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Effective concepts of management against the challenges of the modern world: Lean and Agile: competition or cooperation?

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Abstract

Motivation: For a long time, new strategies, concepts and solutions regarding both process management in enterprises and managing the supply chains have been presented in the literature and implemented in business practice. They are to be an alternative to existing concepts. Considerations regarding these concepts focus on the speed of adaptation to changing conditions in the environment, flexibility, diversification and reducing the risk of disruption. The justification for the implementation of new solutions are the conditions and challenges in the environment of enterprises, especially the Covid-19 pandemic, but also economic crises, wars, terrorism, natural disasters, changes in energy prices. An example of such a concept is the Agile strategy. According to some authors, this strategy is a competitive concept to Lean Management. Other authors believe that they are complementary and that there are opportunities to combine them and thus achieve a synergy effect.

Aim: The aim of the article is to compare the effectiveness of Lean and Agile process and supply chain management strategies in conditions of environmental instability, based on literature review and own research.
Results: Lean and Agile strategies can be combined to some extent. In addition, such a combination may prove to be more effective and more resistant to interference than using "clean" strategies. The result of proper application of both strategies are lower costs, better product quality, higher level of logistics service, greater customer satisfaction and employee involvement, and thus the trade-up effect.

Keywords: agile supply chains; lean management; Covid-19; process management; strategies
JEL: M11; L2; M21

1. Introduction

The concept that for decades has been considered one of the leading one when it comes to improving the efficiency of processes is Lean Management. The solutions used there apply to all aspects of the functioning of both a single company and entire supply chains. The effects are visible not only in the field of production and logistics, but also in the organizational culture, human resources management and quality management. In fact, the Lean tools used in all these areas, merge into one harmonious whole and result from one comprehensive philosophy.

However, for many years the Agile concept has been presented in the literature as an alternative to Lean Management. Agile focuses on the speed of adaptation to changing conditions in the environment, flexibility, diversification and reducing the risk of disruption, while Lean is associated with stability, standardization, space-time synchronization and an equal level of production. The justification for the use of Agile are new conditions and challenges in the environment of enterprises, such as economic crises, wars, terrorism, natural disasters, but above all the Covid-19 pandemic, during which lean supply chains were broken and rapid changes in working conditions, e.g. and energy that reduce the efficiency of global supply chains.

Some authors oppose these two concepts — Lean and Agile, while according to others these concepts are not competitive and mutually exclusive, but have a complementary and synergistic relationship. The authors of this article also agree with the view that under certain conditions it is possible to combine elements of these concepts, which is manifested by LeanSixSigma.

The aim of the article is to compare the effectiveness Lean and Agile strategies, especially in conditions of instability of the environment and to indicate to what extent they are complementary and to what extent they exclude.

The proposed hypotheses are as follows:

– It is possible to combine Lean strategies with Agile elements and Agile strategies with Lean elements.
– Combining one strategy with elements of another may be more effective or more resilient to disruption than using a "pure" strategy.

– Despite the differences, some elements of Lean and Agile strategies are very similar.

The effectiveness of applying Lean and Agile strategies is influenced on the one hand by the environment (disruptions, demand characteristics, customer requirements), and on the other by internal factors of the company (e.g. breadth of the product range, organizational culture).

The article consists of two main parts. In the first part, an analysis of the literature was carried out, the purpose of which was to present the essence of the Lean and Agile concepts and views on the possibility or impossibility of combining them. In the second part, the authors presented case studies of two production companies located in Poland that successfully apply these strategies. The information was collected by the authors during direct research in these companies (interviews with managers, observation of production and logistics processes).

The novelty of the presented research is the presentation of cases of companies that use one of the described strategies (lean or agile), but harmoniously incorporate elements of the other strategy, which increases their effectiveness or resistance to disruptions.

2. Literature review

In the Lean Management concept, the basic issue is the elimination of all kinds of waste (muda in Japanese), not only in the production process, but also in the logistics process, and even in the entire supply chain, including cooperating firms (Nogalski & Walentynowicz, 2009; Womack & Jones, 2008, p. 19). Waste (muda) is considered to be overproduction, overstock, redundant movement, defects, over-processing, waiting, and transport and Mura (irregularity or a lack of uniformity) and Muri (over worked) (Lewis, 2000). The effect of applying this concept is the "leaning" of processes and resources — less human work, production space, tools, inventory, errors, while increasing customer value (products that meet customer requirements, high quality, delivered on time). The definitions also emphasize economic aspects — high production productivity, lower costs, higher profits (Asiński et al., 1999).

Reducing the level of inventories, characteristic of Lean, is primarily the result of streamlining processes (e.g. shortening the changeover time of machines and devices) and solving problems that cause the creation of safety stocks (e.g. reducing the failure rate of machines and absences of employees, increasing stability, reducing the risk of delays in deliveries).

In fact, the primary goal in Lean Management is not only to eliminate waste, but also to increase the efficiency of processes, e.g. processes of the production of goods or services that are to meet the real needs of customers. It is wasteful to produce something that the customer does not need. Hence, the pull flow (PULL) is characteristic of LM, i.e. the production and delivery volume resulting from the actual demand, because the stock of finished products is also a waste. However, in order to eliminate production downtime caused by production

adapted to fluctuating demand, Lean postulates to stabilize demand and reduce volatility. This is not always possible, therefore the Lean system cannot always be fully implemented.

According to the creator of this system — Ohno (1998), Lean Manufacturing is a production system that leads to optimal improvement of the entire system by precise elimination of muda (waste), and its goal is to build quality into the production process while reducing costs. It also includes all associated technologies necessary to achieve these goals.

The postulated incorporation of quality into the production process, taking into account the principle of cost reduction, indicates that the relationship between costs and quality does not have to be treated as a trade-off, but rather as a trade-up (Milewska, 2010, pp. 133–140). The quality of processes, their efficiency is conducive to costs reducution. The quality of work does not have to be associated with high costs, thanks to preventing the occurrence of errors of a given type (using the poka-yoke technique) and by replacing external control with self-control (each employee control himself and is allowed to stop the production in order no to pass the defective element to the next stage of production).

When it comes to the impact on sustainable development, there are reasons to believe that Lean Management also has a positive impact on the environment. The principle of lean management assumes the economical use of available resources (including natural ones), which was the basis for the creation of this concept in Japan. Simplification of processes consists in reducing the consumption of materials and waste as well as energy. For example, thanks to the SMED method, it is possible to shorten the production changeover time, but also to reduce the costs of this changeover, which may be the consumption of energy or materials.

It is also worth emphasizing that, as the founders of Lean Management declare, this concept has never been aimed at increasing only the financial results of enterprises. There is a strong social aspect to this concept, as evidenced recently by the inclusion of safety (6S) and environmental (7S) aspects (Fernández Carrera et. al., 2021). The social aspect is also related to the relationship between employees and the management, e.g. the rule not firing employees, employee loyalty, low fluctuation, which also results from Japanese culture (a company treated like a family, a boss like a father).

The Agile strategy is to be an alternative to the Lean strategy, which focuses on a quick response to changing needs and quick execution of customer orders (Cabral et al., 2012). For example, according to Mason-Jones and Towill (1999) "Agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace" (Fisher, 1997). Agility is an ability that encompasses the entire enterprise, both organizational structures, information systems, logistics processes, and in particular, the way of thinking. The key feature of an agile organization is flexibility.

Agile, like Lean Management, can be implemented in one company as well as in the entire supply chain. Therefore, the term Agile supply systems is used in the literature (Helo et al., 2006; Kisperska-Moron & Swierczek, 2009).

Agile Supply Chain Management is considered a strategy applicable to innovative products that are characterized by a short life cycle, which results in the difficulty of forecasting demand, production in many variants and often in small quantities, a typical example of which is the fashion market (Bruce & Daly, 2004; Childerhouse & Towill, 2000; Christopher, 2000; Dove, 1996). Its implementation allows for the rapid introduction of new, customized, high-quality products and delivering them in accordance with the requirements of customers (Dekkers & van Luttervelt, 2006). Unlike Agile, Lean concepts work well where demand is relatively stable and thus predictable, and where diversity is low (Mason-Jones et al., 2000; Naylor et al., 1999; Van Hoek, 2000). The results of research conducted in Poland also indicate that Agile can be effective in the conditions of instability of the environment, while Lean enables optimization of processes in a mature market (Kisperska-Moron & Haan, 2011).

The justification for the transition from the Lean to Agile paradigm is to be the changed conditions for the functioning of enterprises and supply chains, characterized by greater volatility and unpredictability. Agility is defined as an organization's ability to respond quickly to changes in demand, both in terms of size and diversity (Christopher, 2000). Some publications give examples of companies that used lean supply chain strategies, which included reduction of inventory, and therefore these strategies were ineffective (Christopher, 2000) and vulnerable to unexpected events such as the outbreak of a pandemic (Fonseca & Azevedo, 2020).

The key factors determining the implementation of the Agile strategy are to be proximity to the market, a wide base of suppliers, access to information and the use of information technologies. Agile strategy requires Agile suppliers and logistics operators (Nair, 2001; Preiss et al., 1995; White et al., 2005; Yusuf et at., 2004). A high degree of flexibility is needed the entire supply chain (Swafford et al., 2006).

There are views in the literature that Lean is related to global supply chains and that it has contributed to the increase in globalization (Seric & Winkler, 2020). However, according to the Lean philosophy, the aim should be to "lean" and simplify processes, while globalization results in greater complexity of processes in supply chains. According to the authors of this paper, it is precisely the departure from globalization in favor of local chains that may create the conditions for the full application of the idea of "lean flow" and just-in-time deliveries. When implementing the lean strategy, it happens that a supplier locates its production near a strategic customer, so that the Just-In-Time supply of supplies is fast, cheap and not burdened with the risk of disruptions.

An important feature of Lean is the limitation of the number of suppliers, because it is difficult to integrate with many suppliers. However, there is no defined number of suppliers, distance from them, inventory levels, etc. that would

allow to determine whether a company uses Lean Management. Even Japanese companies, and even Toyota, have always used very different solutions, taking into account the current environmental conditions and the economic calculation (Kaneko & Nojiri, 2008; Milewski, 2022).

The concept of combining Lean and Agile management in the supply chain has also emerged, which has been called "LeAgile Supply Chain Management" (Christopher & Towill, 2000) or "Leagility" (Naylor et al., 1999). Many authors indicate the possibility of combining these concepts (Aitken, 2000; Christopher & Towill, 2002; Mason-Jones et al., 2000). But while the "lean" and "agile" paradigms can be integrated, agility usually requires breakthroughs in manufacturing technology and communication systems (Baramichai et al., 2007; Bottani, 2009; McLaren et al., 2002). The transition from strategies focused on cost reduction (lean) to value creation (agile) is to improve the market position of companies and give them a competitive advantage (Caniato et al., 2015).

In the fashion industry, the possibility of using both concepts in the form of diversification of markets and distribution channels is perceived. Products characterized by stable primary demand can be sourced from low-cost countries (Lean Chains) and additional demand by supply from local sources (Agile) (Fisher et al., 1994).

Vaishnavi and Suresh (2019) reviewed the literature in this field. The conclusions resulting from their research concern, above all, the problem of separating Lean and Agile with the determination of the separation point. It is worth noting that the authors are mainly practitioners who are primarily looking for specific solutions to practical problems. From a practical point of view, it is important what solutions should be used in specific situations (Huang & Li, 2010), what should be the criteria for selecting specific solutions, for example, the selection of suppliers to meet the goals of "agility" (Foladi & Khakestari, 2020), inventory management methods or determining where the optimum separation point is (the point in the supply chain where one strategy ends and another begins) (Meyer et al., 2017).

Agile is based on flexibility understood as the ability to change in changing conditions. However, Lean is also supposed to be flexible, thanks to the flexible processes and production resources. Of course, tight integration in supply chains, which is characteristic of Lean, is a problem in a crisis situation. However, as evidenced by examples from the period of the global economic crisis, it was partnership cooperation in supply chains that allowed some companies to get through the crisis (Milewski et al., 2017).

The essence of Lean Management in crisis situations is to create an effective production and logistics system that has the ability to respond to changes in its environment (Ray, 2020; Rossini & Portioli, 2018).

There are also opinions that Agile should not be opposed to the Lean concept because Lean Management is a coherent system, a structure consisting of many methods and tools, while Agile is only a general concept in both practical and theoretical dimensions. For example, Sharma et. al. (2021) analysed a total

of 160 research articles published from 1999 to June 2019, concerning various aspects of the functioning of supply chains and the applied strategies of these chains. The conclusion from this research is that while the Lean Concept has been extensively researched and has a rich literature, all other (like agile, green supply chains) are new or in their infancy, and their effects of combinations on the SC chain are less explored.

Many authors indicate that Lean and Agile are not competitive with each other (Carvalho et al., 2011; do Rosário Cabrita et al., 2016). If the goal of using Lean is to eliminate waste, while the goal of Agile is to make it more flexible through the use of appropriate technologies, there is indeed no contradiction between them. Lean does not preclude the use of modern technologies, although on the other hand, organizational and non-investment improvements have priority in lean.

Research conducted by Wong et al. (2018) among 203 Thai manufacturing companies, showed that their cooperation in the supply chain with suppliers and customers allowed them to achieve various benefits for all partners — they can be lean, green and profitable.

According to Naylor et al. (1999): "As the Lean thinking and Agile manufacturing paradigms have been developed there has been a tendency to view them in a progression and in isolation. This article shows that this is too simplistic a view. The use of either paradigm has to be combined with a total supply chain strategy particularly considering market knowledge and positioning of the decoupling point as Agile manufacturing is best suited to satisfying a fluctuating demand and Lean manufacturing requires a level schedule."

These authors, like many other authors, believe that the Agile manufacturing is best suited to meet fluctuating demand (in terms of volume and variety), and Lean Manufacturing requires stable demand. However, they do not treat them as mutually exclusive modes of production, but as complementary ("co-operating"). They also point out that this "cooperation" requires the placement of the so-called to the positioning of the decoupling point. However, they also believe that the most important goal in Lean is to reduce costs, and in Agile, service and increasing customer value.

It is worth quoting one more statement: "Through considering the differences between the two paradigms we have shown that they should not be considered in a progression or in isolation. Neither paradigm is better nor worse than the other, indeed they are complementary within the correct supply chain strategy."

Obora (2020, pp. 71–78) draws attention to the problem of differences in understanding these concepts. He believes that differences in supply chain definitions are most often due to two reasons. Firstly, when writing about the supply chain, some authors refer to it as a single enterprise (the so-called internal supply chain), others understand it as a system of two cooperating enterprises (suppliers and recipients), and still others as a network of cooperating enterprises. The second reason for the differences in defining the supply chain is

the variety of flows taking place within it (goods, resources, cash, information, etc.).

Many similar elements of both concepts are indicated in the literature (Aitken, 2000). Such a common element of both concepts may be integration. For example, according to Naylor et al. (1999): "(...) the businesses must work together to form an integrated supply chain (...). Thus the goal in achieving agility is to establish a Seamless Supply Chain (SSC) in which all "players" think and act as one".

According to some authors (de Raedemaecker et al., 2020, pp. 1–6) there is no need to choose between Lean and Agile because both concepts complement each other and their combination can help achieving additional benefits. The authors rightly point out the similarities in the benefits of using both of these concepts.

When examining the differences and similarities between Lean and Agile, there is an analogy to the ongoing discussions about the differences and similarities between Lean Management and Six Sigma. Initially, both concepts were opposed to each other. There was a conviction about their separateness and "competitiveness", especially in the environment of practitioners dealing professionally with the implementation of management systems.

However, both methods, despite the differences, allow to achieve similar results, such as improving financial results, improving customer service while reducing costs (Diwasasri & Kridanto, 2013). Over time, publications on the combination of both concepts began to appear (Shafer & Moeller, 2012; Swink & Jacobs, 2012) and the concept of Lean Six Sigma (LSS) emerged. Moreover, attempts to effectively combine them by using their positive features took place in various enterprises (Anchanga, 2006; Muzaffer et al., 2016; Sharma, 2003; Thomas et al., 2009), and the conducted research showed positive economic effects in various countries (Bożek & Hamrol, 2012) and various sectors of the economy — e.g. in services (Schnellbach & Reinharta, 2015; Urban, 2016).

A similar phenomenon is taking place now as well, which is expressed in the concept of Leagility. Besides, elements of Lean and Agile concepts can be found in others — Flexible Manufacturing Systems, Integrated Supply Chains, Rapid Response, ECR.

At the end of this part and review of the literature, the authors want to refer to the concept of "Teal Management", which has been gaining popularity in recent years. This concept is characterized by a large share of employees in the management of the company. Research in this area was also conducted by the authors of this article and consulted with specialists in the field of Lean Management (Milewski & Protasiewicz, 2020) in order to find similarities between them. A former Toyota manager, after hearing the idea of "Teal Management", commented on these results as follows: "This is not Lean. There is no democracy at Toyota." However, several of the teal companies have implemented the concept of Lean Management. They use tools used in Lean Management, such as

5S, and strive to reduce the time and costs of switching production by using the SMED method.

Based on the above literature review, the authors compared the features of both concepts — Lean and Agile and presented them in Table 1.

3. Methods

The main research methods are direct field research in two companies. The case of first company — DGS Diagnostics was described on the basis of an interview with the company's management and observation of processes at the company's headquarters on February 9, 2023 (direct, open, semi-structured, group interview) with subsequent additions by e-mail.

The case of the second company (POLST) was described on the basis of an interview and observations made on February 2020 (observations of production and warehouse processes) and supplemented by telephone interviews in February 2020 and January 2021.

4. Results

4.1. Case 1: Agile strategy in DGS diagnostics

4.1.1. General information

DGS Diagnostics (formerly known as Oticon Polska Production) is part of the Demant group. It produces medical devices, mainly hearing aids and diagnostic devices (for hearing diagnostics, labyrinth testing, measuring brain waves, etc.). The company employs about 400 people. Currently, the company is located in Rosówek near Kołbaskowo, i.e. in the north-western part of Poland at the Polish-German border.

4.1.2. Production and sale

The produced assortment is very wide. Products are produced both in short series and on massive scale. Even the same product may differ, e.g. in accessories or power supply. The products also differ depending on the customer's location — for example, devices manufactured for customers from Germany are different from those for customer from Great Britain. Due to the large diversification of the product range, it would be economically inefficient to produce all varieties of ready-to-stock products (MTS strategy — Make To Stock). However, the production of finished products from scratch to order (MTO — make to order strategy) would extend the lead time. Therefore, the company produces semi-finished products in stock, and the assembly of ready-made devices from

these semi-finished products takes place for a specific order (ATO Strategy — Assemble to Order). Thanks to such a production strategy, the time from placing an order to producing a finished product is usually 2–3 days. It consists primarily of uploading settings, device configuration and final control.

Some components for assembly are manufactured by the company itself (including motherboards, headphones and some probes), and some are supplied externally, some of the manufactured components are also sold to other companies. Therefore, the company deals not only with the assembly of ready-made devices, but also with the production of many components for these products. Some of the components are produced using the innovative 3D technology.

In-house production of most components is part of the company's production and logistics strategy. Although this is associated with higher production costs compared to the costs of purchasing components from suppliers located in countries with low production costs, it has a number of advantages. First of all, the risk of supply disruptions is eliminated and there is no need to create large inventories (the supplier would like to sell components in large quantities, significantly exceeding the current needs of the company). In addition, transport costs are reduced, and the company has full control over the quality of semi-finished products, which is especially important because medical devices are produced.

4.1.3. Logistics

The company purchases from external suppliers approximately 12,000 supplies, such as electronic goods, plastic housings, power supplies, granules, cables, and some probes. The suppliers are located all over the world. About half of the goods arrive from other continents by sea or air when delivery time is of the essence. Air transport was used especially often during the pandemic. There were also attempts to use rail transport, but it turned out to be problematic — the goods got stuck in Belarus. Delivery times are often long — sometimes up to a year. As a result, the company must place the order well in advance and build up a relatively large inventories.

The company has a warehouse where supply goods and semi-finished products are stored. Some components are stored in the production hall. However, there is no warehouse for finished products, because most products are made to order and shipped immediately after production to the customers. Depending on the location and customer preferences, various modes of transport are used.

4.1.4. Agile strategy in DGS company

DGS's strategy is to be "Agile". The company is and wants to increase its ability to react quickly and flexibly to the changing needs of customers and precisely adjust its products to their needs. In order to achieve the external agility (i.e. for customers) the internal agility was needed. To achieve this, the company

had to change its organizational structure. Even though it is a large company, it wanted to avoid the inertia that this entails. It wanted to increase the efficiency of the decision-making process, and that documents and information not to get stuck in bureaucratic machinery. On the other hand, where possible, the company wanted to achieve economies of scale. Hence the unique organizational structure, combining modern multi-competency teams with traditional departments. However, such a structure is well suited to the specifics of production and customer requirements, as well as to the company's values.

About one-third of the employees (i.e. about 120 people) work in modern "Tribe" teams that operate like small businesses. Throughout the company, there are five such teams dedicated to five customer groups, divided by type of product. Each team is autonomous, independent of other teams. Because a team has simpler procedures and facilitated information flow, it can quickly make decisions and adapt to changing customer needs. The team has autonomy and can run processes in their own way. If there are no orders at a given moment, employees undergo training or improve the processes implemented in their team. In each of the five teams there are employees with different qualifications: production employees, people configuring devices, administrative employees dealing with planning, quality control, technical documentation and customer service. However, these are only their key competences. In addition to these, employees in a team must also have other skills and competences to be as flexible as possible, e.g. to be able to replace other workers. These are open, multidisciplinary people who want to continue learning and develop their competences. Teams do not have a leader imposed from above, the leader should emerge by himself. In fact, the leader should be a customer, because it decides what needs to be produced and when, and the team is supposed to meet his needs.

Since every member of the team is agile, the entire team is also agile. It is the internal agility, which result in the external agility (for customers). However, in accordance with the company's philosophy and values, no one can be forced to do anything. Therefore, employees should not be forced to work in a modern way in multi-competence teams, to constantly learn and be responsible for decisions made. Some employees feel better in a traditional structure with a clearly defined hierarchy and narrow specializations. Therefore, the employee must want to be part of a tribe team, not a traditional department. The company conducts internal recruitment for teams and employees decide for themselves whether they want to work in such a team.

Other employees work outside of teams in traditional departments, with leadership, organizational hierarchy and specific competencies. These departments work for all five teams. These departments are human resources, finance, purchasing, warehouse of supply goods, and production of electrics and semi-finished products. Such solution has its economic justification. For example, it would be ineffective for each team to order supply goods separately, since usually the same supply goods are needed in all teams, and by order-

ing them in larger quantities, economies of scale can be achieved (lower costs of purchasing and transporting). Similarly, many semi-finished products are used in different teams to produce finished products and by producing them in one place, economies of scale are also achieved.

DGS is agile both internally and for its customers, but its suppliers are not agile. In addition, most of them are located far away. Due to the inflexibility of suppliers, long supply chains and long lead times for supply goods, the company has to store them in larger quantities. On the one hand, it involves costs, but on the other hand, during disruptions, it allows to some extent to become independent from the supply market.

4.1.5. Lean elements at DGS

Despite the dominant Agile strategy, the company also successfully uses Lean elements, which may indicate the possibility of combining these strategies. The production of finished goods is agile because this strategy is suitable for one-off and small-lot production, and such finished goods are produced by DGS. Agile is also suitable for high variability of the demand, when a quick response is needed. However, certain components are used in all of the company's finished products. The demand for them is more stable. The company produces them in larger quantities on a massive scale and for these products the Lean strategy works. Mass production makes it possible to apply typical Lean elements — standardized processes, 5S and in general looking for ways to eliminate muda (waste).

4.1.6. Disruptions in the company's environment: Covid-19 pandemic, war in Ukraine and energy crisis

DGS performed well during the Covid-19 pandemic. Initially, the demand for their products decreased as hospitals concentrated on fighting Covid-19, so there was less need for hearing tests. However, there were no production downtimes in the company, neither due to lack of orders, nor due to illnesses or quarantine of employees, nor due to broken supply chains. The company had stockpiles of supplies, and when it was impossible to use sea transport due to the blockade of ports, air transport was used. Although this increased transport costs, the company was able to function without interruption.

The challenge, however, was the year after the pandemic. Due to a decrease in demand for some finished products at the beginning of the pandemic, the company reduced orders for components. Then the demand suddenly increased and it was hard to meet it because the components were in short supply and then some of them got stuck in the Suez Canal. The lead time for an order for supply goods was up to a year. However, the company coped — in individual cases it only had to extend the time of order fulfillment, sometimes to 2–3 weeks, and in some cases to a month.

The war in Ukraine did not significantly affect the company's procurement processes because the company had no suppliers located there. The exception was the supply of steel and construction materials, which delayed the puting into service a new company building. The war, however, had a greater impact on the distribution processes. Russia was a large receiver of the company's products, and after the outbreak of war, DGS no longer cooperates with customers from Russia. In turn, products are currently being shipped to Ukraine, although before the outbreak of the war there were no orders from Ukrainian customers.

Another disturbance has recently been the rapid increase in fuel and energy prices. So far, the company has felt this mainly indirectly. The increase in fuel and energy prices caused an increase in other prices, so the costs of purchasing supplies increased. As for the direct impact, on the one hand, the amount of energy consumption is affected by the need to maintain appropriate temperature and humidity in the production. On the other hand, however, the company has installed solar panels, which allows to reduce energy costs.

4.1.7. Cultural values

The Agile strategy is consistent with the company's values, such as readiness for change, development, innovation, flexibility, and diversity. For example, the products produced are diversified, and the employees in tribe teams are also diversified. Diversity is seen as a company's strength. Teamwork, joint problem solving, joint decision-making, openness and honesty are also values. There are no closed offices in the company, there are open spaces to connect people, not divide them. This is the Scandinavian style of management. It differs from the typical Polish organizational culture, which is more formal and official, with a greater distance between employees and management. However, apparently Polish employees find themselves well in the Scandinavian style, because the fluctuation of employees is very low.

The professed values are also associated with an ecological approach. The company has implemented ISO 14001 and puts pressure on suppliers in this regard. It prefers to work with a supplier that meets environmental standards, even if its products and services are more expensive.

4.1.8. Conclusion

DGS successfully applies the Agile strategy. This strategy applies to the key areas of the company's activity: production of finished products and their distribution to customers, as well as the organizational structure and human resources management. The Agile strategy fits the company both because of the characteristics of the demand and the type of products produced, as well as because of the company's values and organizational culture. The company's strategy also integrates Lean elements in the area of component production in a harmonious way, which confirms the thesis that sometimes Lean and Agile elements can

be combined. However, due to the location of the suppliers and the lead time they offer, sourcing of goods is neither Agile nor Lean and require the creation of a large supply inventories. However, this proved to be an asset in the face of supply chain disruption caused by the Covid-19 pandemic. The company's strategy turned out to be resilient and effective at the same time.

4.2. Case 2: Lean strategy at Poland Smelting Technologies POLST

4.2.1. General information about the company

POLST is a Japanese company based in Wałbrzych — in the south-western part of Poland. It produces two types of aluminum alloys for the automotive industry: liquid, supplied to strategic customers, i.e. two Toyota plants, in the just-in-time system, and solid, produced for other customers. Strategic customers, i.e. Toyota plants, are located in the immediate vicinity of Polst (approx. 200 m), the other in Jelcz-Laskowice a bit further (approx. 120 km). The recipients of solid aluminum alloys are located at a greater distance in various European countries — in the Czech Republic, Germany and Great Britain.

4.2.2. Lean Management in the POLST company

This company is a very interesting case because, on the one hand, it is one of the "Teal" companies, and on the other, it has implemented Lean Management solutions.

Strategic customers, i.e. both Toyota Motor Manufacturing Poland plants, apply the Lean strategy and POLST is the element of the intregrated supply chain. The production of liquid aluminum alloys is fully synchronized with Toyota's needs, and deliveries are made in the just-in-time system many times a day (to Toyota in Jelcz Laskowice nine times a day, and to Toyota in Wałbrzych on an ongoing basis, every several minutes, vats transported using forklifts, internal roads). The POLST company is therefore an extension of both Toyota plants in terms of technology, and the plant in Wałbrzych — also in terms of geography. POLST's production schedules are coordinated with Toyota's production schedule, liquid aluminum alloys are delivered directly to the casting machines without the storage stage. Both on the way to Toyota and while waiting to be poured into the furnace, the temperature of liquid aluminum alloys must be maintained at around 700°C. If more aluminum alloys were supplied than Toyota's production needs, the liquid aluminum would lose its temperature and solidify, so it would have to be reprocessed. Therefore, neither POLST nor Toyota have stocks of liquid aluminum. For such synchronization to be possible, there must be a good flow of demand information. Therefore, Toyota provides demand forecasts for the whole year, then details them every month for three consecutive months, and a specific delivery schedule comes in a given week for

the entire next week. Thanks to such a flow of information, POLST can draw up its production plan for liquid aluminum and assess its demand for supply goods.

4.2.3. Items not included in the Lean strategy

The second type of product are solid aluminum alloys. Their production does not take place in the lean system, but traditionally, and the logistics and production processes are not integrated with the processes of the customers. POLST wins orders for the production of solid aluminum alloys in tenders organized every three months, so it is not a permanent cooperation. Although the POLST company produces solid aluminum alloys to orders, which result from the won tenders, deliveries are less frequent, so inventories are created. They are kept in the production hall, as the company does not have a warehouse. Polst produces solid aluminum alloys only in the case of free production capacity, as production for Toyota is a priority. Recipients of solid aluminum alloys maintain larger stocks, they also have other sources of supply, so a possible delay in delivery by POLST will not stop their production.

4.2.4. Human resource management: Lean or Agile

The human resources management system at POLST differs from the human resources management system at Toyota. POLST uses a Teal management system for some employees. Toyota, on the other hand, has stronger leadership and a greater leadership role.

At POLST, The Teal Management covers several out of 65 employees. The entire managerial and administrative staff is involved in this system — the president, production manager, maintenance manager, purchasing and sales employees, accounting, environmental protection, HR and health and safety employees. However, most of the approximately 50 people working directly in production and in the warehouse work in a traditional mode. Patterns of change are partly included in the Teal management system. Employees have been given more opportunities to make independent decisions than before, for example they can make purchasing decisions up to a certain amount of money.

Employees involved in teal management have a lot of decision-making power, but they must take responsibility for their decisions. Not all employees want to take on such responsibility. For example, warehouse employees do not want to decide whether or not to accept a given order. On the other hand, some people employed in managerial positions did not find their way in turquoise management — two people from senior management left because they felt bad in flattened structures.

Teal management turned out to be more effective compared to the hierarchical structure. The management and administrative staff was reduced by one third — their functions were taken over by other employees. Combining functions is characteristic of teal management. For example, one of the people

dealing with purchasing is also involved in production planning, waste shipment (partly to Germany, partly to Poland), insurance, ISO system and import of parts for maintenance from Japan. The second person from the purchasing department is responsible for improving The Kaizen and employee training. One of the production employees additionally deals with the implementation of software in production and running the website. One of the employees of the warehouse deals with the waste system. Teal management is therefore very developmental for employees — they have the opportunity to learn and take on new challenges. They are creative, committed and willing to develop. Taking up additional functions is associated with additional remuneration — the employee writes to the "Promotions" what additional function he performs and what raise he would like to receive. Employees believe that after the introduction of teal management, the atmosphere at work has improved and that teal management is more effective. This method of management is different from the Lean management system and is more like the AGILE system.

4.2.5. POLST during the disruption caused by the Covid-19 pandemic

The risk of disruptions in deliveries between POLST and Toyota was mitigated by annual scheduled repairs of production equipment, the proximity of both companies, which reduces the risk of problems in transport, the maintenance of additional means of transport in the event of a break-down and the ability to reduce the speed of Toyota's production line to keep the minimum level of flooding the furnace. POLST also maintained a safety stock of semi-finished products, small stocks of solid aluminum alloys and supply stocks sufficient for about a week of production. Toyota has never had to stop production due to interference on the part of POLST.

However, it turned out that the risk resulting from close integration for POLST was not taken into account. The inability to produce liquid aluminum for stock meant that in the absence of demand from Toyota Poland, the production of liquid aluminum at POLST had to be suspended — such a situation occurred during the Covid-19 pandemic. Production at Toyota was suspended, so POLST was also threatened with stopping production and shutting down the furnace. In addition, the demand for solid aluminum alloys from other customers also decreased significantly during this time. However, decisions were made to produce solid aluminum alloys despite the fact that there were no orders for them, i.e. in the MTS (make to stock) system. It turned out to be a very good decision. When production at Toyota was resumed, the demand for liquid aluminum alloys increased and POLST resumed production in larger quantities. Therefore, it did not have free production capacity for the production of solid aluminum alloys, for which customers also increased demand. However, thanks to the earlier production to stock, POLST was able to increase simultaneously production for Toyota and satisfy the increased demand of other customers for

solid aluminum alloys. The possibility of production for stock, although not in line with the Lean strategy, helped successfully overcome the disruptions resulting from the pandemic.

To sum up, in the case of POLST, the LEAN strategy — integration, synchronization of production with demand, just-in-time deliveries, no inventory — was very effective in conditions of stability. In contrast, the pandemic has shown that in the event of disruptions in integrated chains, disruptions in one link spread to others. The way to reduce the negative effects of disruptions — in the case of POLST, diversification of production and customers and production.

5. Conclusions

Lean Management is more than a way of organizing processes. It is a concept and even a philosophy of managing the entire organization, not just the processes themselves. It requires a new approach to all management functions — changes in the organizational structure, incentive system, employee responsibility, the use of appropriate forms of organization of production and logistics processes, etc.

However, eliminating waste is actually its essential element. They can be considered in three levels:

- elimination of unnecessary activities and avoiding waste of resources;
- optimal adjustment of process parameters to actual needs ;
- smooth flow of the product stream.

The first aspect can be considered as the basic one, i.e. it contains the first steps that need to be taken to improve processes — simple actions — e.g. paying attention to unnecessary activities that are performed in a given organization, keeping the workplace tidy (5S method), etc., avoiding waste of materials, better use of time, space, machines, devices, people.

The second level is "7 types of muda", because waste is not only, for example, too much production waste or too high energy consumption, but also e.g. too much stock, quality level not adapted to the real needs of customers (delivering them what they do not need).

The third is the smooth flow, which can be achieved by using tools such as Value Stream Mapping.

Considering these levels in the context of the considerations presented in this publication, it can be said that:

- muda: When it comes to eliminating waste at the basic level, there is no contradiction between LM and Agile or any other concept of management. Any reduction of wastes is beneficial, especially as a result of organizational activities, better management and innovative ideas. Every company should eliminate such waste;

– mura: The implementation may be associated with a specific type of costs, and this would require an economic calculation to assess whether these changes are desirable;
– muri: Smooth flow and the associated the even load on resources, if it also results only from purely organizational activities, is also desirable. However, if it has an impact on process costs, it requires the economical calcualtions to asses if such a strategy is beneficial.

So if "Mura" and "Muri" are difficult to achieve, then perhaps Agile is more beneficial than classic Lean Management.

Both the analysis of the literature and the described cases of companies indicate that Lean and Agile strategies can be combined to some extent. It is possible to combine Lean strategies with Agile elements (as in the case of POLST) and Agile strategies with Lean elements (as in the case of DGS). In addition, such a combination turned out to be very effective in both tested cases. At Polst, the Lean strategy, which was very effective in stable conditions, turned out to be ineffective in the conditions of disruption caused by the Covid-19 pandemic. Only thanks to the Make To Stock strategy, Polst avoided stopping production when orders from strategic customers were suspended. In addition, thanks to this strategy, in a situation of increased demand after the pandemic, the company turned out to be Agile and could meet the increased needs of both strategic and other customers.

In turn, the second surveyed company successfully applies the Agile strategy, but some production processes (typical, produced on a larger scale) are organized according to the principles of the Lean Management. Combining a given strategy with elements of another may therefore be more effective and more resistant to interference than using a "pure" strategy. Thus, it is possible to effectively combine elements of both strategies.

Incorporating elements of one strategy into another is possible because, according to the authors, there are some similarities between Lean and Agile. Both the Agile and Lean require a high level of product quality and short lead times, defined as the time from the customer placing an order to its delivery. On the one hand, shortening the time reduces costs, thus favoring the Lean concept, but also favoring flexibility and quick response to customer needs, i.e. the Agile concept.

Often, thanks to the implementation of Lean Management solutions and tools, such as e.g. SMED, the company becomes more flexible and can quickly respond to changing customer needs, as in Agile.

If the characteristic feature of Agile is the effective flow of information, then in Lean Management information has always played a very important role, e.g. multi-stage information about the planned demand from recipients. Thus, if new opportunities for more effective information management (more effective technologies) appear, this does not exclude the need to use the existing methods of managing or streamlining processes, the processes simply become even more effective.

The thesis was also confirmed that the effectiveness of Lean and Agile strategies is influenced by both internal and external factors. Therefore, each of these strategies is suitable for different conditions of the functioning of the supply chain. Factors such as the risk of supply disruptions or product characteristics may influence which strategy should be used. Comparing them and assessing which is more effective is therefore pointless in many cases. However, although so different, they can be used in the same supply chain, although at different stages of it.

The result of proper application of both strategies are lower costs, better quality of products, better level of logistic service, customer satisfaction and greater involvement of employees, and thus the effect trade — up.

The results of the research carried out by the authors are important for both theory and practice. As it has been shown — these are separate strategies that apply in different conditions (different industries, markets in which companies operate, different characteristics of demand). Therefore, in the opinion of the authors, discussions about which of these strategies is more effective are pointless. Moreover, the results of these studies confirm that combining lean strategies with agile elements and vice versa can be more effective than pure strategies. Therefore, they constitute a significant contribution to science (theory), but also to business practice, because they can support the decision-making process.

Further directions of research proposed by the authors are:

- conducting research in companies that use Lean Management, Agile or a combination of Lean and Agile strategies, in order to examine the impact of these strategies and their combination on the company's financial results and its resistance to disruptions;
- conducting research on the problem at which stages of the supply chains the Lean strategy is used and at which Agile, what factors influence this division (e.g. whether the transition from Lean to Agile is related to the Pull and Push flow and the determination of the junction point) and what is the efficiency and resilience to disruption of such supply chains.

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Appendix

Table 1.
comparison of the lean and agile concepts

Feature	Agile	Lean
demand	changeable, unpredictable	constant, predictable
product	non-standard, innovative	standard
number of varieties	great	small
production type	low — volume, unit production	mass production
inventories	higher	lower
suppliers	many, weak integration	few, strong integration
supply	local, regional	local, regional, global
sensitivity to interference	smaller	bigger
strategy	value creation	focused on reducing costs
workers	flexibility, responsibility, creativity, team work	
quality	high level of quality of the finished goods an supply goods, improvement of processes	
location of suppliers	short supply chains are desired but are not neccessary	–

Source: Own preparation.