

## SUPPLY CHAIN ORGANIZATION: AGILE VS. WATERFALL

### Ana Todorova

University of Ruse "Angel Kanchev",  
Faculty of Business & Management, Bulgaria  
E-mail: attodorova@uni-ruse.bg

### Sen. Assist. Prof. Igor Sheludko, PhD

University of Ruse "Angel Kanchev",  
Faculty of Business & Management, Bulgaria  
E-mail: isheludko@uni-ruse.bg

**Abstract:** *Global supply chains have faced two unprecedented challenges in less than five years. After the worldwide Covid pandemic that hit in 2019, in 2022, businesses faced the fears and problems that arose due to the conflict in Ukraine. The military strike has led to unpredictable vulnerabilities in supply chains, including staff and resource shortages and losses due to closures (or nationalization/confiscation). Organizations continue to try to break away from their dependence on Russia, looking for ways to cooperate with local partners, shorten deadlines and minimize costs.*

*In the past this was achieved through lean operations, long lead times and cheap labour. In the future, this will not be a winning strategy. Instead, flexibility, visibility, automation and highly skilled staff will play a key role. Together, they are expected to reduce costs and improve decision-making and standardized processes. The ability of companies to cope with modern challenges directly depends on their ability to adapt to new realities and the speed with which they do so.*

*This report aims to contrast two of the most common supply chain management models: traditional Waterfall and adaptive Agile. The main characteristics of the approaches are derived from the point of view of their applicability and effectiveness in business processes.*

**Keywords:** *supply chain, agile, waterfall.*

**JEL:** L11, L17, L26

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### Introduction

The traditional supply chain of the mid-20th century was driven by technology: the emphasis was on minimizing unit costs with little product or process flexibility. Collaboration in a positive sense between actors within the scope of a supply chain is considered unacceptable.

Globalization and liberalization, however, increase the intensity of competition. Short product life cycles, hard-to-predict demand and intensive innovation, broadly defining the modern business climate, force companies to show maximum flexibility, efficiency and innovation. The dynamically changing face of contemporary society in recent years has transformed traditional production and led to the appearance of approaches centred on cus-

tomers and their desires. There is a transition from mass flow production and its inherent high automation to the efficient creation of products of high quality, satisfying each customer's individual requirements.

The focus is increasingly shifting from price, quality and service to delivery, flexibility and innovation, and it is the concept of flexibility that should be seen as key, as it reflects the ability of organizations to change or respond to unforeseen events with little loss of time, effort, costs or performance. Flexibility is also a response to environmental uncertainty on a global scale, where it logically follows that supply chain management and capabilities can be a source of severe competitive advantage. As a result, cooperation and trust between partners become essential elements of the

supply chain and should not be neglected by project managers (Lemoine, 2016).

### **Exposition**

A supply chain is any system of organizations and activities related to the processes of creation, movement and storage of products, services, and related information flows from the moment of their occurrence at the extraction stage of raw materials to the place of their delivery to the end user. It includes everyone directly involved in the provision of goods and services to the end customer: from extracting raw materials, supplying materials and components, and producing goods to those engaged in wholesale and retail trade, including transport companies, warehouses, information services, financial institutions and several other intermediaries involved in the movement of material, financial and informational flows, with the client always at the beginning. Each chain has four main types of flows: material, information, financial and knowledge flows (Kuzmanov & Hadjieva, 2011). Due to the objective role of an integrating factor of the material flow, binding the participants in the individual stages of production and realization, the main focus is improving the management of material and related with them information flows throughout the chain (Manasieva).

Exchange relationships coordinate and direct the activities in the production system where resources are used, combined and transformed into output. As resources are interconnected, coordination between actors is necessary, on the one hand, to realize savings and, on the other hand, to effect change and innovate. Organizations, in many cases, have conflicting interests that put their relationships under competitive pressure, i.e. the complexity of the connections is determined by achieving a balance between competition and cooperation through an approach that connects the members of the chain and favours the increase of value for the end customer and the minimization of the time and cost of its creation (Manasieva).

These issues cannot be effectively met only through piecemeal modifications at

individual organizations, because the dependencies between them in the process of production and delivery of products to consumers require coordination and synchronization to a very large extent. The practices used to adapt to the environment and solve its challenges are collectively known as Agile and outline the main differences between the traditional models of the last century and modern supply chain business processes.

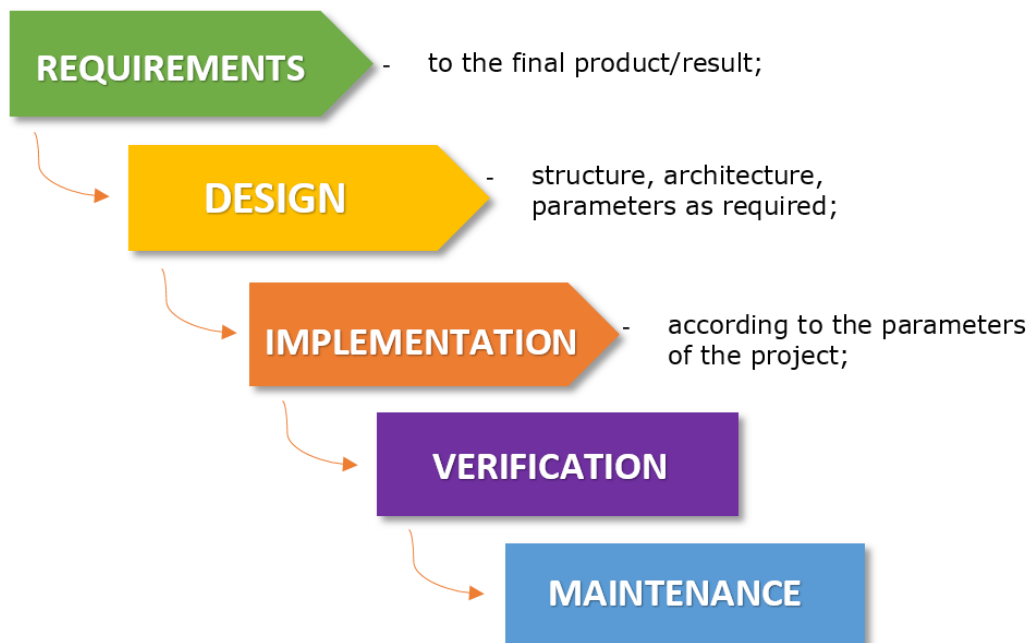
To highlight these differences even more effectively, the present study compares two of the most applied approaches to managing distribution chains: Waterfall, a characteristic of traditional manufacturing, and Agile, preferred in modern entrepreneurial models. Comparing them provides clear and specific answers to questions such as why organizational culture so often becomes a breaking point between partners, why it is so difficult to find the right intersection of collaboration between people performing different tasks in a system, and why the flexibility that characterizes Agile methodology should be a priority of modern business organizations. As Mandajieva (2008) point out, *"Today, companies are scattered in different countries of the world, each producing those components in which they consider themselves competitive and specialized compared to other companies. A successful supply chain must organize the flow of goods at such a level that the distance that separates the individual countries where the various components for the finished products are manufactured is overcome. An efficient chain must be able to synchronize the activities of the individual enterprises that produce the finished product together. But, a successful supply chain must make the global factory work, and this is done by putting in place transport and information management models that enable two separate factories (one for tires in India and the other for wheels in Germany) to be regarded as two departments of a common factory situated in one area."*

### **Agile vs. Waterfall**

Waterfall is so named because of its sequential or cascading approach (Graph.1) - just as water falls down and does not return, the phases follow one after the

other in this model. They are not restarted, or at least it is not desirable, not expected, and it would be pretty expensive if this happens. This methodology is considered most suitable for projects where the scope, in addition to being precisely defined, is also crucial. The project's scope is

fixed, and time is a limiting factor. With a clearly defined area, the main task of the project manager is to plan all types of resources in a schedule in the parallel projects and take into account the necessary sequence of actions (tasks) in individual projects (Murugesan).



Graph. 1 Process logic in the Waterfall approach (adapted from Agile vs. Waterfall: Showdown For Software Development Domination, Conrad, A., 2017)

Source: authors

In a well-funded Waterfall environment, employee responsibilities are more technological than business oriented. They are expected to work on their time-windowed tasks, execute them correctly, integrate one component well with another, and so on. The comfort of tasks in a Waterfall project is ostensibly provided by an analytical network of tasks and roles operating well before the development stage. The main criticisms of it are regarding the lack of flexibility and the dependence on documents (Dautev, 2015).

**Main features of Waterfall:**

- traditional model;
- sequence - only after the first step is completed, the second is started, and so on;
- once the model is complete, it is delivered;
- involves a lot of planning before launching;

- customer suggestions are challenging to incorporate during implementation and/or after project completion;
- suitable for projects that have clearly defined requirements and those that do not foresee changes;
- applied in situations where development is responsible and controlled;
- implementation/development is consistent;
- little ability to quickly respond to changes;
- planning is done only once before the test cycle (Gupta, 2019).

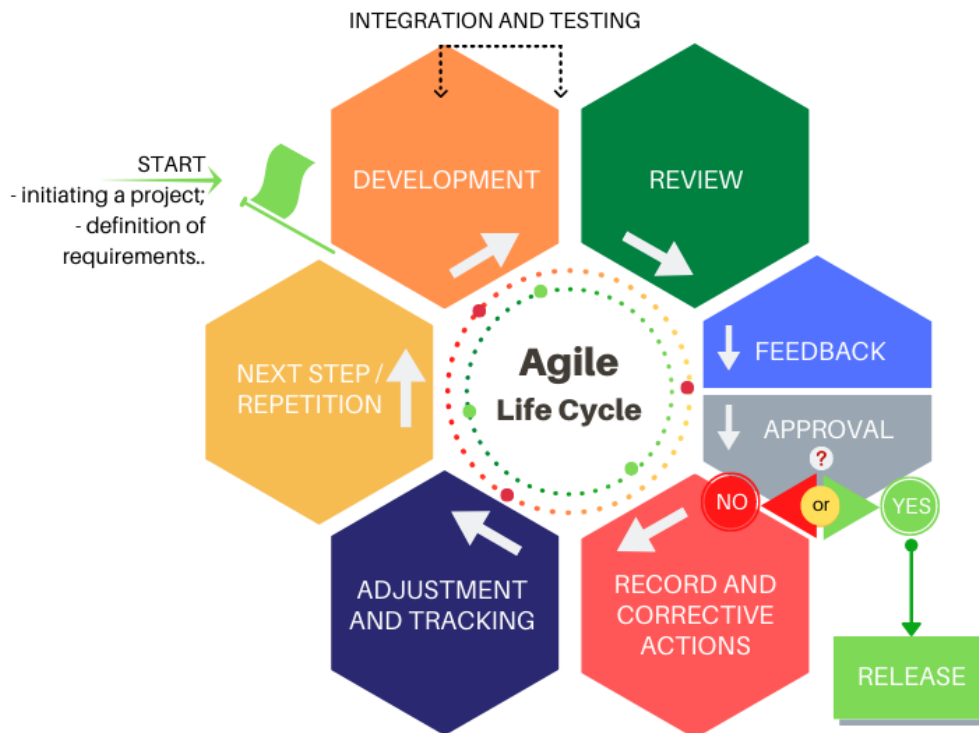
Conversely, Agile is suitable for projects where time is precisely defined, resources are a determining factor, and scope is subject to planning. This is a collective term for all methodologies (Scrum, Kanban, etc.) that can be applied to implement a project in a flexible and adaptable environment and are aimed at providing the maximum added value (Economy,

2017). Their integration does not automatically mean that the project will be successful. Still, if implemented correctly, the result is increased motivation and commitment of people, higher flexibility to specific requirements and adaptability to changes in the environment, minimized risk of failure and saved funds (Durankiev, 2016).

Adaptive approaches have been developing since the mid-20th century, but the concept of flexibility was considered formally formulated in 1995 (Duncan, 1995). As a methodology under the general name Agile, they spread in 2001, when a group of developers united behind a document called Agile Manifesto, which focused on several basic principles of

optimization: interaction between processes, tools and participants; prioritizing development over extensive documentation; cooperation with customers; priority for changes in the work process against the preliminary plan. As consumers are changing rapidly, the business model and the management of the entire supply chain must change commensurately (Economy, 2017).

Agile puts visibility, results and financial optimization ahead of predictability and peace of mind. The expectations of senior management are transformed (but not excluded) from technological to communication and analytical - with great personal responsibility for the success of the product.



Graph. 2 Process logic in an Agile approach (adapted from Agile vs. Waterfall: Showdown For Software Development Domination, Conrad, A., 2017)

Source: authors

Its main advantage is that it breaks projects into small steps with minimal planning but does not affect long-term project planning (Graph.2). The phases, also called iterations, are executed in short time frames of 1 to 4 weeks. During each step, the team of specialists with different competencies works on the functions in sync. The goal is to present a working

product at the end of the respective iteration. Even if it does not have enough functionalities to be released on the market, it provides an available working solution at the end of each stage. It goes without saying that to present a finished result, it is possible to go through multiple iterations (Kapade, 2018).

**Key features of Agile:**

- an iterative approach, which means that it is done in iterations - with each performed iteration, a new "piece" of the task is completed, and at the same time, the results of the previous iteration are improved;
- delivered in batches, and if any changes are needed based on customer feedback, they are implemented in the next set;
- one of the most modern models, involving minimal planning;
- customer proposals are integrated quickly;
- suitable for projects that need to evolve and those that involve changing requirements;
- the whole team controls the process and has the autonomy to make decisions;
- follows a collaborative approach;
- high intuitiveness and ability to quickly adapt to changes;

- planning is at every stage of development, before and after software development;

Many indicators evaluate modern project management, but the following can be marked as key: quality, communication, efficiency, flexibility, and customer satisfaction (Conrad, 2017). According to these main parameters, the differences between the flexible Agile and the traditional Waterfall methodology are summarized in *Table 1*.

It can be seen from the table that the advantages of Agile versus Waterfall are more and only in terms of the key *performance indicator of the project*, traditional methodology turns out to be an advantage. However, the business cannot afford to waste months in the planning, implementation, and finally reaching consumers - it will no longer be adequate for consumer attitudes. In today's dynamic world, this is impractical (Economy, 2017).

**Table 1. Main indicators of Flexible Agile and Traditional Waterfall methodology**

METHOD INDICATOR	AGILE	WATERFALL
QUALITY	Improves work results by stimulating and maintaining open communication between all participants throughout the process to ensure the quality of the final product;	All checks and tests are carried out immediately before the end of the process, which makes correcting errors extremely difficult, i.e. any corrective actions are taken ex post facto;
COMMUNICATION	It favours constant face-to-face communication and cohesive teams over documentation and strict hierarchy, so there is less bureaucracy and corrections can be made more quickly;	Relies primarily on the documentation and Gantt charts. Excessive and aimless communication can complicate and delay the achievement of workable results. Suitable for highly regulated areas and projects;
PROJECT EFFICIENCY	Because of its open nature, it can lead to the risk of disruption and overspending if the parties in the cycle fail to reach a consensus. This is where the critical role of the project manager comes in, keeping the sponsor and contractor focused on the end goal;	When cost and schedule are of the utmost importance, the approach is advantageous due to strict adherence to set budgets and deadlines. Pre-planning is cumbersome and delays the start-up, but problems are more likely to be fixed before the project starts.

<b>FLEXIBILITY</b>	Deliver working iterations to the client in short cycles, allowing both parties to shape and adapt the product to incidental changes before finalization;	Each process step depends on completing the previous one; one stumbling block can stop the entire process. Innovation opportunities in the middle of the project are impossible;
<b>CUSTOMER SATISFACTION</b>	Allows the customer to be actively involved in the development of the product from start to finish, which can lead to the refinement of the final product according to individual specifications;	It relies on strict adherence to a preliminary plan agreed upon between the contractor and the client. If the client is not satisfied with the final product: either the contractor did not strictly follow the plan or the client did not adequately state their requirements.

Table 1 (continued).

Source: authors

An interesting comparison between the two approaches can also be made in a culinary context. Traditional methodologies are likened to ordering at McDonald's: *One cheeseburger, please!* The product has preset parameters, and there is no room for changes - interpretations initiated by employees or customers are unacceptable. At the same time, in an ordinary fast food restaurant, the customer participates in the execution of the final product: *Hamburger, please! Cucumber? Yes. A tomato? Yes. An onion? No!* In this way, a product is created entirely according to the individual preferences of the user, which also implies higher satisfaction on his part. The example, although elementary and extremely superficial, indicates, on the one hand, what we can expect from each of the two compared approaches, and on the other hand, for whom and when it is suitable for the application.

### Organization of Agile supply distribution chains

According to an INVENSIS - Global Learning Services study, about 85% of companies have suppliers worldwide as clients. Of that percentage, two-thirds struggle with increasingly complex supply chains, but businesses with an embedded agile methodology outperform their competitors by multiples. The approach also improves delivery efficiency - 94% of deliveries arrive on time, a nearly 7% increase over traditional or less flexible delivery arrangements. In addition,

adhering to Agile helps to reduce another critical factor inventory holding: inventory holding days are reduced from 108 to 85, i.e. 23 days are saved (Keita, 2022).

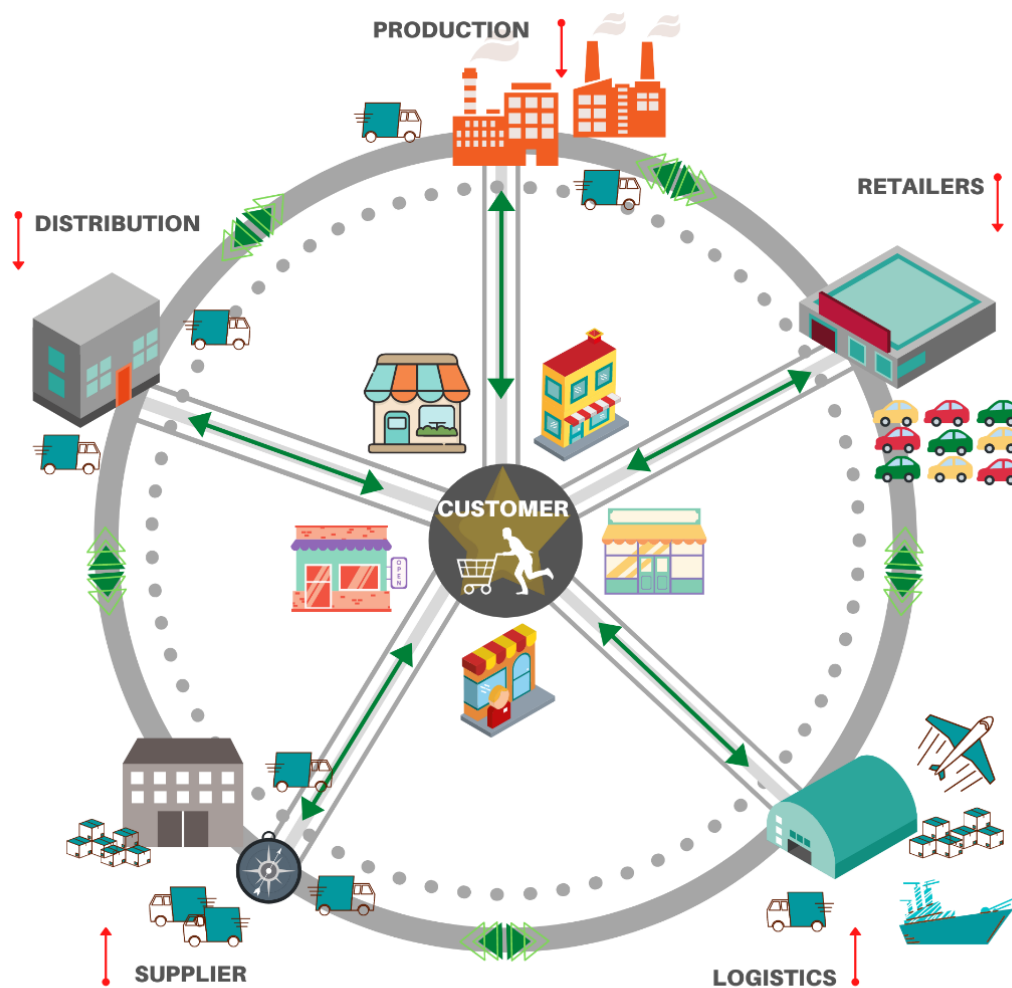
### The Agile chain is based on four foundations:

- ✓ **Virtual integration:** Until recently, complex inventory optimization algorithms drove each company's planning and production systems. As a result, companies and suppliers operated with their own material procurement and production systems that were not connected well or not related at all. Advances in technology allow supply chain partners to be connected in virtual space and share demand data in real-time. The benefit is more precise planning and shorter delivery times between supply chain partners, reducing waste, increasing profitability, and increasing customer satisfaction;
- ✓ **Integrated processes:** Effective sharing of operational and planning data requires integrated systems and supply chains that work seamlessly together. Upstream and downstream actors in the supply chain must also work together, sometimes even to develop joint products. As processes and people integrate and collaborate, the whole can become more significant than the sum of its parts;
- ✓ **A competitive network:** Linking many companies together aims to create an entire supply chain with higher efficiency, faster speed and better customer satisfaction. Furthermore, agile technology specialists argue that we are entering

an era of network competition, and it will be leveraged organizations that can use better structure, coordinate and manage relationships with their network partners, and be tied to their end customers through better, closer and more flexible communication that will be profitable and successful. For this purpose, everyone involved in the chain must make a conscientious and committed individual effort, thereby reducing the burden on individual consumers, i.e. the task should be divided among the collaborators according to their core competencies, and the degree of their performance will matter at each stage;

✓ **Market sensitivity:** The supply chain can sense and respond to actual demand rather than projected consumption rates, which is its greatest strength. In forecast-based systems, production

planning, inventory levels, and material purchasing are driven by extrapolation: sales data and demand forecasts made weeks or months in advance are extrapolated against future expectations. As a result, plans rarely match actual customer orders. In the modern supply chain, demand signals from the customer provide early warning of existing orders. The demand forecast is based on the daily point of sale (POS), and the supplier can change the corresponding production schedule and transmit its new plans accordingly to alert its suppliers. Among the good practices is the ability to listen to customers because, undoubtedly, the success of the supply chain is based on feedback from the end user. Therefore, the consumer's voice is the actual demand that drives the supply chain (Sher, 2016).



Graph. 3 Basic Scheme of an Example Supply Chain (adapted from Snyder, 2013)  
 Source: authors

To achieve excellent integration between these elements, any organization must have a network based on electronic connectivity between retailers and all other actors in the chain, thereby achieving end-to-end visibility (Graph.3). In addition, using modern planning applications to support work teams with factual data when making decisions, and sometimes with alternative options for what to do, will stabilize the chain.

Agile models are not just a modern possibility but a necessity for the success of any company. They are not a panacea, but through them, a solution can be found to many problems generated in modern supply chain management networks (Katsarov, 2018).

### **Agile in Practice**

Among the examples of implementing the Agile methodology stand out Amazon, Dell, Spotify, Tesla, Facebook, WordPress, Netflix, General Electric, Adobe and several other smaller or larger companies - size does not always matter, but the desire to meet user expectations (Poskitt, 2017).

Amazon is becoming a solid and recognisable brand thanks to its omnidirectional focus - books, electronics, cloud services, artificial intelligence, and their Alexa AI assistant is a service that is built into everything from refrigerators to vehicles. The company's success is mainly due to the drive not just to innovate but any innovation to increase efficiency and support customer service because that is what its main priorities are. Unfortunately, many organisations make the mistake of focusing primarily on technological advancements at the expense of efficient and economical product manufacturing and/or completely neglecting consumer interests. Amazon has been developing and implementing its flexible Agile model for years, balancing innovation and efficiency, adapting to change and finding new ways to improve delivery times, logistics and all other elements of its interaction chain (Leonard, 2017). As a result, the most prominent online entrepreneur proves that the symbiosis between two apparently

conflicting priorities is mission-possible and has maintained its position as a leader in e-commerce over the years. The key is in the precise, systematic analysis of the organisation's internal and external environment and day-to-day sales points, revealing the trends that interact in these areas and providing guidance for specific measures against each of them. The success factor is creating a cross-functional team, including all stakeholders, who are equally responsible for communication, coordination and results (Kirova, 2018).

The American corporation General Electric underwent a fundamental change in the management model in 2015. and "opens the eyes" of other global conglomerates to the seemingly right direction for development within the modern business environment. After analyzing the results of their infamous performance appraisal system (ranking employees and removing the bottom 10%), GE concluded that they had a problem and that the solution lay in revamping the performance management system. The new system relies on managers guiding and coaching employees to achieve goals, and accordingly, the latter is considered to be working in a less compressive environment. They also use their custom-built PD @ GE app to facilitate regular feedback from and to employees. With the app, each employee sets a series of priorities and seeks ideas, opinions and feedback, which they can also provide to their colleagues in real-time. Employees can also request an in-person meeting anytime - these conversations focus on transparency, honesty and continuous improvement. Compared to Amazon, however, the innovations and the radical change in the management model at GE do not seem to achieve the desired success - the period from 2015 to 2018 was the most difficult for the company, and it even lost its status as a *blue chip*<sup>1</sup> company. High indebtedness due to failed investments and bad decisions, including those, regarding supply chains, has been cited as the cause of the industrial giant's problems. Whether the fault lies with the Agile methodology and/or its lack of

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<sup>1</sup> The term *blue chip* originates from poker and identifies large and strong companies that have proven their leadership position in a relevant sector. Blue chip companies are considered less risky and less likely to go bankrupt (Chen, 2022).



understanding and misapplication is a question that requires further investigation and knowledge of GE's external and internal environment (GE, 2017).

A highly current example of the benefits of Agile is the outbreak of the pandemic in the second largest economic power - China. The development of e-commerce in Bulgaria is indisputable, and partnerships of Bulgarian companies with manufacturers and traders from China are commonplace. The pandemic and subsequent border closures have disrupted this lean supply chain built over the years. They broke it in terms of production, availability and delivery times (Capital, 2022). A number of online merchants (and not only) in Bulgaria, especially those working on the principle of dropshipping, did not show such foresight and firmly chose to stick to an insufficiently flexible supply chain without ready-made alternatives. As a result, within a few months and especially in January – March 2020, these retailers were stranded, and it was impossible to meet the needs of their customers. Not only did they have no prepared options for a crisis, but despite the subsequent damage of the epidemic, they failed to adapt to the changed environment.

Unlike them, other digital retailers have established a contact network with numerous suppliers from different continents and/or Bulgaria. They do not rely only on China, which is evident in their trouble-free operation and increases in turnover despite the crisis. They build their business model according to the flexible Agile approach and find profitable solutions according to the dynamics of the environment. Still, it's correct to say that the pandemic and especially its aftermath were hard to predict and expected to take a financial toll on even the most resilient entrepreneurs (Kirchev & Dimitrov, 2020).

Even before the corona pandemic subsided utterly, the conflict in Ukraine severely impacted the structure of supply chains. The situation is accompanied by ever-increasing costs and inflation and is reflected in complex, almost impossible supplies of primary raw materials (Neikov,

2022).

Military action, the crisis in Ukraine and wide-ranging sanctions imposed on one of the most significant economic powers, Russia, have caused some flights to be cancelled or diverted, putting pressure on cargo capacity and raising fears of further supply chain disruptions. They also pushed up energy and fuel prices, increasing the cost of supplies and goods and causing many other challenges for companies trying to transport goods.

According to Arama Kukutai, CEO of Plenty<sup>1</sup>, *supply chains are under pressure and have been for some time*, requiring companies to be flexible and seek to reduce their reliance on long, complex supply chains, as well as on imports. He also adds that the new reality requires manufacturing where the customers are, i.e. recommends an approach fully aligned with the characteristics of Agile (Foroohar, 2022).

### Conclusion

The analysis of the methodology and the listed examples of the implementation and organization of supply distribution chains show why the Agile strategy is becoming a priority and preferred in the modern era. It focuses on logistics, supply and inventory management. As a result, excess inventory and potential shortages are eliminated with its help. Supply chains managed through the approach are the best because they get more accurate data and consider current market needs.

It is essential to consider agile systems' specific characteristics and not ignore their shortcomings. Despite the enviably successful example of the giant Amazon, adaptive approaches can be extremely ineffective in large organizations and are recommended to be applied mainly to inconsistent or evolving projects. Also specific to agile is the lower degree of risk since the activity carried out up to the moment of the particular iteration is approved immediately, and there is the freedom to make continuous improvements. But this can be a prerequisite for

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<sup>1</sup> Plenty is a vertical farming company that brings fresh, clean, and craveable produce to people everywhere. Plenty's vertical farms a fraction of the water and land required in conventional farming, are pesticide-free and produce zero fertilizer runoff (Source: [www.plenty.ag](http://www.plenty.ag)).

lack of correspondence between the design and the final product, which ultimately does not meet the client's expectations, although in most cases, the changes made are precisely at his request.

Many organizations do not accept agile approaches and define them as extreme and claim that they are used only because they are fashionable but not proven cost-effective and practical. As a trend, hybrid methods are applied: a cross between agile and planning approaches, since managers cannot free themselves from traditional practices such as planning and forecasting

a database from past periods.

Regardless of the chosen methodology that business managers adhere to, there is no doubt that the current market environment requires a supply chain capable of handling sudden changes in demand and strategies focused on cost and speed to reach customers. In addition, dynamics in market demand, different delivery times of raw materials, product quality and information are sources of uncertainty that create the need to build a flexible and adaptable supply chain for any company to be successful and competitive.

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