The impact of the Kanban model on Toyota's agility

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Abstract

This study investigates the working mechanisms of agile organizations by exploring theoretical concepts associated with their practices and applications. The Kanban model is examined as one of the key models contributing to organizational agility, particularly in the context of Toyota's operations. The study focuses on the implications of applying Kanban principles, including visualizing the workflow, limiting work in process, managing the flow, and pulling systems, in improving Toyota's agility. The results show that the implementation of the Kanban model has a significant positive effect on Toyota's agility, highlighting the model's potential as a key driver of organizational agility.

Keywords: Agile Organization; Kanban Model; Agility; Toyota Company.

JEL classification codes: L23, L51, O31.

أثر نموذج كانبان على رشاقة شركة تويوتا

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ملخص :

تبحث الدراسة في آليات عمل المنظمات الرشيقة من خلال استكشاف المفاهيم النظرية المرتبطة بممارساتها وتطبيقاتها. وقد تم إختبار نموذج كانبان كأحد النماذج الرئيسية التي تساهم في تحقيق الرشاقة التنظيمية، لا سيما في سياق عمليات شركة تويوتا. تركز الدراسة على الآثار المترتبة على تطبيق مبادئ كانبان، بما في ذلك تصور سير العمل، والحد من العمل قيد التشغيل، وإدارة التدفق، وسحب الأنظمة، في تحسين رشاقة شركة تويوتا. توصلت الدراسة أن تنفيذ نموذج كانبان له تأثير إيجابي كبير على رشاقة شركة تويوتا، مما يسلط الضوء على إمكانات النموذج كمحرك رئيسي للرشاقة التنظيمية.

الكلمات المفتاحية: منظمات رشيقة، نموذج كانبان، رشاقة، شركة تويوتا.

تصنيف JEL: L23, L51, O31.

Introduction

The rapid and transformative changes in the business environment have necessitated a paradigmatic shift in organizational strategies to ensure long-term sustainability. In response, organizations are embracing agile practices as a means to adapt to complex environmental variables, thereby enhancing their competitiveness and strategic resilience. Strategic agility has emerged as a critical concept in this context, enabling organizations to adapt their strategic direction, expand their options, and maintain their competitiveness in the face of uncertainty.

Agile organizations possess the capacity to identify opportunities and respond promptly to potential risks, while simultaneously tracking changes in their business environment to realize advantages and mitigate risks. The Kanban model is a prominent framework that enables organizations to manage their operations more effectively, thereby fostering agility.

The escalating complexities and unpredictability of the business environment have prompted organizations to seek innovative approaches to achieve agility. The Kanban model has garnered significant attention in this regard, with numerous studies highlighting its potential to improve organizational agility. This study seeks to investigate the application of the Kanban model in enhancing Toyota's agility, specifically examining the effects of workflow visualization, work-in-progress limitation, flow management, and pulling systems on organizational agility.

To address this research problem, the following research questions are posed:

- How does the application of the Kanban model contribute to the development of Toyota agility?

- What are the key drivers of agility in organizations, and how do they relate to the Kanban model?

- How do the concepts of workflow visualization, work-in-progress limitation, flow management, and pulling systems contribute to the development of agility in organizations?

This study aims to contribute to the existing body of knowledge by identifying the key characteristics of agile organizations and the most effective means of achieving agility in organizations. Specifically, this study will investigate the intellectual and conceptual framework of agile organizations and examine the applications of the Kanban model to enhance their characteristics. The findings of this study are expected to provide valuable insights into the effects of Kanban model applications on improving Toyota's agility.

Agile organization overview

In this part, basic principles related to agile organizations and the core elements they compose will be recognized.

Agile Organization Definition

The concept of agility has emerged as a modern entry point in contemporary administration and has evolved considerably, especially with increasing uncertainties. Agility is the viability of an ever-changing and unpredictable business environment and a comprehensive response to the challenges of rapidly changing global markets (Bundtzen & Hinriches, 2021, p. 36). Strategic agility depends on different concepts in management theory that relate to the organization's success in turbulent times and the company's ability to integrate, build, and reshape internal and external competencies and

resources to address rapidly changing environments (Kumkale, 2016, p. 120). Self-organization enhances agility by reducing response times and allowing for quick, easy, and adequate decision-making (Ozkan, 2020). Cross-functionality reduces communication costs and enables rapid action.

Agile organizations are defined as those that find and use opportunities in their market environment using their primary asset, knowledge. This agility depends on members' knowledge, experience, inventiveness, and information. Agile enterprises activate social capital and involve customers in creating value, responding quickly to market changes and customer needs (Funda & Ebru, 2022, s. 1135). These companies have standard features such as customer focus, collaboration, fast learning, open communication, flexibility, and fast decision-making.

The agile organization recognizes and responds to environmental changes, competitive market opportunities, dynamic and continuous change, consumer preferences, regulatory changes, economic shifts, and technological advancements (Katalin, 2020, p. 23). Agile organizations are thinking beyond how to deal with changes, potential opportunities in a turbulent environment, and access to a competitive position characterized by the integration of communications and information technology systems performance within organizational boundaries (Azam & Mehrzad, 2014, s. 317). Agile organizations leverage smart teams, a supportive culture, and a high-performance mindset to respond quickly, adapt, and respond to changing circumstances. They can achieve agility through all-in, step-wise, and emergent approaches.

Agile organizational features

Agile organizations rely on non-hierarchical flat organizational structures, singled out in a complex network of strategic alliances and partnerships by leveraging strategic information on the changing market trends provided by strategic agility (Agnieszka & Ewa, 2020, p. 384). Small teams are formed by agile organizations where administrative changes are made by allowing employees to express their opinions without having to fear hierarchy. An agile organization must have the great power of innovation to be sustainable in the long term, serving customers and stakeholders, and shaping the entire ecosystem. Agile organizations have an innovation structure, the means, and the creativity to constantly create renewal, which can lead to disruptive innovations that create new markets and turn industries upside down.

A comprehensive model for developing corporate agility was developed, focusing on volatility, uncertainty, complexity, and ambiguity, as these environmental forces have impacted economic scenarios during the pandemic. This model is practical and widely accepted, allowing for the development of leadership and strategy (Bundtzen & Hinriches, 2021, p. 40).

Agile organizations are known for their ability to anticipate environmental changes, reduce costs, focus on innovation, and quickly integrate resources and capabilities to maintain and increase competencies (Mehmet, 2021, p. 30). Agile organizations prioritize effective, user-friendly technology for decision-making, communication, and feedback. These organizations are open to experimentation and encourage employee engagement, ensuring they stay competitive in the market.

Agile organizations adopt a systemic approach, treating each organization as a complex adaptive system. They focus on catalyst leadership, continuous learning, open communication, long-term business value, skill mastery, customer value, change readiness, and virtual partnerships.

Critical Elements of Agile Organizations

Agile organizations have different characteristics from traditional organizations, and studies differ in determining the elements that make up agile organizations. The most important are the following:

- **Agile Mindset** (AM) is a concept that encompasses various elements, including abilities and behaviors. It involves a specific attitude, way of thinking, and behavior of both individuals and the entire team (Necmettin, Mehmet, & Büşra).

- **Cross-functional teams** (CFT) are groups of at least three members from different functional entities working together to achieve a common goal. These members have different skills and experiences and come from different sections within the organization. CFTs provide the advantages of multiple sources of information and perspectives as they work together to fulfill common assignments (Laura & Carmen, 2012, s. 454). Cross-functional teams are essential for complex product development, decentralizing decision-making, and reducing hierarchical information overload. However, they face challenges in integrating knowledge due to the extensive functional diversity among team members with little shared experience.

- **Service orientation** is defined as the widespread adoption of a fundamental set of relatively long-lasting organizational rules, practices, and processes designed to support and reward service-giving actions that foster and deliver exceptional service (Pedro & Aleda, 2012, s. 181). Service orientation refers to attitudes and behaviors that impact staff and customers, influencing a service organization's performance. A service-oriented company aims to satisfy customers, create value, and increase profitability. It positively influences service delivery characteristics, business performance, and customer satisfaction. Service orientation is crucial for organizational success and includes leadership, encounter, system, and human resource management practices.

- **Adaptive planner**: Adaptive planning foregrounds specific plans, as they are often tailored for the current planning situation and make available previously computed causal and ordering relationships between steps. Even in cases where a more specific plan must be re-fit, the cost of such changes is often much less than dealing with the sub- goal and sub-plan interactions inherent in a process that instantiates more general plans (Richard A. , 1986, s. 66). Adaptive planning involves access to background knowledge, situation matching, foregrounding specific plans, and treating failing steps as representative of action categories.

This process allows for the re-use of old plans in various situations, improving understanding of unfolding circumstances, and using old plans as starting points.

Kanban Model

In this section, aspects of the Kanban model and the role it plays in improving organizations' working mechanisms and enabling the operationalization of agility in organizations will be presented.

Kanban Model Definition

Kanban, developed by Toyota in 1962, is an excellent tool for reducing waste and optimizing material flow in production industries. It aims to signal the need for more parts and ensure they are produced at the right time, allowing for subsequent fabrication or assembly (Rajat, Wakode, & Raut, 2015, p. 2518). Kanban is a visual process management system that focuses on removing bottlenecks and waste, reducing waiting times, and increasing throughputs.

The Kanban System significantly improves productivity by optimizing processes, reducing idle time, making units flexible, reducing waste, and increasing plant efficiency. It leads to "just-in-time" manufacturing and improved flexibility in production. Proper implementation of the Kanban System can lead to increased efficiency, continuous delivery, and improved overall efficiency (Vijaya, Elanchezhian, & Kesavan, 2010). The Kanban system is a combination of the JIT methodology and the pull system production mode, which has been adopted by both small and large-scale industries. Kanban is an efficient framework for production systems, promoting improvement by identifying

lead time, cycle time, and incompatibilities. It sets upper limits on work-in-progress inventory to prevent overcapacity and minimize complexity bias.

The Agile Kanban method enhances understanding, visibility, and control of workflow by identifying bottlenecks during software project development. It uses the pull system to expose system problems and stimulate collaboration for continuous improvement. It focuses on avoiding bottlenecks and achieving faster turnaround times (Reto, 2019). The Kanban system reduces production costs, makes units flexible, and promotes organizational management. The principle of Kanban is to eliminate waste, which requires continuous growth and commitment from personnel and management.

Implementing Kanban in production units' benefits companies in various ways, such as reducing inventories, improving workflow, being flexible, improving organizational management, increasing quality, lowering production costs, and reducing idle time.

Kanban Principles and Practices

Kanban's basic idea depends on customized production and a continuous delivery process, enabling it to accurately determine the elements of work and the amount of work for each individual on the team. This contributes to improving the process and making the crisis change in a timely manner.

Kanban is a Material Flow Control Mechanism (MFC) designed to control inventory levels, production, and supply of components and raw materials. It is commonly used worldwide as a card system, as it manages the delivery and production of parts, items, or raw materials (Muris & Moacir, 2019, p. 17).The Kanban model is based on a set of principles and applications that are relied upon to achieve the desired results.

- **Visualize the Workflow:** Kanban is a visual workflow that helps visualize the process from "not done" to "done right." It can be used for simple or complex projects, and creating a kanban board allows for quick visibility of work status (Ryan & Choobineh, 2003, p. 410).Thus, when the tasks become clear to all those who do this work, it will facilitate the way the work is done and how long an individual needs to do each task.

- **Limiting Work in Process (WIP)** is a powerful idea that allows for more work to be done by doing less. Kanban metrics help find the optimal number of tasks to be completed at one time, ensuring efficiency and productivity (Sarah & Fred, 2002, s. 414). When everyone on the team adheres to their work and tasks, this will reduce errors in the productive process that are due to unclear tasks or unnecessary tasks in the process.

Manufacturers can benefit from controlling work in progress (WIP) by limiting material release, allowing orders to remain on paper, and reducing cycle time variability. This allows for scheduling and design changes, reducing scrapping and reworked material, and reducing financial losses from inferior products. Additionally, WIP control reduces cycle time variability, allowing pull systems to achieve the same throughput level with less WIP than push systems. Accurate quote time in pull systems should include both paper and physical production time (Richard, Debra, & Donald, 2001, p. 922) .

- **Managing the flow**: This principle emphasizes the need for not just keeping a work or activity going but also for using the flow as a driver for improvement. The focus on flow rather than waste elimination is mastery (Hamza, Mazni, & Rohiada, 2019). Flow management is associated with changes in the level of tasks assigned to individuals in the team, such as reducing waiting time between a production line and another, as well as adding or reducing procedures that calculate what the situation requires at work.

- **A pull system:** is a type of production system that involves a job card being transferred stage by stage according to its sequence, causing work-in-process inventory accumulation. This method is used when unpredictable changes in demand or production hindrance cause jobs to deviate from their schedule, requiring inventory planners to set the safety stock level on the higher side (Sendil & Panneerselvam, 2007, p. 396). On the other hand, pull systems involve a sequence of workstations, with value addition at each workstation. Each workstation has an inbound and outbound stocking point, with the primary advantage being reduced inventory and associated inventory reduction costs. Kanban cards, either single-card or two-card systems, control the flow of parts throughout the product line.

The Kanban system, designed for specific company needs, has limitations like handling unstable demand, processing time, non-standardized operations, long setup times, and raw material supply uncertainty (Ghozali, Diekola, Imran, & Othman, 2022).

Decision-making is highly linked to planning, where organizations must understand their objectives, policies, and problems. An effective Kanban system begins with understanding, designing, applying, and adapting the specific environment to meet those needs (Maria, et al., 2018, p. 4).

Application of the Kanban model in agile organizations

The application of the Kanban model generates many implications at the organizational level, which contributes to improving an organization's agility. These effects include the following:

- **Transparency** refers to the availability, speed, and high structuring of information in the operational aspect of an interaction. It is a fundamental characteristic of the modern information society, promoting total openness of information and enhancing social design supervision. In postmodern philosophy, transparency is seen as a manifestation of freedom and social capital, increasing trust among actors in social relations (Jan & Liudmila, 2018). In management theories, transparency is an element of planning and accountability, and in public administration, it is associated with control over corruption processes.

Transparency is a critical aspect of agile's methodologies, as it helps overcome resistance to changes and ensures project quality. Kanban is a framework designed to overcome complex adjustment problems and deliver a product as valuable as possible to the customer based on transparency through teamwork, product, and automatic adaptation.

- **Continuous Improvement**: The Kanban model is used to reduce waste, predict stock breaks, organize the warehouse, and facilitate the planning process, which effectively facilitates daily work and production planning (Flavia, Radu, & Joao, 2019, p. 169).

Organizations can create a culture of continuous improvement if they implement the actions associated with the Kanban model, where a workshop is carried out to resolve the problems faced by the manufacturing unit in a systematic and structured manner that depends on holding regular meetings. And so organizations can improve efficiency, performance, and quality while continuing improvement activities and countermeasures to address deviations. (Hamza, Mazni, & Rohiada, 2019). The Kanban system helps organizations save costs by reducing inventories and controlling quality improvements as delivered products meet certain standards before they reach the customer. This improves processes, provides a competitive advantage for producers, increases consumer demand, and reduces costs (Rahman, Sharif, & Esa, 2013, p. 176).

Continuous improvement in organizations is highly linked to the applications of the kanban model, as work on the application of the cable system improves the time frame, inventory, and areas of

finished goods, enhances manufacturing capabilities, and synchronizes the pace of production with market demand (Naufal, Jaffar, Yussof, & Hayati, 2012, s. 1724).

Kanban improves process efficiency by smoothing the process and eliminating waiting time. This leads to a simplification of work in production planning and reduces manufacturing lead time. The Kanban system also encourages continuous improvement in production by reducing the allowed inventory level from time to time (Hwang, 2017, p. 5).

- **Collaboration and Communication**: Kanban can help promote communication and collaboration in common spaces, which are essential for effective teamwork and overall success. Effective communication is critical to successful enterprise development, and thus the application of meager principles, such as waste removal and value creation, will constitute effective management of ongoing work, focusing on continuous improvement of the process, but explicit policies and feedback rings must be implemented (Tanner & Dauane, 2017, p. 185). The implementation of the Kanban system shows positive results in performance for many companies that use workers' capabilities to increase efficiency.

Thus, the Kanban model has many advantages, such as improving assembly line space, reducing operational material inventory, solving quality problems, and achieving cost savings. Thus, Kanban's system has provided significant improvements in the level of real performance, cost savings, production delays, financial costs, efficient business processes, and the reduction of waste and errors (Houti, Abbadi, & Abdellah, 2017).

All these characteristics are needed by organizations to be agile in their business and practices and easily achieve their goals and objectives.

Unleashing Agility at Toyota: The Power of the Kanban Model

In this section, Toyota will be introduced, and its application mechanism for the Kanban model will be indicated, as will the effects of the application of the Kanban model on the agility of Toyota.

Toyota Company Profile

Toyota Motor Corporation, founded in 1937 by Kiichiro Toyoda, is a Japanese multinational automaker noted for producing high-quality, dependable vehicles at reasonable rates. Globally, the corporation expanded by launching new models such as the Corolla and offering hybrid engines to improve fuel efficiency and pollution. Toyota developed the Lexus premium brand in the 1980s, with a focus on sustainability and the development of electric automobiles. (Anoop & Muhammed, 2020).

In the late 1980s, Toyota Motors began experiments to address labor market shortages, including automation of manual work and increasing the attractiveness of assembly work. These changes were seen as breaches of the successful "classical" Toyota Production System (TPS), which was characterized by cost consciousness, zero stock, and a well-developed continuous improvement program. However, as labor market shortages have been resolved after the "collapse of the bubble," the initial motivation after these changes has disappeared (Benders & Morita, 2004, p. 437).

Toyota is one of the world's top automakers, with a presence in over 190 countries and a reputation for excellence, dependability, and innovation. The corporation provides a wide range of products and services, including hybrid automobiles like the Prius and all-electric vehicles like the Toyota bZ4X and Lexus UX 300e. Toyota's global mission statement is to lead the way into the future (Head, Ondracek, Saeed, Peterson, & Bertsch, 2023, p. 4).

Application of the Kanban Model at Toyota Company

Toyota agility includes a scheduling method called the Kanban model. It is a graphical tool that aids in inventory and production management by indicating when additional supplies are required.

Just in time

Just-in-Time (JIT) is a manufacturing management process that focuses on making only what is needed, when it is needed, and in the amount needed. Kanban, a component of JIT, is used to indicate specific demands. JIT control systems are only effective in JIT environments, and introducing kanban systems into a non-JIT environment means nothing to a company. Waste is not only a control technique but also a way to improve the manufacturing environment. Poor product design, such as incorporating fancy functions not required by the customer, can lead to waste. Standardization can reduce planning and control efforts, the number of parts, and the inventory required. Toyota identifies seven wastes resulting from poor manufacturing methods: overproduction, waste of waiting, and waste of movement. Poor plant layout results in materials being moved extra distances, causing unnecessary material handling costs (Soliman, 2017, p. 6). (JIT) philosophy that shaped Toyota's manufacturing process by focusing on producing only what is required and then transferring only specific requirements. It is the basis of the Toyota process, focusing on the manufacture and transfer of only what is required, when needed, and to the extent required. In addition to quality control, everything must work perfectly (Aggarwal, Kumer, & Sikor, 2005). Just-in-time (JIT) inventory management is a system of production control that aims to minimize raw materials and work-in-progress inventories, control defects, stabilize production, simplify the production process, and create a flexible, multi-skilled work force. JIT purchasing involves matching receipts of materials closely with usage, reducing raw material inventory to near zero levels (Batth, 2021, p. 20).

This results in significant savings in storage costs, material handling costs, spoilage, and obsolescence.

The Toyota Production System focuses on just-in-time production, which involves implementing several key concepts to maximize labor potential. These include withdrawal by subsequent processes, one piece production and conveyance, levelling of production, and elimination of waste from overproduction. (Sahiil, 2017, pp. 16-18):

- **Withdrawal** by subsequent processes is crucial for accurate knowledge of the timing and quantity required. Toyota adopts this approach, following the production schedule of a particular product in an automotive plant, which is based on various parts schedules and instructions. This approach ensures that the final assembly line can judge the number of parts it requires and the time it will take to finish the vehicle.

- **One-piece production** and conveyance are another important aspect of just-in-time production. All processes must meet the criteria of producing one part in their respective process, leaving only one piece in stock. This results in no lot production and no lot conveyance, leading to improved production methods and the elimination of inventory within the processes.

- **Leveling of production** requires assistance from managerial positions, such as creating mixed product lines and calculating the cycle time of different vehicles on a daily basis. This allows Toyota to produce what is required without exceeding the limit and adjust its production levels as needed.

- **Eliminating waste** from overproduction is essential for Toyota's production system. Overproducing a particular item by more than the required amount is considered the worst waste, leading to increased production costs. This waste hinders employees' potential and hampers the overall growth of the company.

JIT focuses on supplying the right type and quantity at the right time and place, reducing inventory

levels and investment. Jidoka, the backbone of TPS, helps stop processes or machines safely due to quality, process, or material issues. Stoppages can occur due to defective components, noise, or a shortage of necessary components.

Visual Management

Visual management is a management system that aims to improve organizational performance by aligning the organization's vision, core values, goals, and culture with other systems, work processes, workplace elements, and stakeholders. It uses stimuli that directly address one or more of the five human senses (sight, hearing, feeling, smell, and taste) to communicate quality information. Visual management uses information-giving, signaling, limiting, or guaranteeing visual devices to communicate with "doers" and make places self-explanatory, self-ordering, self-regulating, and self-improving (Tezel, Koskela, & Tzortzopoulos, 2009).

Toyota gradually created VM tools in the 1950s and 1960s, with the most well-known being the kanban and andon. VM can be viewed as a component of the lean information management toolkit, as a sensory communication interface for knowledge management and coordination efforts, and investigated through organizational studies, visual content analysis, visual aesthetics, semiotics, rhetorical, and ethical dimensions (Koskela, Tezel, & Tzortzopoulos, 2016, p. 780).

Toyota's implementation of visual management (VM) is the cornerstone of a lean transformation. The process includes six components: standards visualization, systems/priorities, department-level management, group-level management, Kaizen/A3, and change point management.

Pull system

Conventional production systems involve parts produced by one process being delivered to subsequent processes, even if they are not yet needed. This method is effective when parts can be produced on schedule throughout the entire process. However, if one process has trouble and the line stops, the processes directly related to the troubled one may suffer from shortages or backups of parts. A pull system eliminates underproduction or overproduction by limiting production to those parts demanded by the next downstream process. Kanban, a visual signal that conveys instructions to withdraw parts or produce a product, is used in the pull system to allow material flow through manufacturing. The flow of material and information through each process is monitored using a picture as a guide (Wada, 2020).

The Toyota Production System (TPS), also known as lean manufacturing, has been a success story for many companies. TPS focuses on using less investment, material, space, manpower, and inventory, making the facility financially and physically leaner. Its uniqueness lies in its ability to create a more comfortable and efficient work environment for employees.

TPS was founded by Toyota founder Sakichi Toyoda and industrial engineer Taiichi Ohno, who defined it as a production system with quantity control at the center, working on the foundation of quality, with the sole purpose of cost reduction. The underlying principles of TPS are encompassed by the Toyota Way.Waste elimination is a key goal of lean manufacturing (LM), and it is believed to be one of the most effective ways to scale back assembly prices and increase profits. (Anoop & Muhammed, 2020, p. 2507). The seven wastes identified by Ohno include transportation, inventory, motion, waiting, overprocessing, overproduction, and defects. Lean tools like Kanban, Standardized Work, MIFC/VSM, Total Productive Maintenance, Single Minute Exchange of Dies, Continuous Flow Production System, Kaizen, 5S, and the Heijunka system support the effectiveness of TPS. The seven mudas (wastes) are non-value-added inputs outside of a line.

Overproduction, or producing more than customer demand, ties up valuable labor and material resources that might otherwise be used to respond to customer demand. Inventory, on the other hand,

negatively impacts cash flow and overall profitability. To achieve TPS, companies must identify and reduce wastes, such as overproduction, inventory, and wastes that add no value to a process or product. By implementing these principles, companies can increase their profitability and reduce waste in their manufacturing processes.

WIP-limit

WIP limits are a key component of the Kanban method, a project management approach that originated at Toyota to address inefficiencies in stock management. It focuses on visualizing workflows and implementing WIP limits to enhance productivity and provide clarity (Rantala, 2018). It is essential to limit work-in- progress (WIP) to reduce multitasking and promote continuous development without wasting resources (Damij & Damij, 2021, p. 3).

One of the benefits of setting a (WIP) is to prevent task switching, increase productivity, reduce cycle time, and reduce lead times. It is very important to maximize the benefits of Kanban because it helps prevent errors and rework (Skeie, 2014).

WIP limits can be beneficial for increasing task completion rates, identifying bottlenecks, assessing actual capacity, balancing team engagement, boosting efficiency, and reducing costs.

From the foregoing, we conclude that the Toyota Kanban model is a production and inventory control system based on visual signals to manage the flow of materials and information within the production system and is the main component of the Toyota Production System (TPS), often referred to as lean manufacturing.

The Agile Influence of the Kanban Model on Toyota

The application and development of the Kanban model by Toyota achieved many benefits and contributed to improving its agility, which is shown in the following points:

Improved efficiency

JIT-KANBAN is an important system used in production lines to reduce the working time in the process and maximize productivity, maximizing the efficiency of the line (Kumar & Panneerselvam, 2007, p. 394).Toyota's Kanban model has improved production efficiency through loss analysis, job balance, and Kaizen implementation (Minh, 2023, p. 391) . The fusion of Kanban and Kaizen principles has been pivotal in Toyota's journey towards manufacturing excellence, showcasing that the quest for perfection is a journey, not a destination (Rüttimann & Stöckli, 2016, p. 142).

Effective communication and collaboration

Electronic Kanban solves constraints such as mixed production but generates additional costs for suppliers and customers (Houti, Abbadi, & Abdellah, 2017, p. 1266). The e-Kanban supplier framework promotes operational tasks, such as providing materials and ensuring smooth operation, while reducing ongoing work (WIP) and improving operations (Grant, Maneesh, & Ann, 2014, p. 170). Kanban's system allows companies to save money and reduce lead time, making them more flexible and responsive as a direct communication system that communicates with the production system and guides production when removing products (Apreutesei, Arvinte, Suciu, & Munteaunu, 2010, p. 162).

Toyota views dual sources as a way to reduce costs by making suppliers compete in bidding wars, as the company wants its suppliers to be profitable so they can invest in new technology and better designs. Trust, support, and suppliers are key principles of the technical services system (Shih, 2022). Relationships around long-term partnerships should be built, not transactional in nature. When a supplier faces problems, Toyota offers to help address them, and they are willing to accept them.

Flexibility in production processes

The Kanban model contributes to transforming companies into lean, high-performance enterprises (Rmnath, Elanchezhian, & Kesavan, 2009, p. 58). Toyota Production System (TPS) is the cornerstone of modern manufacturing, this has helped it relieve excessive burden and uneven production schedules, prevent unequal production schedules, and ensure high quality products, as Kanban provides the basis for developing sophisticated solutions to demand for highly cyclical resources (Liker & Morgan, 2006, p. 6).

Toyota's flexible manufacturing system, which aims to respond to market changes by providing timely products required by customers, has contributed to shortening the lead time between activities in the company while improving production planning and demand (Tomino, Park, Hong, & Roh, 2009).

Toyota's use of the Kanban model has greatly improved its efficiency and effectiveness in managing production, especially the importance of just-in-time in aligning stock levels with actual consumption. Through continuous improvement and flexibility in manufacturing, the company has been able to improve the agility of its production processes and manage its supply chains fully and effectively. It has also contributed to strengthening its relations with suppliers and achieving high performance at all levels.

By implementing just-in-time production, reducing work-in-progress, and facilitating real-time feedback, Toyota has reduced lead times and improved overall performance. The Kanban model has also enabled Toyota to respond quickly to market changes, reducing lead times and improving production planning.

Conclusion

This study reveals that the Kanban model can be a powerful tool for agile organizations to increase their strategic agility and achieve significant results. By applying the Kanban model, Toyota was able to enhance its business vision, improve communication and collaboration among teams, and boost productivity and flexibility. The key findings suggest that effective implementation of Kanban requires a focus on teamwork, empowerment of individuals and teams, a process-oriented approach, and raising awareness of the importance of processes.

The study recommends the need to improve business perception, reduce lead times, and increase Toyota's productivity by fostering a culture of teamwork, continuous monitoring and adaptation, training, and celebrating successes. The study also recommends that achieving a high degree of agility requires effective leadership in order to communicate effectively, foster a culture of continuous improvement, and provide the necessary resources, such as training and support, for successful implementation.

Limitations of the Study

- The study's findings may be specific to Toyota's context and may not be generalizable to other organizations.
- The study's focus on a single case study (Toyota) may limit the scope of the findings and make it difficult to draw conclusions about the applicability of Kanban to other organizations.

Future Research

- Conduct a multi-case study to explore the applicability of Kanban to various organizations and industries.

- Investigate the role of leadership in implementing Kanban and its impact on organizational performance.

- Explore the impact of Kanban on organizational culture and its relationship with employee engagement and motivation.

- Develop a framework for measuring the effectiveness of Kanban implementation in different organizational contexts.

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