Toyota Way – the Heart of TPS and its Impact on Sustainable Company Growth

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ABSTRACT

Purpose: This paper intends to evaluate the impact of Toyota Way (TW) focused activities on operational performance and its connection to sustainability and long-term success.

Methodology/Approach: Three theoretical-practical activities were implemented in a real pickup assembly plant. Performance was assessed through the recording of standard documentation before and after implementation, direct observation at the *gemba*, and anonymous qualitative surveys of those involved.

Findings: Results show how TW enhances workers' skills alongside TPS through experiential learning, fostering continuous improvement with minimal or no financial investment and creating value iteratively and exponentially. However, it had a limited impact on environmental factors. TW emerges as a critical link between short-term operational performance and long-term sustainable growth.

Research Limitations/Implications: The sample is restricted to a single assembly plant in Portugal. The surveys involved between 5 and 13 respondents per activity.

Originality/Value of paper: In contrast to TPS and lean manufacturing, current literature on TW is limited, often outdated, and lacks clarity regarding its Japanese and American interpretations. Furthermore, few studies emphasise the human element as a driver of company growth—a factor often overlooked by companies.

Category: Case study

Keywords: Toyota way; TPS; sustainability; continuous improvement

Research Areas: Quality by Sustainability

1 INTRODUCTION

The ability to respond effectively to today's turbulent business environment is essential for sustaining and enhancing competitiveness. In the automotive industry, however, Toyota Motor Corporation has been the undisputed leader for the past 70 years, seemingly unaffected by such challenges. The Toyota Production System (TPS) is widely credited with underpinning Toyota's sustained financial and operational success. When Toyota sought to standardise and unify a shared working culture during its global expansion – the Toyota Way (TW) – the core values of Respect for People were often undervalued, and the principle of Continuous Improvement was misinterpreted by competitors attempting to replicate TPS in their own operations. This superficial approach to TPS, particularly the disregard for its human-centric foundation in favour of immediate results and cost-cutting, is often cited as the primary reason for the limited, short-lived success of TPS adaptations outside Toyota.

This case study implements a series of activities and methodologies in a real-world pickup assembly plant, focusing on training and skill development to foster continuous improvement and competitiveness. The primary objective of this paper is to assess the impact of TW-focused activities on short-term operational performance, the three pillars of sustainability, and long-term growth.

2 LITERATURE REVIEW

Toyota Way

The Toyota Production System (TPS) was developed to achieve the highest quality at the lowest cost and with the shortest delivery time, a concept often referred to as *muda*, or waste reduction. Lean production similarly prioritises cost efficiency by eliminating waste through a structured set of tools (Ramos et al., 2013; Silva et al., 2020; Vanichchinchai, 2021; Teixeira et al., 2022; Sun et al., 2023). TPS is an integrated, adaptable system that holistically manages materials, equipment, and people to create "value"—defined as "a product or service that meets the needs of the end customer at a specific time and price" (Womack, 2003). The Toyota system permeates its culture at all organisational levels, where continuous training in Lean Manufacturing principles, tools, and mindset is essential for managers and employees alike (Vaz de Carvalho et al., 2013). However, Toyota's global expansion—particularly into the United States—revealed inconsistencies in how its values and methods, long embedded implicitly in Japan, were understood by international managers. To address this, Toyota formalised and articulated its cultural philosophy as the Toyota Way 2001—a unified set of principles standardising Toyota's work culture worldwide (Loyd, et al., 2020). Toyota recognises that efficient procedures alone cannot guarantee long-term success (Takeuchi, et al., 2008). The Toyota Way 2001 provides a framework for guiding

people's thinking and actions (Coetzee, et al., 2016) based on two core principles: *Continuous Improvement* and *Respect for People* (Figure 1).

The principle of Continuous Improvement encompasses a long-term vision (*Challenge*), a commitment to ongoing, incremental improvement (*Kaizen*), and problem-solving by investigating issues at their source (*Genchi Genbutsu*). The principle of Respect for People, in recognising individuals, promotes responsibility, mutual understanding, and trust (*Respect*), as well as fostering personal and professional growth through opportunities to enhance individual and collective performance (*Teamwork*) (Jayamaha, et al., 2014; TMC, 2012).

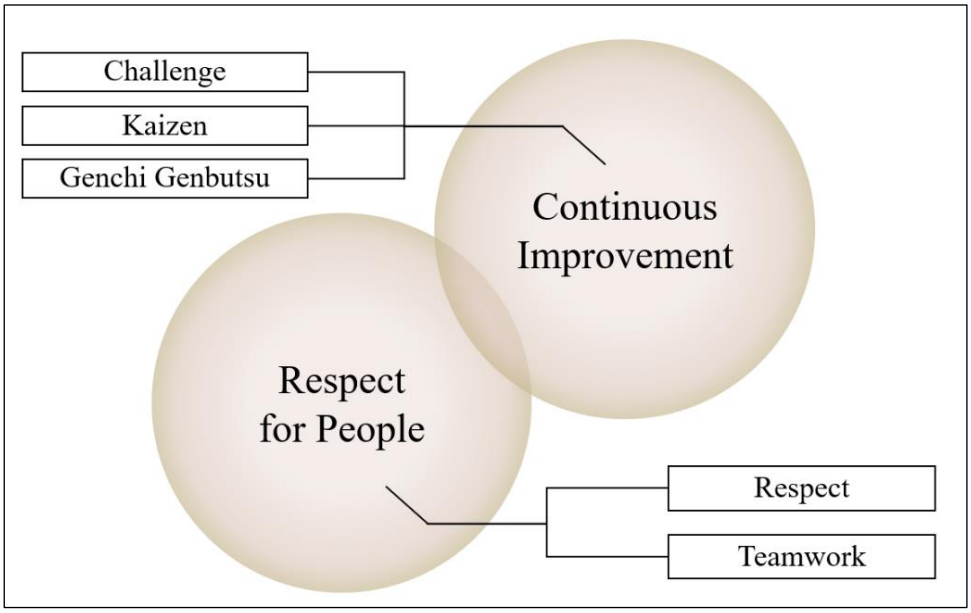


Figure 1 – Toyota Way 2001 (TMC, 2012)

In 2020, the Toyota Way was updated to include a new version comprising ten principles loosely derived from the core values previously mentioned (TMC, 2024). Meanwhile, Jeffrey K. Liker, who spent 35 years studying and working within Toyota factories worldwide, published a book in 2004 also titled *The Toyota Way*. In this book, he outlines 14 foundational management principles that, according to him, underpin Toyota's success, organised into four categories: philosophy, process, people, and problem-solving.

In the second edition, Liker (2020) refines these principles into an interconnected system known as the *4P Model* (Figure 2). Each category functions as an essential, interlinked piece of a broader puzzle, with *scientific thinking* positioned at the centre. Scientific thinking is defined as "adopting an iterative, fact-based learning approach to tackle challenging problems" (Liker, 2020).

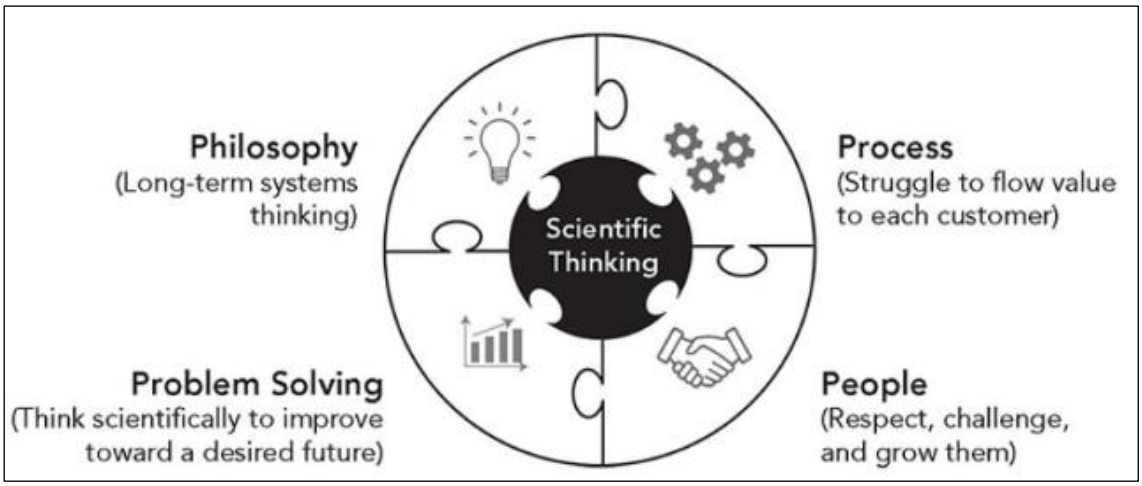


Figure 2 – Toyota Way as the 4P Model (Liker, 2020)

The Toyota Way (TW) can be seen as an evolution of the Toyota Production System (TPS), though not a replacement (Chiarini, et al., 2018); as Jeffrey Liker notes, TW and TPS together "constitute the double helix of Toyota's DNA" (Liker, 2020). TW serves as the cultural foundation that enables a sustainable and adaptable TPS to flourish, integrating robust improvement techniques with softer organisational human factors (Vanichchinchai, 2022). At its core, Toyota places immense value on its employees, viewing them as collaborators with deep insights into the front lines and the value creation process (Loyd, et al., 2020).

Sustainability

Sustainability has become an increasingly urgent issue, driven by intense discussions surrounding climate change, pollution, waste, and other environmental concerns. These issues have prompted governmental bodies to enact legislation targeting emissions and consumption (Santos and Barbosa, 2006; Santos et al., 2014; Sá, et al., 2022). Concurrently, organisations aim to reach excellence not only by improving quality and performance to tackle the daily challenges of a VUCA (Volatility, Uncertainty, Complexity, Ambiguity) world but also by striving for long-term sustainable outcomes (Doiro et al., 2017; Vieira et al., 2019; Sá, et al., 2023).

The United Nations defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). This framework encompasses social, economic, and environmental dimensions, aiming to foster mutual reinforcement among them (Bľanda and Urbančíková, 2020). The overarching goal is to achieve long-term stability and resilience across these areas, ensuring that economic growth does not come at the expense of environmental resources and that social equity is upheld (Pisano, 2012; Yülek and Santos, 2022).

Silva, et al., (2022) and Abualfaraa, et al. (2020) conceptualise these three dimensions as the "Triple Bottom Line", represented in Figure 3. Emphasising the need for genuine implementation of sustainability as an integrated triad within

organisations and society. Putnik and Ávila (2016) assert that governance and sustainability are cross-disciplinary and often interdependent. Effective governance can drive sustainable practices and robust sustainability initiatives, which, in turn, foster strong governance.

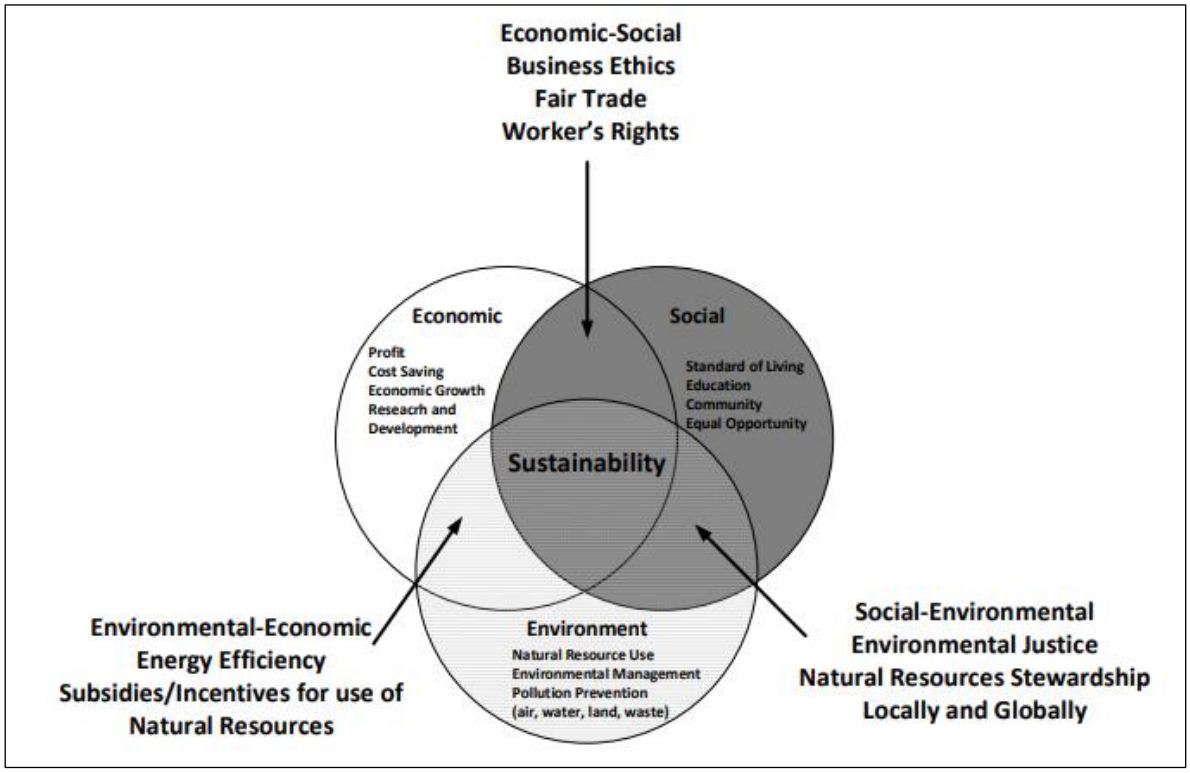


Figure 3 – Triple-Bottom-Line (Abualfaraa, et al., 2020)

Building on this framework, Sá, et al. (2022) developed a conceptual model integrating Lean principles, Green practices, Key Performance Indicators (KPIs), and Science-Based Targets (SBTs) to support companies in achieving their sustainability goals more effectively. The model unfolds in four stages, beginning with a standardised set of 12 KPIs, enabling cross-sector comparison of results. The KPIs are structured as follows:

- Economic – earnings, expenses, resources acquired, resources dispensed
- Environmental – emissions, water usage, energy consumption, waste generated
- Social – number of accidents, work-related illnesses, worker valuation, equity

In the second stage, SBTs are established, informed by these KPIs and aligned with the key regulatory standards for each pillar of sustainable development. The third stage introduces Lean and Green tools, supplemented by newly developed social tools, to drive progress towards the defined targets. Finally, the fourth stage focuses on meeting the sustainability objectives across the economic, environmental, and social dimensions.

Toyota Way and Sustainability

Currently, there is limited scientific literature publicly available on the integration of Lean, Green, and Science-Based Targets (SBTs) in sustainability models. However, two notable case studies provide insight into these themes.

In *The Relationships between Soft and Hard Factors of the Toyota Way: A Socio-Technical Perspective* (Vanichchinchai, 2022), the impact of the original Toyota Way pillars on manufacturing strategies was examined within automotive parts manufacturers in Thailand. This study found that, at the highest level, the *Respect for People* principle significantly impacted *Continuous Improvement*, supporting the notion that the "soft" human factors strengthen the "hard" improvement techniques. At a more granular level, both *respect* and *teamwork* positively influenced Continuous Improvement, with teamwork showing a particularly strong effect. At the element-to-element level, all hypotheses were confirmed except for the effect of respect on *kaizen*, which was insignificant. These findings suggest that blending soft and hard factors within lean manufacturing creates a socio-technical system that enhances efficiency and supports sustainable technical improvements.

In contrast, TPS's *Process Design in American Automotive Plants and Its Effects on the Triple Bottom Line and Sustainability* (Bergenwall, et al., 2012) investigated the Toyota Way through the lens of the Triple Bottom Line. By comparing American car manufacturers' process designs with Toyota's, the study highlighted key differences not only in profitability but also in labour management and environmental performance. It found that while American manufacturers have adopted some TPS principles – often with minor modifications – significant differences remain in areas such as the use of pull systems and technology design that prioritises reliability and alignment with people and processes. These gaps impact the sustainability of production processes, as the socio-technical design of TPS plays a crucial role in achieving sustainable operations.

3 CASE STUDY FRAMEWORK AND METHODOLOGY

This research was conducted in a small automotive company in Portugal, which has been specialising in the assembly of pickup trucks since 2015. The pickups are available in eight variants, distinguished by cabin size (single with two seats or double with four seats) and four engine models, with the exception of the beige and white colour options. The company operates under a Completely Knocked Down (CKD) system, whereby all components are manufactured by a supplier or another factory within the same group and imported to Portugal for assembly. It predominantly uses a pull system guided by takt time.

During the course of this case study, a project was undertaken that reduced the previous production volume of twelve pickups per day by half while maintaining the same takt time of 38 minutes. The pickup assembly process is divided into five work sections, outlined in Appendix A. The process begins with CKD Logistics,

where imported lots are received and stored in either the Welding or Final Assembly zones, depending on the components' use in the subsequent stages. These components are then organised according to the pickup model using a First In, First Out (FIFO) system. When necessary, materials are moved to the opening areas of the two zones, where Team Members replenish their respective supermarkets. This process ensures that the picking Team Members can swiftly supply the assembly line with the required materials.

The first key section is **Welding**, where the structural components are assembled across three main lines: the frame, deck, and body. The last two lines converge at the metal finish line. Due to their complexity and need for efficiency, these lines operate with different turnaround times, necessitating the use of an intermediate stock area known as "night storage". Here, five cabins (formerly referred to as bodies) and attached decks are stored, along with six chassis, ensuring that production continues smoothly.

Next is the **Painting** section, which has distinct takt times for its four lines and operates across different business days to enhance equipment setup, improve energy efficiency, and adjust for variations in cycle times. The PT/ED line is responsible for a pre-chemical treatment and electric discharge coating that prevents corrosion. This is the final line for the chassis before it moves on to the **Final Assembly** section. Meanwhile, the cabin and deck proceed to the metal repair/PVC line, where sealants and polymer coatings are applied, followed by the topcoat line, where two coats of paint are applied. The section concludes with the rectification line, which operates only when required by the Final Assembly, while the remaining parts stay in standard work in process.

The **Final Assembly** section is where all the pickup components are combined. It is supplied by the CKD Logistics and Painting sections. The trimming line for the cabin and deck and the chassis line for mechanical components are synchronised and work in parallel to converge on the final assembly line. This stage involves the attachment of the vehicle's three main parts, as well as additional components such as seats, the steering wheel, and the spare tyre. Fluid bleeding (fuel, brakes, etc.) is also carried out, followed by the vehicle's first ignition.

Quality control checks are conducted throughout the process, both by operators as they perform their tasks and at specific workstations, known as "Quality Gates". However, the **Inspection** section is dedicated exclusively to the thorough assessment of all vehicles at the end of the process, focusing on both functionality and appearance. Additionally, a daily audit is performed on one pickup that is ready for dispatch. This vehicle is assessed from the customer's perspective as part of a production control process. If any non-conformities are identified, an analysis is conducted, and if necessary, the remaining vehicles in the batch are also re-examined and reassessed.

From a management perspective, the company defines its **mission** as: 'We assume our responsibility and balance at all times in our operations, through innovation and constant improvement of our products and services, based on good

relationships and fair value propositions'. Its **vision** is: 'We believe that our solid relationships guarantee successful business deals', with its core **values** being trust, cooperation, ambition, responsibility, and commitment.

In terms of long-term strategic planning, the company intends to become "FLAP" – a **Flexible, Lean, and Agile Plant**—while prioritising safety and quality. In 2023, the factory's carbon footprint was recorded at an average of 411kg of CO2 emissions per unit produced.

This case study was integrated into the daily operations of a newly formed continuous improvement team called the **TPS Office**. The team's objectives are to drive moments of disruptive transformation, develop employees, promote a continuous improvement mindset, and reduce costs. The TPS Office was established by the factory's management in response to a recent decline in competitiveness and a weakening of company culture, largely attributed to the retirement of senior workers and the influx of new hires. The team consists of two senior in-house members with over 20 years of experience working on the shop floor and one junior member who joined after completing a professional internship with the company. The case study involved two types of human-focused activities:

- **Jishuken** – a theoretical and practical workshop designed to educate and develop TPS (Toyota Production System) skills applied to a real *gemba* problem (Marksberry, et al., 2010).
- An adapted **mini TPS Obeya** – a "war-room" space dedicated to visual control, where short, focused meetings are held to discuss problems and brainstorm potential solutions. This space serves as a central hub for team collaboration, allowing for real-time problem-solving and decision-making while ensuring that the team remains aligned with the overall continuous improvement goals. The use of visual controls in the Obeya helps to track progress, emphasise key issues, and foster open communication across team members (Womack, 2003).

The first *Jishuken* activity addressed the bulk parts sorting station located in the logistics department's trimming/final assembly supermarket. For three weeks, 7 Team Members (TMs) from the five sections and maintenance and one Team Member from the Process Engineering (PE) department were supported by the TPS Office with the goal of eliminating the extra TM allocated to the station. The second *Jishuken* activity addressed a workstation in the Final Assembly section exclusively dedicated to double cabin vehicles, used to improve the skills and knowledge of the TPS Office through education in standard documentation and the *kaizen* mentality to continue the training and development of employees of the most critical principles in the factory. Meanwhile, a prototype of the mini TPS *Obeya*, or *Obeya* Board, was also introduced in the Final Assembly section, focused on promoting efficient decision-making and bottom-up collaboration between the *gemba*, TPS Office and PE in problem-solving and continuous improvement.

4 RESULTS

4.1 Jishuken I – bulk parts sorting station

The purpose of this workstation is to unpack all the small parts, place them in the boxes of the trimming line and final assembly line stations, transport and supply the racks as a pickup model arrives at the Final Assembly section. It supplies five stations on the lines in batches of five units (instead of a single piece), so it is given five takt times (190 minutes) to carry out its operations on one series of boxes while the other is in use. Each model, therefore, has two series of bulk boxes. The activity arose from the difficulty in receiving empty bulk parts boxes, which didn't arrive in time for the TM to carry out his tasks and return them back to the line when needed. Therefore, an additional TM was assigned in the hope of resolving the situation, which proved to be ineffective.

The first of three weeks was dedicated to theoretical training for the participants, who were introduced to the TPS philosophy and the fourteen principles of the Toyota Way in order to familiarise themselves with the concepts, understand their importance and apply them through a series of interactive games, which made the knowledge acquired easier to digest and retain. This served as the foundation for the next stage, workstation analysis of the current status by the four standard documents: Standardised Work Recording Sheet (SWRS), Standardised Work Combination Table (SWCT), Standardised Work Chart (SWC) and *Yamazumi* chart. This analysis determined that the delays were due to the initial wait for empty bulk parts boxes created by the recent changes to the Final Assembly line and the lack of variability in the models assembled each day. Take, for instance, the worst-case scenario in Figure 4.

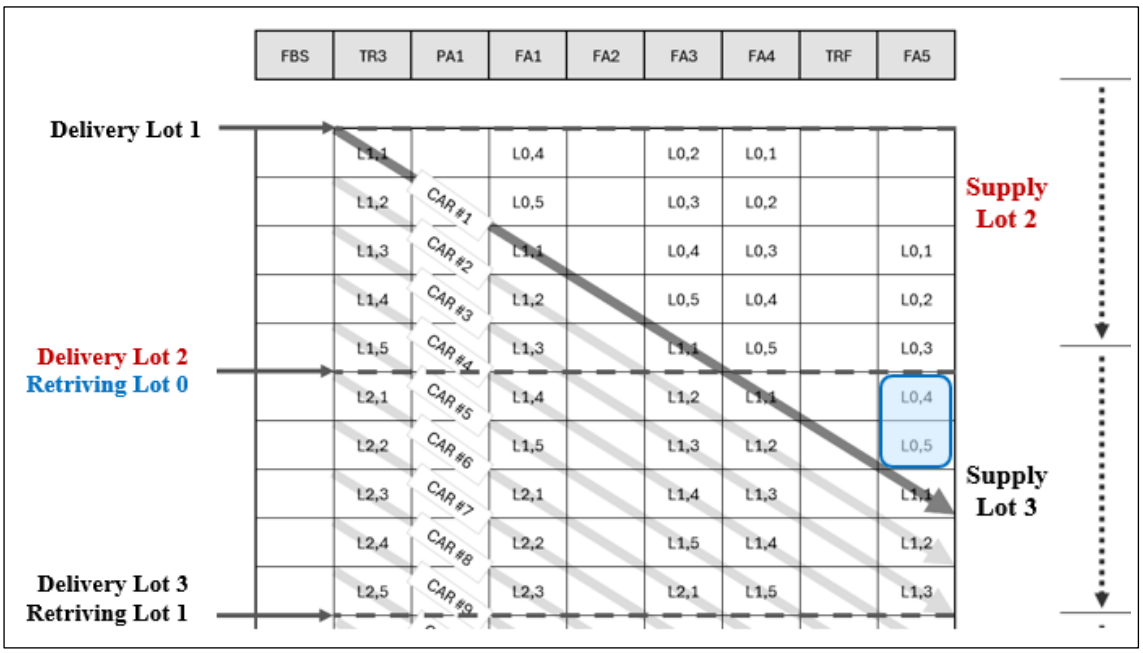


Figure 4 – Delivery scenario for three consecutive batches of the same model

When the station's TM needs the boxes from the five empty stations to supply the next lot (2), as there are two intermediate stations currently unused, the boxes from lot 0 that should be empty are still being used, two *takt* times behind schedule, with this bottleneck, TM was trying to compensate by refuelling and collecting the boxes post by post. Not only was there an unreported change in the standard, but it also increased the number and duration of the operations carried out. Throughout the process, all TMs were responsible for recording their list of *kaizen* proposals to solve this problem and new ideas for improving the workstation according to the TPS principles. As such, after a week of meetings with the Logistics and Maintenance departments to receive feedback on each proposal and raise the necessary resources, the third week was exclusively dedicated to carrying out the approved *kaizens*. Of a total of 90 proposals, 70% were approved by both departments, of which 36 *kaizens* were implemented (8 are under development at the time of writing).

The solution to the waiting time problem was an extra series of bulk part boxes available to the TM when necessary. Sixty-four boxes were needed to fulfil all the pickup models, so a multi-purpose system was designed to reduce it to eight. To do so, the common bulk parts were shared as much as possible. For the rest, pairs of models were put together in a single box, each with the part identification labels on opposite sides, so that everything needed for the same model could be seen in front of the employee. In order to know which model is in use and avoid mistakes due to changes in direction, each side of the boxes has a Velcro loop part. When the TM needs to use them, it sticks the Velcro hook, identifying the model in use on the respective side. Of the station's total cycle time, 36% of operations were considered *muda* and 41% necessary but non-value-added, mainly due to the multiple journeys required to transport the boxes to and from the station racks.

The results obtained after the 36 implemented *kaizens* allowed the fulfilment of the objective of having the station taken over by a single Team Member, who can carry out all operations without delay for any model of pickup. As such, a TM from Logistics was allocated to receive individual training from the TPS Office and be part of the team for six months. 7 minutes and 11 seconds of *muda* were eliminated, supply routes are more efficient and standardised, and the standard documentation has been updated and faithfully represents reality. There were also significant improvements in ergonomics, quality, and safety through the application of 5S, as well as new routing and layout of tools and components by preserving a proper posture and preventing possible damage to bulk parts, tools, and/or the operator. The total monetary investment was 52€ on a partially used Velcro. From a human perspective, the activity allowed direct communication between management and the *gemba*. The eight participants acquired and retained knowledge and experience in the TPS philosophy and methodologies. They can now communicate openly, are highly motivated for continuous improvement and have the technical bases to detect and execute *kaizens* autonomously. An anonymous survey, based on the principles of the Toyota Way 2001 and addressing sustainability pillars, was also

used. Each question was rated on a scale from 1 to 10, with the following description:

(1) Strongly disagree – this idea was absent throughout the activity

(5) Neutral – I am neutral, unsure, or feel like this idea does not apply to the activity

(10) Strongly agree – this idea was fully achieved

After this *Jishuken*, six of the eight participants asked the TPS Office for help in their daily work at least once and maintained a collaborative attitude with the team, showing communication and cooperation with the team, and openness to new ideas centred on continuous improvement.

4.2 Jishuken II – double cabin station

For the TPS Office to be able to follow up on employee training and development, the team itself needs to have a more in-depth understanding of TPS, starting with the concepts it needs most. As such, a specialist in those topics travelled from a partner factory in Japan to mentor the team and provide in-house practical training for two consecutive weeks. The first week began with two days of theoretical training in the basics of TPS thinking, *Jidoka* and movement and standard work *kaizen* initiatives. The knowledge acquired was discussed and compared with the current status of the factory. Due to variations between the pickup models, implementing and maintaining the type 2 standard becomes significantly more complex, but it is essential to identify abnormalities and, consequently, opportunities for improvement. As for *kaizen* initiatives focused on movement, they involve transforming movement into value-added work. Only after improving work operations should you move on to improving equipment (and reducing TM waiting times). Careful attention to the operator's arm, foot, and eye movements is essential during workstation analysis.

Regarding standard documentation, the categorisation of the type of operations (VA, NVA and *muda*) was further improved during the rest of the week, and the "walking" category was created separately from the remaining *muda*. A new template was also introduced for the *Yamazumi* chart from a macro perspective: it shows the station’s activities by type, including the value-added ratio and the waiting time between the cycle end and the *takt* time. It also shows a second version, with all *muda* eliminated, since this is the real capacity of the station, and therefore, reaching this stage should be the first goal of any improvement activity. This mentality intends to motivate the team with a tangible result and restrict their focus to what is a priority, and only then move forward with *kaizen* initiatives aimed at the necessary tasks without value and displacements. Another issue highlighted in the new *Yamazumi* is what to do with waiting time and whether a possible rebalancing of the line would benefit the line's overall productivity. Efficiency should be seen as integrated into their context to guarantee structural gains. The entire team developed a list of *kaizen* initiatives, considering the *gemba*

visits and the priorities of safety, quality and the reasoning in Fig. 3. For a *kaizen* to be registered, the potential gain was always identified. This made it possible to immediately filter out ideas that arose without a measurable objective and were therefore ineffective, thus introducing critical thinking during brainstorming.

The second week began with the rest of the theoretical TPS Office training, this time focusing on problem-solving and *kaizen* leadership, which is needed for the rest of the activity. The main idea conveyed was that without a standard, solutions remain cause-oriented; only then can goal-oriented solutions be developed. Thus, without a standard, there is no improvement. The identified *kaizen* initiatives for safety and quality, *muda* elimination, and improvement were discussed with the Group Leader of the Final Assembly section to once again receive feedback, assess their feasibility, and identify what could be carried out by the team or done by maintenance. It is crucial to engage in dialogue and guarantee the support of the team subject to any improvement activity. The next step was to implement them during breaks and assembly of single-cab pickups in order to promote safety and quality and eliminate/reduce *muda* without interrupting the work of the Team Members. Only then were walking and non-value-added operations improved.

Of a total of 71 developed *kaizen* initiatives, 62% were approved, of which 31 were implemented, and 13 were under development at the time of writing. 4 minutes and 48 seconds of operating time were eliminated, more efficient standard procedures were defined, and a new order of priorities for implementing *kaizen* initiatives (safety and quality, *muda*, non-value-added tasks) guaranteed significant improvements in all critical points for the TPS Office without any monetary investment. The 'walking' operation was introduced, and standard documentation was updated. The TPS Office acquired and deepened the technical knowledge needed at the factory: Jidoka, standard work, problem-solving, and *kaizen*. All developed the scientific approach and critical mindset necessary to further apply, disseminate, and teach the TPS philosophy. The team understood the importance of *genchi genbutsu*, defining measurable objectives, balancing operations, communicating with the *gemba* and using standard documentation to visualise opportunities for improvement and the progress made. The SWCT's purpose is to see cycle time shortening in each sheet, SWC is to see walking distance reduction, and *Yamazumi* allows the visualisation of cycle time, workload, and work balance review needed to approach improvement. Figures 5, 6 and 7 visually show those improvements. Highlighted in red, it is possible to see in the SWCT how 78.5 seconds of *muda* tasks were eliminated after the improvements (in a slot of 120 seconds) and how much free time is now available. The SWC shows that moving the (grey) trolly closer to the TM shortened the walking distance, so all frequent tasks are done in the same place. Finally, the Yamazumi shows the ratio for all types of operations, including the 4.2% improvement in the value-added ratio. It also represents the waiting time available, including the 206 seconds of *muda* eliminated, and visually describes the time for each task and workload of the station.

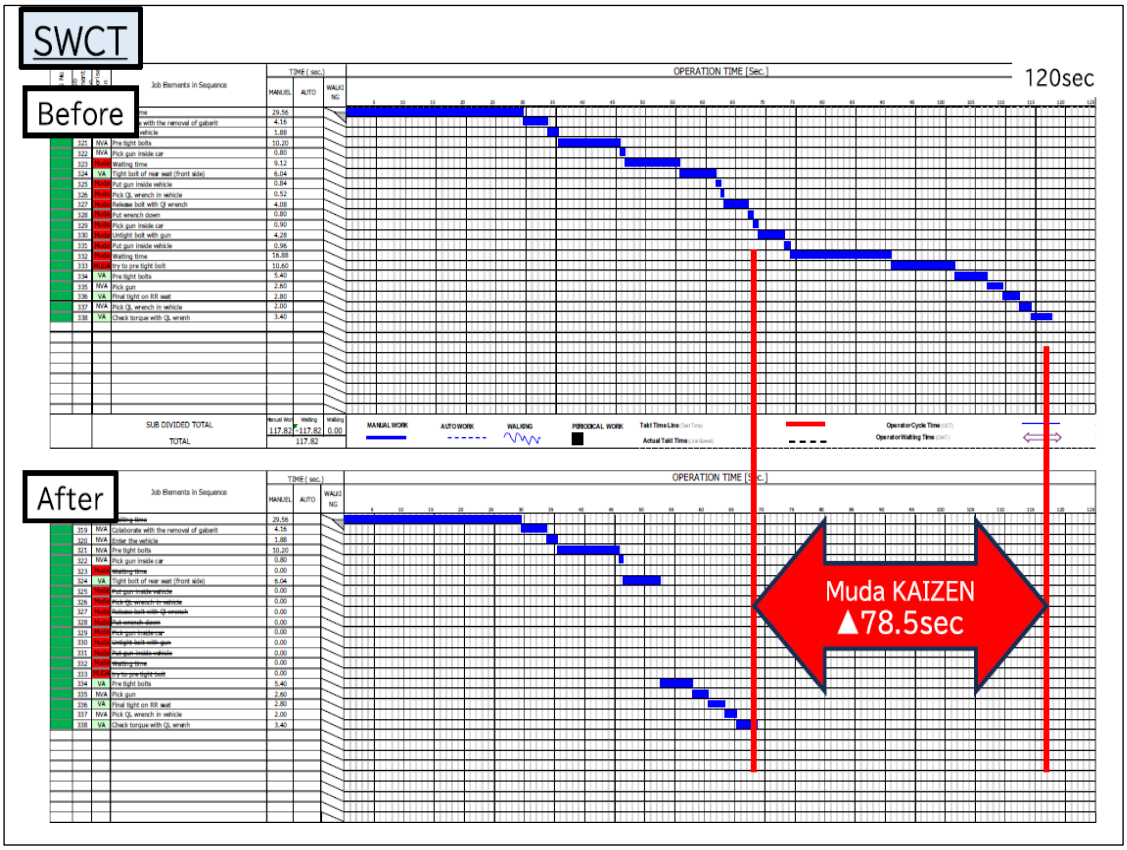


Figure 5 – Before and after of the station by its SWCT

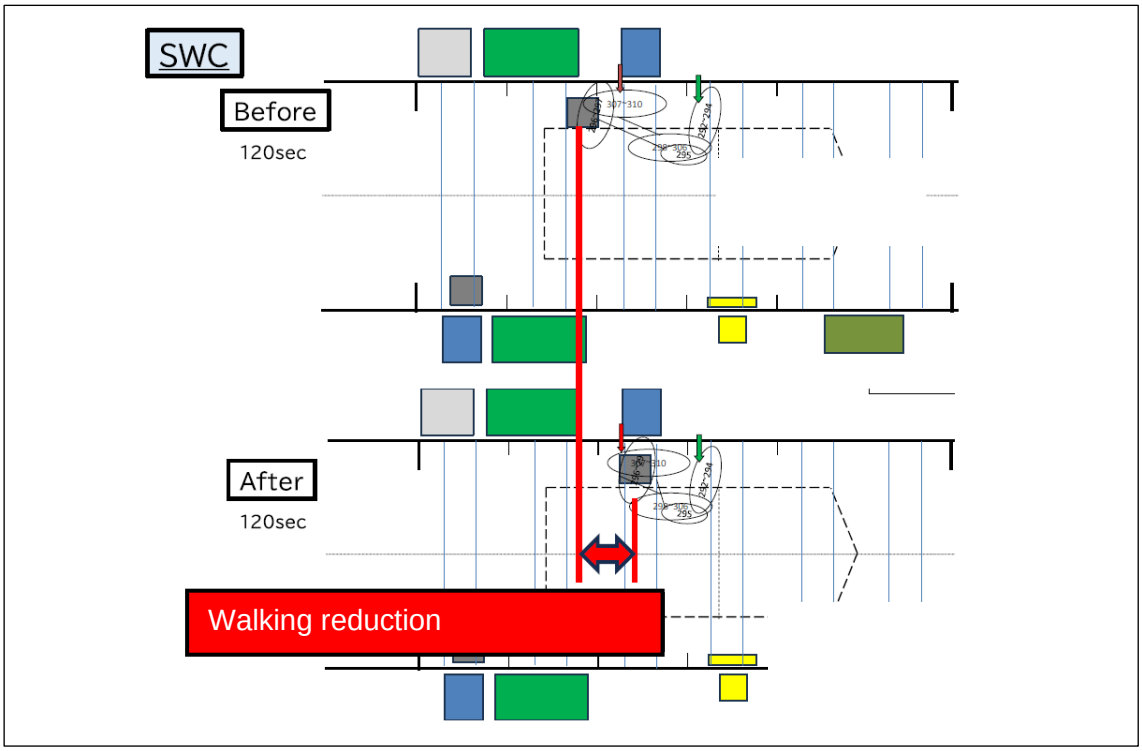


Figure 6 – Before and after of the station by its SWC

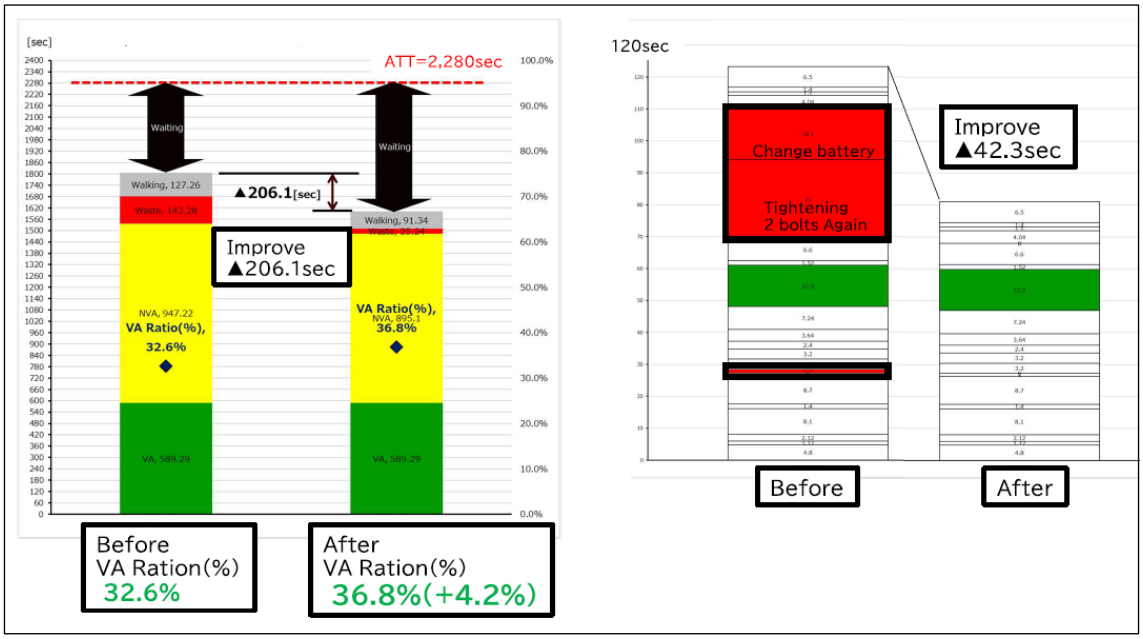


Figure 7 – Before and after of the station by its Yamazumi

In order to assess the progress of the team's TPS skill level, the members filled in an internal questionnaire based on 10 given basic principles: MandI flow, JIT, Small-batch production, *Kanban*, *Kaizen* based on standard work, Motion *kaizen*, *Kaizen* Leader, Problem-solving, Equipment and line capacity and Shop floor and abnormality control. According to a 0-5 scale ranging from *(0) – does not know* to *(5) – can teach it and adapt to the context*, level four or higher means that the respondent has developed enough knowledge of a principle to go from student to teacher. For confidentiality reasons, it is impossible to share the content of this questionnaire, but there was an average rise of 0.27 points, so the main theme of the *Jishuken* was achieved. An additional anonymous survey was also used. A longer preparation period was the main thing to rectify so as not to jeopardise continuous improvement. On the other hand, the learning attitudes, motivation and balance between the members of the TPS Office were positive points. Everyone was able to think and take action independently, remained highly motivated, and enjoyed the *Jishuken* despite the obstacles.

4.3 Obeya Board

During multiple visits to the *gemba*, it is possible to see various visual management tables with information recorded by the Team Leaders and Group Leaders of the Final Assembly. However, much of this information is not used by the Process Engineering (PE) department, and it is necessary to know its context. On the other hand, there is a clear difficulty in quickly and effectively transmitting up-to-date and accurate information as the *gemba* employees are constantly on the move. This has already resulted in situations where crucial information has been misinterpreted, distorted, updated without the consent of all involved, or even ignored due to oversight. Finally, the *gemba*-PE relationship is mostly passive:

many of the decisions involving both parties are entirely conceived by the managers, and *gemba* workers are limited to executing instructions. This is reflected, for example, in outdated standard documentation and a general attitude of mistrust, as the *gemba* does not understand why changes are being made and fears that it will increase their workload. On the other hand, PE is frustrated by the TM's resistance and how changes that should be possible on paper are not being implemented.

The proposed Obeya adapts the original structure of an Obeya Room to the specific needs of the *gemba* members, TPS Office and PE, optimising the (small) available space at the *gemba* for a practical and flexible solution that connects both low- and high-level data in a common meeting and physical space. This intermediate-level proposal can be improved over time with minimal resources.

The Obeya meetings will be held weekly, last 15 to 30 minutes and involve the TPS Office, the Group Leader of the section, the Team Leaders of the chassis, the trimming and final assembly lines, and the person responsible for Final Assembly at PE. The meeting can have an invited participant if necessary for a specific issue. Fig. 8 presents the initial proposal:

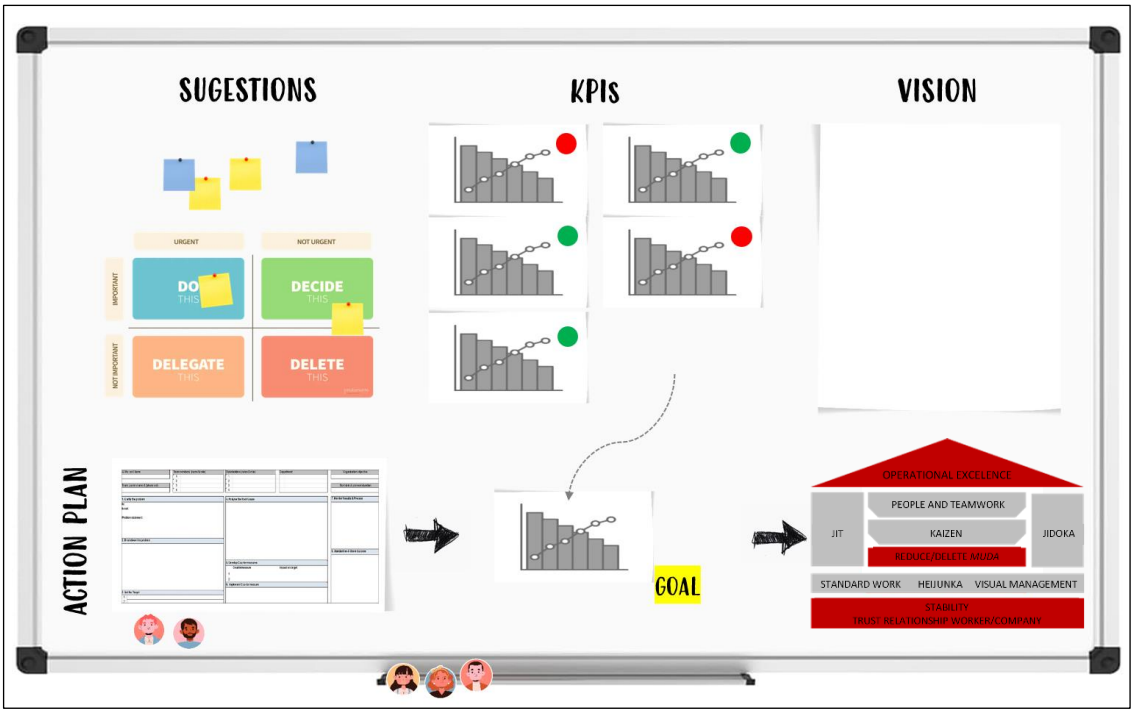


Figure 8 – Proposed Obeya Board

The *Obeya* Board has a grid format with three columns. Under "Suggestions", Group and Team Leaders are encouraged to post chronic issues on the line throughout the week and require support from the TPS Office within their area of expertise: productivity, quality, safety and costs. During *Obeya* meetings, the team should briefly discuss each suggestion, after which it is evaluated within the Eisenhower Matrix. After that, it is necessary to decide whether to delegate or to delete. The 'KPIs' column refers to the line indicators that should be analysed

and/or followed up by the TPS Office, either because objectives are not being met (marked in red), they are critical issues for the team, or improvements have been made in previous meetings that require a follow-up. What inspires and mobilises people to communicate and act around a clear and passionate purpose is associated with the part of the brain linked to emotions and decision-making, which makes it extremely difficult to convey in corporate terms. This is known as the "Why", according to (Sinek, 2009)'s Golden Circle theory. Therefore, the "Vision" section of the Obeya Board will initially remain empty to encourage a deep understanding of each participant's "Why".

Due to a physical prototype and two *Obeya* meetings, it was possible to identify numerous points for improvement. Defining a clear procedure for meetings and using the Eisenhower Matrix, a redesign of the activity follow-up sheet and a graphic have been introduced to record the ideas suggested versus those solved. While the first meeting surpassed the time limit, the second lasted 22 minutes. Besides the suggestion's column, the remaining components of the *Obeya* Board have not been used, but one suggestion was being evaluated as a possible A3 project. As a result of other factory activities becoming a priority, it was only possible to carry out this iteration of the PDCA cycle. Feedback indicated that the team understood and received the project's objectives. Having a short face-to-face meeting was essential for speeding up communication, fulfilling its role by transmitting up-to-date information to all who need it. It also allowed the *gemba* to collaborate with each other and with the PE. Thus, the project's objectives were mostly met, particularly concerning making informed, quick and effective decisions. However, implementing these measures for the week proved the main weakness. No monetary investment was made during this project. From now on, the focus should always be on learning by doing in an iterative, step-by-step manner. An attitude of continuous improvement not only operationally but also in the management of the Obeya itself can incorporate feedback from all of those involved.

5 DISCUSSION

Survey respondents agreed that, economically, all activities should positively impact long-term financial performance by boosting productivity and reducing costs in areas like quality control and defect repair through quicker, more effective problem-solving and detection. However, the environmental factor was mostly not affected. No accidents or work-related illnesses were reported, and most participants considered the activities significant for both professional and personal growth. Reapplying their learned knowledge, they noted improvements in motivation, and feelings of being valued and respected also stood out. Such evidence proves that, while TPS achieves better results at the business level, additional environmental practices are needed to promote all three pillars of the Triple-Bottom-Line (Abualfaraa, et al., 2020; Bergenwall, et al., 2012; Sá, et al., 2022). Regarding operational performance, effectiveness in identifying and

solving problems, how implemented improvements were maintained and how the frequent visits to the *gemba* influenced decision-making.

All three activities' primary focus of developing Team Member's knowledge and critical skills with practical case studies turned out to be critical for improving effectiveness in solving existing problems in the addressed stations and in quick and low-cost solutions that created value. On the other hand, workers were significantly more motivated to perform and exceed their day-to-day tasks by developing continuous improvement ideas and promoting TPS among peers. The results reinforce existing findings in the literature that support the positive impact of TW on manufacturing results (Loyd, et al., 2020) and how merging soft and hard factors as a socio-technical system - rather than isolated elements - is needed for more efficient and sustainable technical improvements (Coetzee, et al., 2016; Vanichchinchai, 2022). This is particularly valuable with the added complexity of a factory with a low production volume and long *takt* time. The proposed KPIs were also effective in evaluating each activity's impact on the three sustainability pillars (Sá, et al., 2022) by having a common standardised set that addresses the main issues for each, allowing us to infer that the Social aspect is the main focus of TW related projects, with indirect, but positive consequences on Economic growth. As originally mentioned by the author, the environmental pillar was not significantly affected, with only minor contributions to reducing residues.

A deep, principle-based understanding of Toyota's system, paired with a structured approach to continuous improvement and learning, sustains success and supports long-term company viability. Without it, TPS tools decline or fail to adapt to changing conditions, thereby deteriorating performance (Lander & Liker, 2007).

CONCLUSION

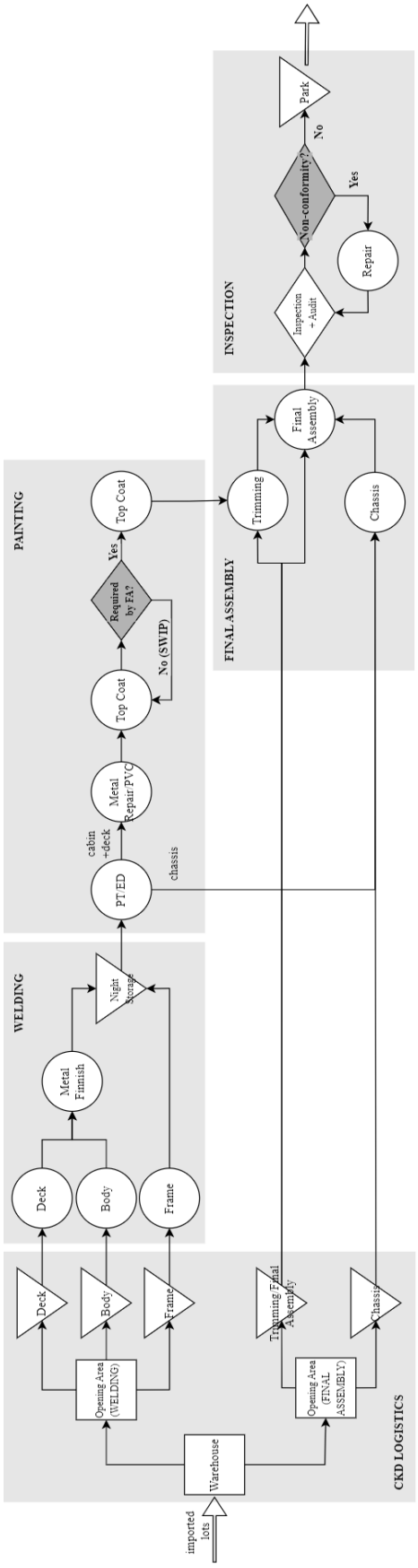
The results shown in this paper suggest that the soft dimensions of the TPS, namely *Toyota Way 2001*, do indeed have a significant positive impact on operational performance, by using and maximising workers' skills alongside TPS. The first *Jishuken* activity achieved multiple objectives: it solved an ongoing issue with one fewer worker, implemented 36 new improvements, and eliminated 7 minutes and 11 seconds of wasteful tasks. It also led to the development of seven promoters of continuous improvement on the shop floor and one Team Member beginning a six-month comprehensive TPS training programme. The second *Jishuken* substantially improved TPS Office's technical skills regarding chronic issues in the factory (standard work and *kaizen*), updated the standard documentation and further developed the member's scientific thinking, providing the knowledge needed for more complex issues that arise with having a low production volume and long *takt* time that is constantly adapting to ongoing demand. Thirty-one *kaizen* initiatives and 4 minutes and 48 seconds of *muda* were also eliminated. While still in its preliminary stage, the *Obeya* board project incentivises frequent communication among the *gemba*, TPS Office, and PE teams, allowing for faster, more informed and effective decision-making among all. It also promoted a bottom-up

involvement in continuous improvement, beginning with those who are actively bringing value to the company through production.

For all projects, it was necessary to gain a deep, onsite understanding of operations at all organisational levels involved before proposing improvement ideas with little or no monetary investment. Alongside developing people skills, this strategy created value consistently and exponentially during short-term focus groups, but results were sustained over time, alongside a continuous improvement mindset among participants and the capability for its independent application.

Thus, TW connects short-term goals to long-term strategies, supporting the idea that the TPS tools should be applied accordingly to an interconnected socio-technical system involving an entire company. The key to success lies in focusing on developing people. Respected, motivated, and capable workers can adapt a company's systems to volatile and complex markets by promoting continuous problem-solving and improvement, which drives both efficiency and sustainable long-term growth.

APPENDIX A


imported lots
Warehouse
Opening Area (WELDING)
Opening Area (FINAL ASSEMBLY)
Deck
Body
Frame
Trimming Final Assembly
Chassis
CKD LOGISTICS
WELDING
Metal Finnish
Night Storage
PAINTING
cabin +deck
chassis
PT ED
Metal Repair PVC
Top Coat
No (SWIP)
Required by FA?
Yes
FINAL ASSEMBLY
Trimming
Chassis
Final Assembly
INSPECTION
Inspection + Audit
Non-conformity?
Repair
Yes
No
Park

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CONFLICTS OF INTEREST

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.