move from a fragmented to a holistic view, thereby gaining insight into cause-and-effect relationships. Another systems theorist, Russell Ackoff (1974), provides a similar concept for systems thinking, explaining that systems thinking is holistic; it is aimed at gaining an understanding of the behaviour of the whole and its parts. He also emphasises that "a system is never the sum of its parts; it's the product of their interactions". This means that the performance of a system does not depend on how its parts work separately; it depends on how they work together – how they interact. Therefore, "improving the performance of only one part of the system can destroy the system." The researcher emphasises that improvement must occur by understanding the overall system and be guided by what needs to be improved. When improving parts of the system, it is necessary to understand how the improvements interact with the overall system and other parts.

Summarising the findings of the aforementioned researchers, it should be noted that the concept of wholeness or integrity is the core of systems thinking. To understand how a system works, it is necessary to study not its individual elements, but the connections between them. When thinking systemically, it becomes possible to see changes in the system and thereby contribute to the formation of a new and improved system.

In 1958, the Harvard Business Review published an article by Jay Forrester, a professor at the MIT Sloan School of Management, entitled "Industrial Dynamics: A Major Breakthrough for Decision Makers." This article launched the systems thinking movement in business education. The results of the study published in this article showed that when decision makers were asked to improve system performance using a dynamic model of a business system, they mostly performed worse [13]. The study found that most people had a poor understanding of how to fundamentally improve systems, as decisions were usually based on intuition and made in a hurry, which in turn did not lead to long-term systematic improvements. In his article, Jay Forrester highlights three significant reasons why decision makers have difficulty understanding and managing systems:

- lack of knowledge about system dynamics – its behaviour over time depending on the structure of the system elements and their mutual interactions; feedback loops, nonlinear behaviour of the system and their effects on other systems;
- lack of understanding of the root causes of problems (and methods for their detection): in systems thinking, the causes

of problems are diverse, indirect and dynamic;
- lack of understanding of how and why hasty decisions and local decisions deteriorate the overall performance of the system over time [13].

The researcher explains that the above-mentioned reasons typically arise when traditional management methods clash with the implementation of Lean or Agile manufacturing principles in a large organisation. Moreover, the management team or decision-makers are part of the system that is deliberately disrupted during the change process, and if they don't apply systems thinking themselves, they can actually disrupt this system.

In his scientific work "The Fifth Discipline", Peter Senge describes five main disciplines (personal mastery, mental models, shared vision, team learning and systems thinking), which are related to the change of thinking of organisational leaders (from the Greek, metanoia) along with environmental changes in order to promote organisational performance, innovation and competitiveness [12]. Special attention is paid to systems thinking, which the author considers to be the main one. He emphasises that "the causes and effects of system behaviour are rarely closely related in time and space" Senge, therefore, as a system, especially a complex system, there are several interconnected causes that are not linear – the effects are not proportional to the causes, and vice versa [14]. Consequently, in this system, clear causal relationships cannot be traced due to multiple influences. To understand the behaviour of a system and draw correct conclusions about it, it is necessary to apply systems thinking, which, first of all, determines the change from a linear worldview to the perception of a dynamic and chaotic environment, and then allows:
- see system dynamics – see indirect feedback loops and their impact on the system using causal loop diagrams;
- see mental models (beliefs, assumptions, conclusions) and develop metacognitive skills to see and question one's own assumptions and logical chains by drawing cause and effect diagrams and using the 5 Whys method;
- implement global system goals and avoid local optimisation – create final value quickly, with high quality and morality; prevent unilateral and hasty decision-making [14].

Summarising the above, it should be concluded that no system can exist in isolation: each system interacts with other systems and is part of a larger system. To see and distinguish a system from its external chaotic environment, and to understand the impact of that environment on the system, it is necessary to develop systems thinking. This focuses on individual system elements and direct cause-and-effect relationships, providing an understanding of how different parts of the system influence each other and the system as a whole. It should be noted that systems thinking is essential for effective decision-making. It helps identify and analyse complex relationships between factors influencing decisions and make more informed decisions based on a holistic understanding of the situation; it allows you to predict the possible consequences of decisions made and assess their impact in the long term. Furthermore, systems thinking creates a shared understanding of work goals and objectives, thereby facilitating teamwork. Only by getting rid of the illusion that the world consists of separate, independent parts does it become possible to build an organisation in which people continually expand their knowledge and skills, and in which new, active ways of thinking emerge that foster creativity, continuous improvement, and high results.

Conceptual Description of Lean and Agile Philosophies

Globalisation of processes, rapid technological development and geopolitical events cause instability in the external environment and thereby actualise the need for organisations for new and effective management methodologies. Environmental variability forces organisations to develop new and adaptable management approaches that are flexible enough to respond quickly to environmental changes. In this regard, traditional management methods become ineffective and do not allow achieving the set goals. Modern technological innovations have significantly influenced the traditional production processes, contributing to real achievements in the field of cost, convenience and customisation and creating high value for end consumers, while simultaneously raising the level of organisational performance even higher [7]. In addition, volatility, which never completely disappears and is further intensified during a crisis, changes everything from relationships with suppliers to overall business models. This, in turn, makes it challenging to implement changes in organisations in the long term – strategies that were previously developed for the coming years are no longer effective and require adjustments and adaptation to new conditions [7].

Scientific literature and practitioners emphasise that Lean manufacturing (hereinafter – Lean) and Agile manufacturing (hereinafter – Agile) approaches are today among the most effective management concepts that have significantly transformed process management. Although the roots of these concepts can be found in engineering and technology, their impact extends far beyond these traditional fields. They are comprehensive, deep and adaptable approaches that can be applied in various sectors and industries. They are more than just tools, they are philosophies that develop development policies, transform production processes, improve personnel management, and improve products and services. These philosophies are focused on continuous improvement of the production processes, developing sustainable, environmentally friendly, and efficient development strategies [15].

Lean is a concept of efficient production that emerged in the scientific literature from the creation of the Toyota Production System in the mid-20th century. It is based on the philosophy of defining value from the customer's perspective and continuously improving the way value is delivered, eliminating any use of resources that are wasteful or do not contribute to value creation [16]. Lean is focused on preserving value with less input, with the ultimate goal of providing the customer with perfect value through the production processes that are free of waste. This is done by giving each individual employee the opportunity to fully utilise their potential and thus make the greatest possible contribution [17]. The Lean philosophy includes the concept of Kaizen, which means continuous improvement. The goal of continuous improvement is to eliminate all waste from the value-creation process [18]. To achieve excellence in the production processes, Kaizen involves the entire workforce, from top management to shop floor workers, encouraging them to generate new ideas and implement improvements. Within the

framework of Lean, by applying systems analysis to processes and value streams, organisations improve cost control, increase product quality, promote employee engagement and, as a result, customer satisfaction – and often achieve this simultaneously [19]. The basic principles of Lean manufacturing are based on the following general considerations:

- maximum value creation: all activities are consistently aligned with the benefits received by the customer
- waste minimisation: activities that do not create added value are eliminated
- continuous improvement: all processes are subject to optimisation [20].

Lean encourages managers to take a systems approach and view an organisation as a unified, interconnected set of elements that create value, from the conception of its creation to the generation of revenue [21]. Emphasises that "Lean cannot be reduced to a set of rules or tools; it must be approached as a system of thinking and behaviour that is shared throughout the value stream" [22]. Lean thinking is no longer limited to the manufacturing industry; it is now used across a range of industries, including construction, healthcare, IT, and many others. It has already been proven that organisations that consistently practice Lean are more innovative, profitable and competitive [23].

Practice shows that by implementing Lean manufacturing principles, namely by creating a simple flow chart and rearranging its workplace, a leading automotive parts manufacturer has been able to reduce production time by 40%, increase overall productivity by 30%, and decrease work-in-progress inventory by 50% [24]. These improvements not only increased production volume, but also significantly improved the competitiveness of the organisation. Another manufacturing organisation, by transforming its production line and implementing visual management tools, has been able to reduce production time by 40% and increase throughput by 25% [24]. In addition, by streamlining processes and reducing waste, organisations can save 15-20% of costs in their manufacturing operations, as well as improve their profit margins and experience up to 30% faster growth rates [25].

The Lean philosophy is sometimes described as similar to Agile philosophy, which is misleading [26,27,28]. Rather, Lean and Agile together help both managers and employees in organisations develop a new way of thinking, changing the vector of organisational activity that shows how to work differently to achieve better results than they have so far. Agile is a concept of flexible manufacturing that appeared in scientific terminology relatively recently, in the 1990s in the software development process, and over the past decade has rapidly gained ground in various industries, such as telecommunications and banking [19]. Agile represents a philosophy that describes a set of attitudes and beliefs, creating a holistic approach to process management. It requires greater flexibility, wider availability of resources, faster response to changes, and trust in employees. One of the key elements of Agile is highly adaptable, self-organising teams, whose members can change their roles at any time and focus on different tasks [29,30]. Instead of the traditional production processes, which used to be very sequential and time-consuming, the Agile approach is much faster and more flexible. The focus of Agile is an iterative approach that aims to provide the customer with a prototype of a new product or service as quickly as possible, never compromising its quality. Work teams then obtain feedback and, through repeated production cycles, make improvements to the product or service [19]. The essence of Agile is smooth adaptation to the changing needs of the environment through:

- teamwork and collaboration with the end user
- focus on value creation (working software)
- rapid response to change (fast response time) [29,31].

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Porsche Consulting provides a similar opinion, explaining the operation of their organisation: Agile is primarily about adaptability – the ability to change depending on the surrounding context [32]. This is achieved by short planning periods and short work stages, as well as increased cooperation between teams and a focus on the final product. This allows for continuous feedback and always focusing on people and mutual interaction. The author and trainer of the Agile approach, E. Claims that "Agile teams produce a continuous stream of value, at a sustainable pace, while adapting to the changing needs of the business" [33]. In addition, a group of authors studying Agile organisations emphasises that it is the people, using various Agile methodologies (e.g., Kanban), who make organisations flexible [34].

Analysing statistics, it should be noted that 93% of organisations that work based on the Agile philosophy demonstrate higher customer satisfaction compared to those that do not apply the Agile philosophy in their work. In addition, 73% have higher employee engagement and 93% have better operational performance [35]. Similarly, organisations that use the Agile philosophy have been able to increase team interaction by 59%, improve the work environment by 36%, increase the quality of produced software by 25% and improve the user experience by 14% [36].

Summarising the aspects of the Lean and Agile philosophies, it should be noted that they are considered philosophies rather than methodologies because, as methodologies, they include specific methods, procedures, and rules for achieving a specific end result. However, Lean and Agile do not prescribe a specific method or procedure for achieving a result, they provide key considerations that help to choose a methodology that is consistent with the principles of Lean and Agile, respectively.

Systems thinking as a Conceptual Foundation of Lean and Agile Philosophies

One of the well-known management theorists, Edwards Deming, emphasised that "90% of all problems in an organisation are related to the responsibility of management, and only 10% of all problems are the responsibility of employees. The main cause of most problems is the way in which work is organised in the production system" [37]. It follows that in order to solve the problems that organisations face every day; it is necessary to understand the systems in which they exist and the processes that influence them. To explain how these systems work, systems thinking skills must be applied. This helps to see the mutual relationship and influence of their components – by revealing the relationships, clarity arises about the structure of the system and conclusions are drawn about the overall behaviour of the system.

Both Lean and Agile philosophies are based on a holistic approach that assumes a comprehensive view of the system, emphasising that any system (physical, social, economic, behavioural, etc.) is a single whole in which various processes take place that determine its behaviour [38,21]. Although it is important to focus on the system as a whole, it is equally important to consider its individual components and their unique contributions. It is essential to balance systems thinking with attention to the details of the system. The main difference between the aforementioned philosophies is that Lean focuses primarily on the production processes, managing the material flow, while Agile focuses on the final value of the output, managing feedback with all participants in the production processes. In addition, both philosophies provide an idea of how to improve the quality of the production processes and output, continuously improve, expanding learning opportunities, and decentralise decision-making (see Figure 1).

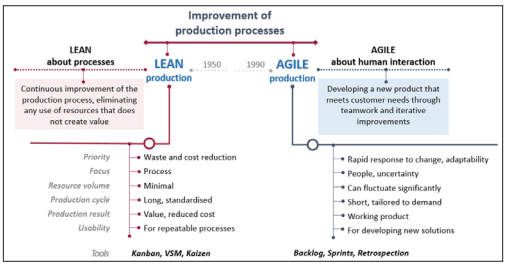

Figure 1: Lean and Agile philosophies concepts in the context of systems thinking (image created by the authors, based on Wiggins [38,26,7]

Importantly, systems thinking, by providing a holistic view of production processes, helps identify hidden relationships that may hinder system effectiveness. Tables 1 and 2 summarise the findings on how systems thinking helps implement Lean and Agile philosophies.

Table 1: The role of systems thinking in implementing Lean philosophy (author's table based on Wiggins, Cooper K [38,26]

Focus	Object of influence	The nature of the influence of systems thinking
Lean philosophy		
Value stream	Value Stream Visualisation (VSM) and its analysis	Discover how value is created and delivered to the customer, identifying bottlenecks and their impact on the production processes
Waste	Discovering the causes of systemic waste	Discover how and what waste is formed as a result of the interaction of various system elements and what solutions can eliminate it
Continuous improvement (Kaizen)	Analysis of general production processes	Discover how various elements of the production processes are interconnected and influence each other as well as the processes as a whole

Table 2: The role of systems thinking in implementing Agile philosophy (author's table based on Wiggins, Cooper K [38,26]

Focus	Object of influence	The nature of the influence of systems thinking
Agile philosophy		
Final product value	Visualisation and analysis of the product development process, task prioritisation and decomposition	Discovers how the decomposition of tasks and their execution influence the production of the final product and their compliance with customer expectations
Collaboration	Team relationships	Allows teams to better understand their role in the system; analyses how team interactions and decisions influence the overall performance and results of the production processes
Iterative improvement	Retrospections, impact of changes on the system	Evaluates how changes in one iteration influence the entire system, including subsequent iterations; reveals not only the symptoms of problems, but also their root causes and identifies opportunities for systemic improvement

It is important to note that both philosophies presented in Tables 1 and 2 are focused on high value creation, continuous improvement and adaptability. Furthermore, the main challenge is that Agile emphasises rapid iteration and achieving results in short cycles, while Lean focuses on deep process analysis and waste reduction before work is done. The philosophies also have the following differences:

- priorities: Lean prioritises careful planning and waste reduction, while Agile prioritises speed and iteration;

- short-term and long-term goals: Lean focuses on sustainability, while Agile focuses on quick results;
- resource use: Lean aims to reduce resource use, while continuous experimentation in Agile manufacturing may require additional resources [38,26].

Based on the above, it should be noted that the systems thinking and holistic approach used within the framework of the Lean and Agile philosophies allow organisations to focus on the main principles of the philosophies, manage complexity, optimise processes and provide excellent value to end customers. Systems thinking helps to move from local improvements to systemic optimisation, use feedback to ensure continuous process improvement, as well as motivate teamwork and cooperation to generally promote the formation of more flexible and efficient systems. It is a misconception that modern organisations have to choose between the two philosophies. In fact, there is no need to choose, because both philosophies complement each other and increase their impact on processes. Separately, these philosophies also work and produce good, noticeable results, but several scientific articles demonstrate the usefulness of the synergistic interaction of both philosophies, especially when it is based on a holistic approach and the development of a new way of thinking in management [6,5,28]. By using a combination of these philosophies, organisations can combine tools, ways of working, and organisational elements, creating a solution adapted to the environment that more fully and quickly meets the unique needs of the organisation.

Synergistic effect of Lean and Agile philosophies

The combination of Lean and Agile philosophies and their focus on both process optimisation and flexibility creates a strong synergy. The strength of Lean philosophy lies in streamlining work and eliminating waste, while the strength of Agile philosophy lies in the flexibility of work teams' responses and customer focus [15,28,39]. The combination of these philosophies provides organisations with the ability to respond quickly to changing market conditions and customer demands, while maintaining a clear focus on eliminating waste and increasing value. The combination of Lean and Agile philosophies creates the following synergistic effect:

- Agile's iterative approach allows breaking down large, complex tasks into smaller, more manageable tasks; Lean allows eliminating waste in each work cycle; this not only ensures fast task completion, but also allows improving the quality of the final product based on customer feedback.
- Agile empowers the team to make decisions at the lowest level, while Lean unlocks the potential of each team member; this reduces vertical decision-making delays and allows teams to respond to problems faster, promoting both efficiency and innovation;
- the use of Lean visual management tools, such as value stream maps or Kanban, provides transparency in workflows; combined with Agile's short work cycles and stand-up meetings, teams gain a clearer understanding of their tasks, priorities, and progress, which in turn allows for operational adjustments and continuous improvement;
- both Lean and Agile emphasise the importance of customer value; Agile's rapid iteration cycles ensure continuous value creation, while Lean eliminates activities that do not create value;
- the use of regular retrospectives allows reviewing the progress of work and identifying shortcomings that need to be addressed in the next iteration [15,28,39].

Summarising the above, it should be concluded that these philosophies together form a dynamic system that:

- promotes cross-functional collaboration and continuous improvement at all levels of the organisation;
- optimises resources and time by prioritising each task;
- provides flexibility in meeting customer requirements while focusing on quality;
- promotes operational efficiency while promoting innovation [40].

The combination of the best approaches of the Lean and Agile philosophies provides a solid framework for achieving organisational operational excellence. By focusing on optimisation and flexibility, organisations can reduce waste, increase productivity, and promote customer satisfaction [41].

Conclusion

- The need to adapt to dynamic environmental conditions highlights the importance of continuous improvement of the organisation's operational processes; continuous improvement helps to develop the organisation's potential and strengthen its competitiveness.
- Each organisation should be perceived as an open system in which various processes take place that interact with the environment; systems thinking allows seeing and highlighting this system from the external chaotic environment, as well as understanding the impact of this environment on each element of the system.
- There are two management philosophies – Lean and Agile, which have common roots – the Toyota Production System, and each of them is effectively used by organisations to improve the production processes.
- Lean philosophy is focused on process improvement, the Agile philosophy – on human interaction. Both philosophies are focused on value creation and continuous improvement.
- Lean philosophy focuses on production efficiency and the exclusion of activities that do not create added value.
- The basic principle of the Agile philosophy is to divide work tasks into small, manageable tasks, continuously reviewing and improving them based on feedback, thereby ensuring greater flexibility and efficiency.
- The combination of Lean and Agile philosophies allows organisations to streamline their processes and respond more quickly to customer needs and market changes.

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