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Toyota Kata for continuous improvement: an action research project in the Construction industry

Purpose
The purpose of this study was to investigate how Toyota Kata can be effectively applied in the Engineer-to-order manufacturing within the construction industry. The objective was to identify the critical success factors for the Toyota Kata implementation in this environment and to develop a continuous improvement method - based on Toyota Kata and adapted to the Engineer-to-order manufacturing within the construction industry.

Design/methodology/approach
An action research approach was applied, which includes a participatory form of inquiry and learning from both intended and unintended outcomes, while simultaneously building up scientific knowledge about successful implementation of Toyota Kata.

Findings
All the critical success factors in the action research project are addressed by the earlier literature, thus confirming the existing body of knowledge. Moreover, the existing knowledge was arguably extended through the modified Toyota Kata as an approach for continuous improvement. New elements regarding how to run the small experiments by extending the core team with personnel who work with the problem on a daily basis.

Originality
This research addresses a gap identified in the literature regarding how Toyota Kata can be adapted to the Engineer-to-order manufacturing within the construction industry. It also presents an overview of critical success factors for the Toyota Kata implementation in this environment.

Keywords Toyota Kata**,** continuous improvement, learning, action research, engineer-to-order manufacturing, construction industry.

Paper type Research paper

Introduction

To increase their competitiveness, companies in the construction industry strive to minimize their cost overruns and schedule delays, while safeguarding quality, health, safety, and environment. In a study by the Lean Construction Institute in USA, 70% of the construction projects were delivered too late and over budget, and the accident reports were worrying (Seed, 2015).

Achieving significant performance improvements is particularly challenging for companies operating in an Engineer-to-order (ETO) environment, as a construction or any other product dedicated to a construction project can only be engineered and produced after an order has been received.

To overcome these challenges, the implementation of Continuous Improvement (CI) is seen as a valuable approach (Bajjou and Chafi, 2018). The CI implies the application of standardized problem-solving approaches, targeting the complete elimination of waste

and defects, and the continuous monitoring and streamlining of all the systems and processes in an organization and its value chains (del Solar Serrano *et al.*, 2020). Moreover, it implies the active participation of the company's entire workforce (Garcia-Sabater and Marin-Garcia, 2011).

The research on the implementation of CI in organizations as a part of different management systems is rather vast. It addresses topics such as success factors (Aleu and Van Aken, 2016), barriers (Sanchez-Ruiz *et al*., 2020), and enablers and inhibitors (Garcia-Sabater and Marin-Garcia, 2011, Bateman, 2005). Nevertheless, as companies often find their CI program in a fledging state, it is important to know how to scale it up, by mobilizing the entire workforce and developing a CI culture (Garcia-Sabater and Marin-Garcia, 2011, McLean *et al.*, 2017). CI programs may include approaches such as Lean, Lean Six Sigma, Six Sigma, Kaizen, and Toyota Kata.

Toyota Kata is an approach that can significantly facilitate a culture of CI and learning at all the organizational levels, and thus the achievement of sustainable benefits (Rother, 2009). However, to the best of our knowledge, apart from Casten *et al.* (2013) and Michels *et al.* (2019), there has been very limited research about the Toyota Kata implementation in the construction industry. For instance, the study of Tillmann *et al.* (2014) addresses only two out of four Toyota Kata steps, stopping at problem identification. To avoid any pitfalls, it is important to understand the critical success factors of the Toyota Kata implementation process. Like Lean, Toyota Kata should be adapted to the environment where it is applied. To guide the investigation, we adopt the following research questions (RQ)s:

- *RQ1: What specific elements of Toyota Kata should be modified to fit the needs of an ETO manufacturer in the construction industry?*
- *RQ2: What are the critical success factors (CSF)s for implementing the adapted Toyota Kata?*

Theoretical background

This chapter provides the background on the main theoretical domains that frame and support this research – CI, Toyota Kata, and ETO industry.

Continuous improvement

CI is an essential component of modern business management. It has been the focus of numerous studies and has been examined from various angles, including TQM and Lean. Regardless of the management system and organization chooses to employ, CI is a critical principles that can benefit every aspect of a business (Dahlgaard-Park, 2011). CI is often defined as a "continuous stream of high-involvement, incremental changes in products and processes for enhanced business performance" (Ljungström and Klefsjö, 2002). In essence, it involves a never-ending quest for perfection in all aspects of a business, achieved through small, continuous improvements driven by the active participation of the entire workforce (Garcia-Sabater and Marin-Garcia, 2011).

A key component of CI is the application of standardized problem-solving approaches that aim to eliminate waste and improve quality across all systems and processes within an organization. By implementing such an approach, organizations can continuously introduce incremental improvements in their operations and value chains, reduce product defects, and enhance overall efficiency (del Solar Serranoet et al., 2020).

One specific approach to CI that has gained significant attention is Toyota Kata. This approach involves structured, scientific method of problem-solving that encourages employees to experiments with solutions and learn from their experiences. The Toyota kata approach has been shown to be highly effective in driving continuous improvement in organizations across a range of industries (Rother, 2010).

Critical success factors for implementation of CI

There are reports showing that many companies adopting CI fail (Garcia-Sabater and Marin-Garcia, 2011). It means that there is something that inhibits or facilitates the implementation of it. Many authors have attempted to identify and analyze the enablers and inhibitors of CI implementation (Bateman, 2005, Garcia-Sabater and Marin-Garcia, 2011, Aleu and Van Aken, 2016). Aleu and Aken (2016) provide the latest systematic literature review of CSFs for CI. The authors state that the list of factors can be used in future empirical research to develop a more complete understanding of the relative contribution of each to influencing CI success. In this study, we use this list of factors to compare them to our findings and discuss in the light of the construction project characteristics. The authors identified 53 factors and grouped them into four categories: organization, task design, team design, CI process. The full list of factors in each category

and factor definition can be found in their publication (Aleu and Aken, 2016). Below, we provide a summary of the four categories of CSFs.

Organization. Organization factors aim at establishment of managerial support, provision of necessary resources (financial, material, equipment, software, team member time, etc.) for CI implementation, and organizational structure (policies, procedures, culture, structure) that is supportive of CI implementation. This group of factors also emphasizes the necessity of recognition and rewards, follow-up activities and lessons learned to ensure that changes are successful.

Task design. Task design factors aim at determining the correct problem scope and target area, as well as correct, clear and aligned goal design setting. The factors also emphasizes the necessity of target area employees to change and understanding of improvement principles, methodologies and tools used by the continuous improvement team.

Team design. Team design factors aim at establishment of a correct team size and composition. For successful CI implementation, teams should be cross-functional, include members experienced in CI implementation, have a champion, be autonomous and have skills in problem-solving, improvement and change management methodologies and tools.

Continuous improvement process. CI process factors aim at establishing team commitment, harmony, communication and coordination. They emphasize necessity of having a structured methodology for CI implementation and choice of correct tools for problem-solving and improvement. And finally, they require CI progress reporting and technical documentation.

Toyota Kata as an approach to CI

Toyota Kata is an approach developed to emphasize the importance of non-visible things, such as routines, behaviours, scientific and systematic thought within continuous improvement (Rother, 2009). It combines systematic improvement and coaching approaches to help managers and supervisors support, guide and demand improvement work. The approach consists of two linked behaviours: Improvement Kata and Coaching

Kata (Rother, 2009), which are shown in Figure 1. By consistently practicing Kata routines, employees and the organization can internalize the CI process.

The improvement Kata is a four-step routine that provides a systematic approach for working toward a goal: (1) Understand the desired direction, (2) Grasp the current condition, (3) Set the next challenge, and (4) Run small experiments (PDCA – Plan, Do, Check, Act). Coaching Kata is used to ensure that improvement happens and people internalize the CI process. Coaches guide people in making improvements in processes by teaching them to sense and understand the situation and react in a way that moves the organization forward.

According to Rother (2009), leading people to implement specific Lean solutions like assembly cells, Six Sigma tools, Kanban, etc. will not make companies continuously improving and competitive. Instead, it is essential to teach people to develop behavioral routines and habits that are practiced daily. This is what Kata is about – building a culture of CI through the development of routines and behaviors that support scientific and systemic thought. The coaching Kata approach emphasizes the role of leaders as facilitators and the importance of teamwork in problem-solving. By internalizing Kata routines, organizations can achieve better efficiency, constantly insert incremental improvements in their processes, and minimize the amount of product defects.

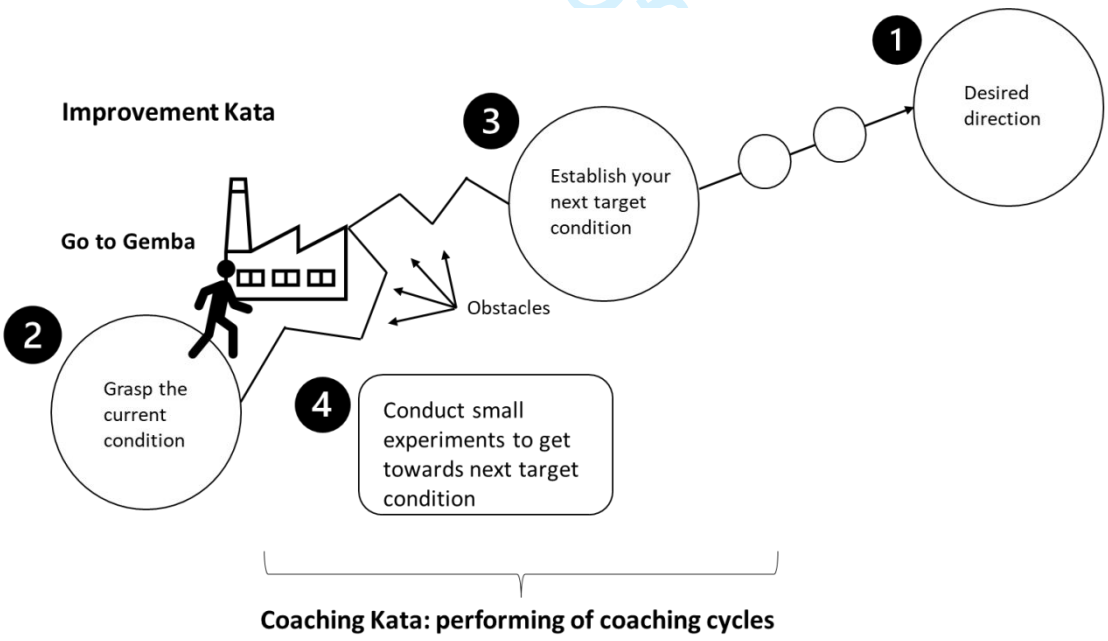

Figure 1: Toyota Kata

Toyota Kata as enabler of learning-to-learn capability

The ability to learn and adapt is a crucial success factor for implementing Lean principles in organizations (Powell and Coughlan, 2020). Recent research by Saabye et al. (2022) suggests that developing a learning-to-learn ability is key to achieving this. This can be achieved by applying lean and action learning principles, which involve structured problem-solving routines that encourage reflection and experimentation among both shop-floor workers and managers. Toyota kata, as a standardised problem-solving practice in lean management, can enable the development of this capability (Kristensen et al., 2021). Effective problem-solving is a crucial component of developing a learning-to-learn capability (Hines et al., 2004; Powell and Coughlan, 2020; Saabye et al., 2022), and Toyota Kata Provides an effective means of achieving this.

In addition to problem-solving, the development of a learning-to-learn capability can also be achieved through formalization, organizational learning, and action learning (Saabye and Powell, 2022). In this paper, however, we focus on learning through the Toyota Kata process. While this view of learning is more limited than that suggested by Powell and Coughlan (2020) and Saabye et al. (2022), it is an important part of the Kata process that contributes to the development of learning-to-learn capabilities in organizations.

Toyota Kata empirical studies

Toyota Kata is rarely mentioned in academic literature, and even less in academic investigation into real-life use. Existing investigations show positive effects and importance of Toyota Kata implementation as a part of CI process. Casten et al. (2013) tailored and implemented Toyota Kata in a construction firm. After Starter Kata, they introduced "Conformance Kata" with amended coaching questions. The new routine had a success with both workers and managers as it standardized and clarified interactions for both. The results of this study are in line with suggestions from Rother (2010) who stated that organizations develop their own Katas after becoming comfortable with the Starter Kata.

Enhi et al. (2015) studied two manufacturing companies which implemented Toyota Kata approach. Both companies added elements to Toyota Kata's Improvement and Coaching Katas: roles assignment, detailed procedures and process analysis and a

procedure to transform the vision into individual improvement targets. The Toyota Kata implementation showed positive monetary results, as well as companies' long-term development.

Holmemo et al. (2018) presented longitudinal case study at a big consultancy firm trying to implement "soft" Lean with Toyota Kata, as opposed to "hard" Lean where a set of tools is imposed on a company. In the case description Toyota Kata is seen as an A3 tool. The consultancy was implementing A3-focused coaching in a public sector company in Norway. The researchers report that implementation was unsuccessful: after 18-month enthusiasm of client had vanished. Holmemo et al. suggestion that his happened due to reversion to the consultants' instinctive directive style. Instead of true Toyota Kata implementation for CI as philosophy, consultants reverted to CI as a set of tools – approach proven not to work.

Brandl et al. (2020) developed updated Toyota Kata routine for innovating business processes. They created a hybrid approach between Toyota Kata and stage-gate model – at each stage of the strategic level plan Toyota Kata is applied. This allows to gather data at operational level by applying Toyota Kata to formulate more mature next target states of the stage-gate model. The authors tested the routine on a very complex re-design of ETO business processes of a machine manufacturer. The report on testing is very brief though and does not give a full picture of Toyota Kata implementation in the company.

De Souza et al. (2022) used Toyota Kata for the development of cyber-physical systems in the manufacturing firm. Toyota Kata is unchanged and used as prescribed by Rother (2010). The testing was done in hypothetical and simulated case study conducted by post-graduate students. Such testing is, however, limited as it cannot reflect real-life work in manufacturing companies. Even though the study showed positive outcome of Toyota Kata use, testing in natural environment is needed.

ETO industry characteristics

Contingency theory suggests that contingency factors often affect the use of management practices and the associated performance outcomes (Sousa and Voss, 2008). Morris and Lancaster (2006) advise that management approaches should be adapted to industrial conditions when transferring between different sectors. In a similar vein, CI implementation is likely to vary depending on the production environment. The research reported in this study was conducted with the ETO company delivering products to

construction companies. Here, we provide characteristics typical for the ETO industry.

ETO is a production environment where all activities – design, engineering, purchasing, production, assembly, testing, delivery – start after the customer order is received. Customer orders in this environment are handled as separate projects (Hobday, 2000). ETO products are one-of-a-kind, produced in low volumes, and can range from products build on a base of existing solutions to completely new designs (Bertrand and Muntslag, 1993). Examples of ETO products are buildings, heavy machinery, ships and oil platforms. Supplier relations in the ETO environment are often established for the duration of one project with opportunistic collaboration (Stavrulaki and Davis, 2010). Since product mix, volume, and specifications is difficult to forecast, production and supply chain operations are uncertain both in terms of tasks composition and durations (Muntslag, 1994, McGovern *et al*., 1999). Production processes in ETO companies are usually highly labor-intensive, where operations are designed to handle a wide variety of product designs (Olhager, 2003).

Research design

This study is part of a national research project that was conducted in the period between 2018 and 2022. The overall goal of this project was to increase the competitiveness of the in-situ casting of concrete constructions, through effective value chain collaboration and value chain performance optimization. One of the objectives was to investigate if Toyota Kata can facilitate a CI program in the construction value chains, and if so how. Thus, the Toyota Kata approach needed to be applied to real problems at the project companies. In this study, the case company had no previous experience with Toyota Kata. This competency was held by the participating research institute, including a senior researcher within CI, and a senior advisor within Toyota Kata. The latter also had 18 years' experience in the construction industry. Thereby, the Action Research (AR) was evaluated as a suitable approach, since it enables a researcher to intervene in organizations while generating knowledge about the implementation process (Coughlan and Coghlan, 2002).

Data collection and analysis

In AR, data is generated through self-inquiry during the application of the cyclical AR process (Coughlan and Coghlan, 2002, Coghlan and Brannick, 2005). The cyclical

process consists of diagnosis, action planning, taking action, evaluation and identification of findings, as shown in Figure 2. In this study, the researchers actively participated in the teams that were established, while observing how these teams analyzed the problems, took decisions and evaluated the results. The researchers reflected on their direct observations and experiences with the Toyota Kata approach, both through the AR cycles and afterwards. The data collected through direct observation concerned different aspects of group dynamics, such as team roles, communication patterns, the relation among team members, leadership behavior, and culture (Coughlan and Coghlan, 2002).

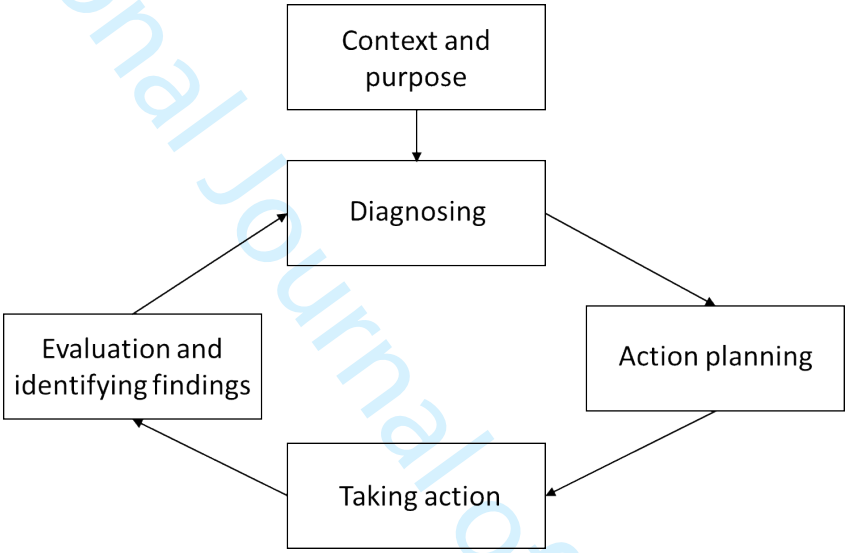

Figure 2: The cyclical process of AR (Coghlan and Brannick, 2005).

The researchers kept journals throughout the entire research period and during all the phases of the cyclical process (McNiff *et al.*, 1996). The journals included field notes describing the researchers' observations and separate reflection notes, describing why events occurred (Tjora, 2010). This helped the researchers to understand the participants' subsequent behavior and laid the ground for the final data analyze.

After collecting the empirical data, the lead author wrote the 'narrative' of the studied Toyota Kata pilot - as a first step in the data analysis process (Karlsson, 2016). Second, the narrative was divided into the four CSFs categories in the theoretical background: organization, task design, team design and CI process. Third, the events were coded in a database, for retrieval and organization purposes (ibid.). Finally, through logical relationship building, the Toyota Kata elements to be adapted to the construction industry

and the CSF for the implementation of the adapted Toyota Kata were derived from the narrative.

Research quality and reliability

To ensure a high research quality, the researchers need to systematically enact the cyclic Action Research process consciously and deliberately- from action planning, implementation and evaluation to the development of actionable and usable knowledge (Coughlan and Coghlan, 2002). Moreover, the AR needs to address real-word problems, deliver workable solutions, and foster close collaboration between the researchers and the participants and a joint understanding of the phenomena (Levin, 2003).

The researchers actively participated in the action cycles together with the case company participants. In addition, one of the researchers had 18 years' experience from the construction industry, while the other had over 16 years' experience as action researcher. Thus, the researchers managed to collaborate closely with the company participants, through a common language and the case company's rather high trust level and high willingness to share information. However, a known challenge for action researchers is to both act – in order to contribute to practice, and objectively reflect on the actions - to contribute to the body of knowledge. To ensure research quality, action researchers must deliberately and frequently open their reasoning to public critique, and actively seek alternative explanations (Coughlan and Coghlan, 2002). Thus, the authors discussed results with academic reviewers and other researchers outside the project, at workshops and conferences.

To understand their experiences and perceptions, encourage self-inquiry and develop a joint understanding of the phenomena, the researchers interviewed the participants through each of the four-step routine of the Improvement Kata. Finally, as mentioned at the beginning of this chapter, the Toyota Kata was applied to real problems at the project companies and the solutions were developed in close collaboration with the company participants.

Apart from the team activities, empirical data about the Toyota Kata pilot were collected from corporate documentation, meetings and workshops with the case companies, e-mails and through telephone and direct conversations with the research participants. The variety of data collection methods for the same phenomenon enabled the triangulation of data, increasing the internal validity. To ensure the reliability of

collected data, the lead author recorded the date, place and individuals present, for all the observations and their interpretations.

The Actin Research project – trial pilot of Toyota Kata

Company description

The study was conducted in an established ETO company with over 30 years of experience in delivering products for the Norwegian construction industry. The company is a key participant in a national research project focused on joint housebuilding projects in Norway, along with the entrepreneur and three of the main suppliers. The company examined in this study is one of these suppliers, and it is a subsidiary of a larger European company.

The construction industry is known for its high variability, cost/delay overruns, poor performance, significant production waste, and unsafe working environment. As a solution to these issues, the implementation of Toyota Kata as an approach for CI was identified as a critical objective for all companies in the consortium. This will help to improve collaboration and facilitate a learning process that addresses the root causes of inefficient flow in joint housebuilding projects.

Understanding the context and purpose of the AR project

The first step was to understand the context and the purpose of the AR project based on the previous work performed in the ongoing national research project – an extended value stream mapping for a joint housebuilding project with the purpose to create a common overview over the situation for a specific casting process including identification of problem areas creating an inefficient workflow (Rother et al. 2017). The entrepreneur and three of the main suppliers were involved, where our case company was one the participants.

The study found that a prevailing opinion among stakeholders was that a large number of deviations occur daily at the construction site, which are then addressed reactively rather than proactively through root cause identification and elimination. This reactive approach, akin to firefighting, was found to be pervasive (Lodgaard et al., 2021).

Interestingly, the entrepreneur did not face significant issues with their suppliers, but rather had internal problems. The reverse was true for the suppliers, who identified the

entrepreneur's behaviour, such as changing schedules or orders close to the delivery date, as their main challenge. Consequently, suppliers had to make several changes to their internal production process to accommodate the firefighting approach. It appeared that suppliers were more focused on pleasing the customer at the expense of their own internal processes and production plans.

Another notable finding was that only a few of the entrepreneur's identified problem areas related to their suppliers, which surprised everyone involved and reinforced the perception that a strong customer focus can lead to unnecessary problems for suppliers.

As a result, stakeholders agreed on the need to shift from a firefighting culture to a more predictable one, achieved through systematic improvement and better process flow. This realization was the starting point for the case company to adopt a more planned, organized, and systematic approach to improve their organizational performance in collaboration with the entrepreneur.

Designing and performing Toyota Kata

The next step in the improvement process was to define a specific task to be undertake by a workshop consisting of two senior managers from the case company and external resources – a senior advisor with expert knowledge of Toyota Kata and a senior researcher specializing in Continuous Improvement. The group agreed that Toyota Kata was an excellent starting point to help them transition to a more systematic approach. Since this was the first time the company had used such a structured approach to improvement, it was important to gain experience and work more systematically withing the organization.

Initially, the plan was to select a challenge from the extended Value Stream Mapping related to the joint housebuilding project. However, during the workshop, the group found this too challenging. Instead, they decided to focus on improving the internal production process to streamline the flow and reduce waste. One reason for this decision was the more demanding process of collaboration with external actors, where decision-making was not as straightforward as it was within the company.

The manager of the production department wanted to improve the lead time for a product mix due to financial losses and the potential for significant improvement. The production process was labor-intensive and included operations that required handling a wide variety of standard product designs. This made it a cyclical, internally repeating process that did not produce typical one-of-a-kind products.

During the same workshop, the group discussed how to approach the composition of an internal core team and how to collaborate with the external resources – the researcher and the advisor. The manager responsible for the chosen production process recognized the value of involving operators from the shop floor who work with the production process on a daily basis. The following quote from the production manager illustrates this point: "If we want to succeed in solving improvement issues, we have to involve the people who work with the improvement issue on a daily basis."

As a result, an internal core team was created consisting of two senior managers and two operators from the production department. One of the operators works as a team leader and the other is an experienced operator. Together with the senior advisor and senior researcher, the internal core team was defined as the AR core team.

Further, it was agreed that the senior adviser acted as a coach according to Coaching Kata, to teach people by guiding them in making improvements in processes. Participation of this AR project was voluntary, although no team members declined to participate.

The approach for the trial pilot of Toyota Kata was decided by conducting regular workshops with the AR core team. In addition to these workshops, regular internal meetings were held for the internal core team to ensure progress based on the actions taken on a daily basis.

A second workshop was planned with the AR team to establish the first version of the improvement Kata. The workshop included the AR team, and an additional team member, the Quality Manager, who expressed interest in the improvement process. The workshop followed a systematic approach guided by the external coach, with a focus on the four-step routine of the improvement Kata: (1) understanding the desired direction, (2) grasping the current condition, (3) setting the next challenge, and (4) running small experiment through learning cycles (PDCA – Plan, Do, Check, Act).

The results of this workshop were documented on a prescribed storyboard, which was used to visualize the status and results categorized withing the four-step routine. The storyboard was placed on a wall in a dedicated room for the trial pilot of Toyota Kata. The team agreed upon a desired direction of reducing the lead time for the product mix in the selected production process by 50% within a timeline of 8 month.

Although the company had a sufficient amount of data to identify the current condition, they lacked a good overview of the process flow. Therefore, this was performed during the workshop, and it was highlighted as valuable since it made the

current state of the process visible and clear, enabling the team to evaluate the production process and create the desired effect.

The team defined the first target condition as a 30% reduction of the lead time. Along with this, they identified obstacles to achieving the desired lead time and chose three specific small experiments to embark on.

The AR core team, along with experienced operators from the shop floor, conducted the first trial of small experiments to solve the identified obstacles. The advisor provided training to the team, resulting in several actions being taken. Two additional small experiments were planned at the end of the workshop to continue to remove obstacles and improve the production process until the next planned workshop.

To ensure progress, the internal core team planned for regular meetings focused on running small experiments and removing obstacles. The production process manager was responsible for managing the meetings and updating the storyboard to visualize the action taken and results from the learning cycles.

However, during the third workshop, insufficient progress was revealed due to the storyboard not being updated and regular meetings not being held. The managers involved had not prioritized the work sufficiently. As a result, the AR team and the internal team were extended with an additional manager who get the responsibility to follow up the progress. Due to insufficient progress the AR team decided to focus on running small experiments based on the list of defined obstacles from the last workshop and to update the storyboard.

The fourth workshop, the AR team spent time on reflection and learning about the trial pilot of Toyota Kata. Since the start of this trial pilot of Toyota Kata, they had achieved approximately 40 % improvement in lead time and were optimistic about achieving their goal of 50% improvement.

Result and discussion

We set out to address the RQs: *What specific elements of Toyota Kata should be modified to fit the needs of an ETO manufacturer in the construction industry?* and *What are the CSFs for implementing the adapted Toyota Kata?*

Task design

Undoubtedly, when an organization begins to explore a new approach for continuous improvement while also dealing with a culture of firefighting, it is important to start with

simplicity. For this reason, the client organization decided to exclude the original plan to collaborate with an external actor based on the process of the Value Stream Mapping for a joint house building project. They recognized that embarking on an unfamiliar approach for CI would be challenging enough without adding the complexity of a joint project.

The production department manager determined which area needed improvement based on their knowledge and experience. They identified the lead time for the product mix as a key area for improvement due to the potential for cost savings. Additionally, the manager was motivated to try a more systematic approach, in line with the goals in the company's strategy set by the management team (Aleu and Van Aken, 2016).

The selected production process was highly labor-intensive and involved a variety of product designs, all with a cyclical repeating process. This is not a typical production process for ETO manufacturing, which involved one-of-a-kind products, but rather standardized products with a cyclical process. However, as Rother (2009) notes, Toyota Kata can be applied to any situation in an organization.

Team design

Another CSFs which represented a good starting point was the selected cross-functional team which was based on issue to improve (Aleu and Van Aken, 2016). The team working with improving specific issues should involve the people who normally work on those issues (Jakobsen and Poppendieck, 2011) and one must be knowledgeable about the issues to be improved (Soebek and Smalley, 2008). An interesting observation made during the AR project was the importance of involving workers at the shop floor level. As the manager of the production department put it, "If we want to successfully solve improvement issues, we must involve the people who work with these issues on a daily basis." This emphasis on the collaboration between managers, employees, and unions is a characteristic of the Norwegian work model, which features a low level of hierarchy and encourages involvement at all levels of the organization (Levin et al., 2012).

To facilitate the application of Improvement Kata and Coaching Kata, the senior adviser took on a coaching role, enabling the internal core team to develop the necessary skills and knowledge to apply the method correctly. This approach, which has been noted by Anjos et al., (2012), proved effective in achieving impressive results.

After the second workshop, the Quality Manager expressed interest in the AR project and asked to become involved due to the remarkable results achieved through the

application of Toyota Kata. Additionally, another member was added to the internal core team who would serve as an expert in Toyota Kata. This decision reflects the organization's recognition of the need for in-house knowledge and a systematic approach to improvement, rather than depending on external expers (Aleu and Van Aken, 2016).

Another important finding was the focus on involving people who work with the problem on a daily basis during each experiment and learning cycle. This involved going to Gemba, or the place where the work is done, and to extend the core team to involve those who work on the problem daily. After implementation of the action plan, the team would return to Gemba and define the learning together with the extended team. The composition of the extended team would depend on the specific obstacle being addressed, increasing the likelihood of success with incremental improvement and exploratory learning, as shown in Figure 3. This approach aligns with the findings of Powell et al. (2017), who noted that broad involvement makes improvement initiatives easier. As noted by Casten et al., (2013) and Rother (2010), organizations often develop their own Katas after becoming comfortable with the approach.

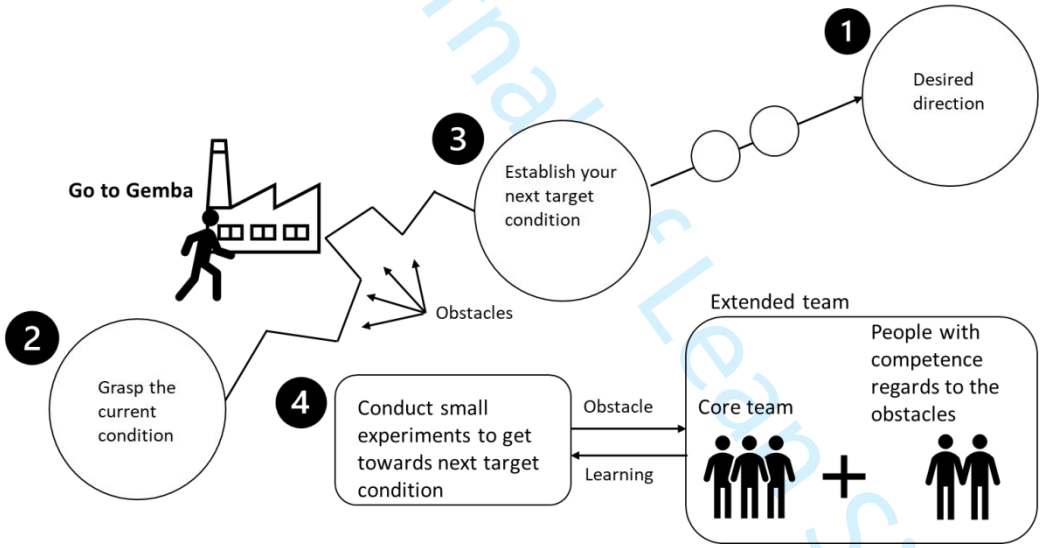

Figure 3: Adapted approach for improvement Kata.

CI process - Toyota Kata

At the outset, the client organization aimed to shift from a reactive firefighting culture to a proactive improvement approach that emphasizes continuous learning from experiments and mistakes (Rother, 2009). This served as an excellent foundation for the successful adoption of Toyota Kata as a continuous improvement methodology.

However, during the initial pilot phase, the team faced challenges in maintaining regular meetings, resulting in poor collaboration and coordination within internal teams.

The manager acknowledged this issue and took steps to prioritize regular team meetings (Aleu and Van Aken, 2016). Additionally, documenting experiments on the storyboard proved to be a challenging process that required better coordination within the internal team. This issue was eventually resolved when a dedicated internal expert was brought in to support the team towards the end of the project period.

A surprising finding was about the company's strategy about digitalizing and digitalizing the storyboard. Undoubtedly, the general strategy was to digitalize to improve efficiency in the organization but not the storyboard. To enable the learning process, it was seen important for the involved team members, to manually write on the storyboard.

Despite these challenges, the team recognized the importance of taking small, structured steps towards improvement through the implementation of the Toyota Kata approach. They focused on addressing day-to-day problems systematically, working towards achieving the next target condition. As one shop floor worker stated, "it is useful to think outside the box and discuss together what we should be better at", emphasizing the importance of establishing new behavioral routines and habits that are practiced daily (Michels et al., 2019).

Through involvement in the continuous improvement process, the internal core team gained a sense of belonging and satisfaction by leveraging their creativity, knowledge, and skills to solve day-to-day problems. This iterative learning cycle was critical in enabling problem-solving and promoting a culture of continuous improvement (Rother, 2010).

Organization

Effective management commitment and leadership are CSFs when implementing CI and adopting new approaches withing an organization (Aleu and Van Aken, 2016; van Assen, 2020). This requires a thorough understanding of the chosen CI approach, as highlighted by Bessant et al. (2001), who noted that management plays a key role in maintaining CI behaviour patterns. However, managers themselves often fail to recognize their leadership responsibilities. Our study found that a manager who understood this still struggled to devote sufficient time to the CI process.

In the case of the chosen production process, the manager demonstrated empowered leadership by fostering a participative decision-making climate where team members interacted and solved obstacles together, resulting in a remarkable 40% reduction of lead

time for the entire production process. Empowered leadership was essential for successful implementation and execution of CI, as supported by existing literature (Aleu and Van Aken, 2016; Netland, 2019).

Through the application of the adapted Improvement Kata, the internal team achieved significant results not only in terms of efficiency but also in terms of mindset and culture. They experienced a systematic approach that helped transform their firefighting mentality into problem-solving and learning based on scientific thinking (Casten et al., 2013).

Our study revealed an important success factor: the need for an experienced coach due to a lack of knowledge and experience with systematic approaches such as Toyota Kata in the organization. This finding is consistent with the studies of Garcia-Sabater and Marin-Garcia (2011) and Tillmann (2014), which highlighted the importance of guiding the team to think scientifically and perform the steps of small experiments as learning cycles (Rother, 2009).

However, the implementation was not self-driven, as Rother (2009) noted that the improvement approach becomes ingrained in an organization when it is incorporated into daily work. Although the manager for the production department supported the AR project, the degree of involvement was a critical factor in the team's achievement, as advocated in the literature (Aleu and Van Aken, 2016; van Assen, 2020). Between the first and second workshop, the manager had limited time allocated for daily involvement, resulting in a temporary shift in focus back to regular production tasks after resolving defined actions.

Gradually, the internal team improved their ability to carry out small experiments scientifically and were motivated to undertake CI. However, it takes time and effort for an organization to acquire sufficient knowledge and skills to become independent of an external coach. To sustain and continue using Toyota Kata, the organization needs to prioritise education and appoint an expert in Toyota Kata to facilitate and coach the organization throughout the implementation phase after the trial pilot.

Conclusion

The AR project was to explore the application of Toyota Kata as a CI approach for an ETO manufacturer in the construction industry. The study revealed that transitioning from a reactive, firefighting culture to a proactive, scientific problem-solving culture takes time and requires structures that enable problem identification and resolution. As

noted by Bessant et al. (2001), implementing a systematic approach to CI does not happen overnight.

The pilot trial demonstrated that the use of Toyota Kata was highly successful, resulting in significant improvements in organizational performance. However, to enhance the likelihood of success in incremental improvement and problem-solving learning, we propose modifying the Improvement Kata by expanding the core team to include people who work on the problem daily.

In examining CSFs, we found that managerial commitment and empowered leadership, a willingness to embrace a systematic approach, and the use of an internal problem area as a starting point were the key. In addition, internal knowledge of Toyota Kata was essential for knowledge transfer and real-life problem-solving, and involving people who work on the problem daily and expanding the team were important factors for success. Despite the importance of digitizing in order to improve efficiency in an organization, it is seen important to write manually on the storyboard due to an enabler for the learning process for the involved people.

Our study confirmed existing knowledge on CSFs for applying Toyota Kata as an adapted improvement Kata, while also contributing to a deeper understanding of CSFs for CI in the construction industry. It is important to note that this study was conducted in a single organization using AR as a method, and therefore, generalizing the results may be difficult. Further research is needed to explore the implementation of Toyota Kata and proposed modified version in other construction industry organizations.

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Figure 1

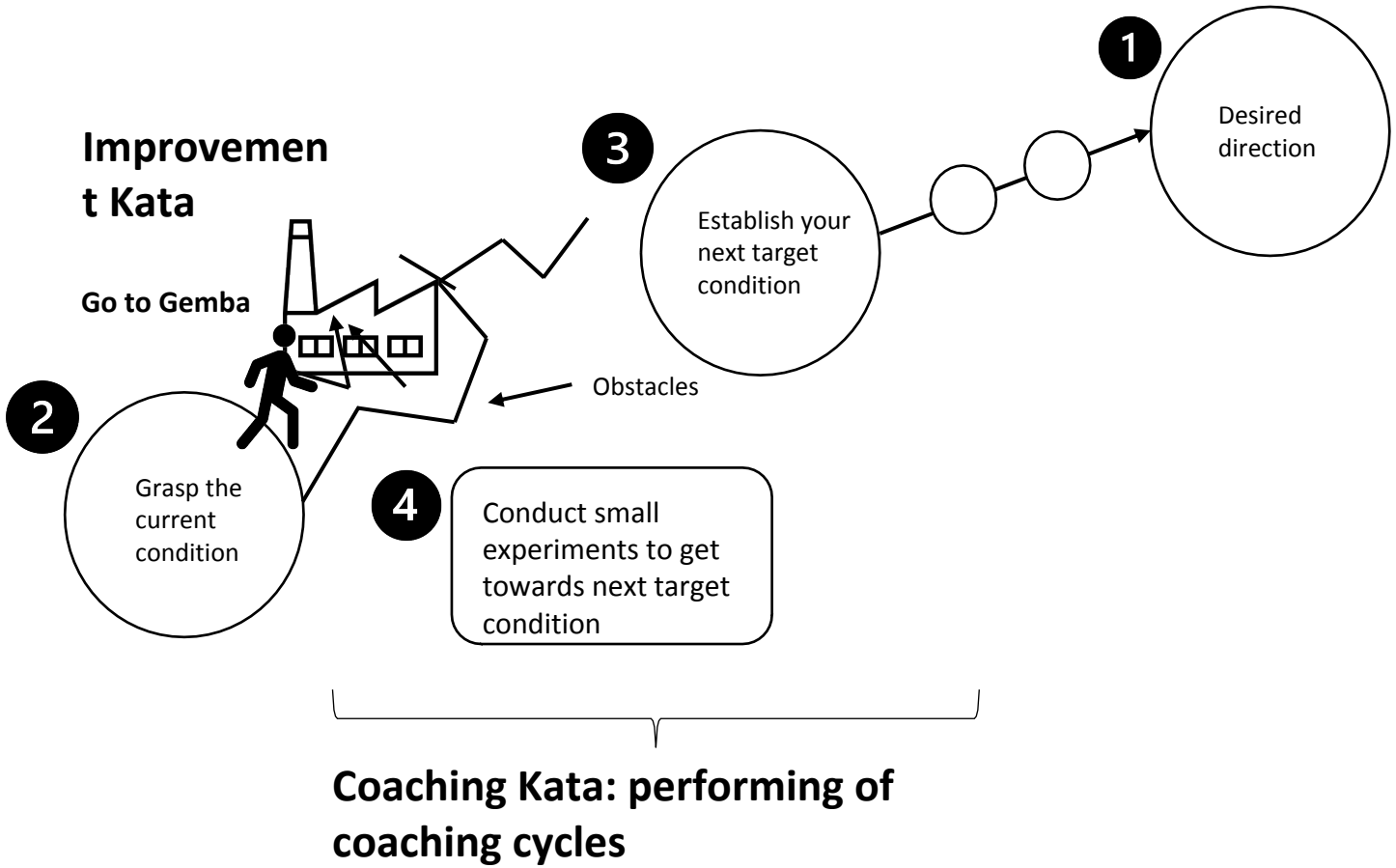

Improvement Kata
Go to Gemba
1
Desired direction
2
Grasp the current condition
3
Establish your next target condition
4
Conduct small experiments to get towards next target condition
Obstacles
Coaching Kata: performing of coaching cycles

Figure 2

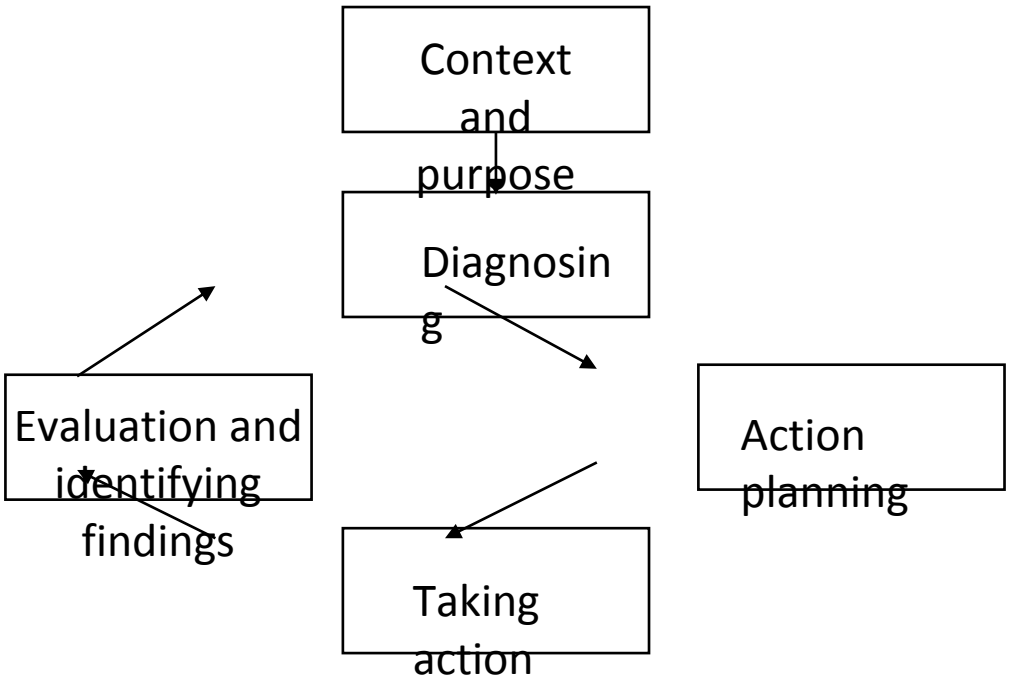
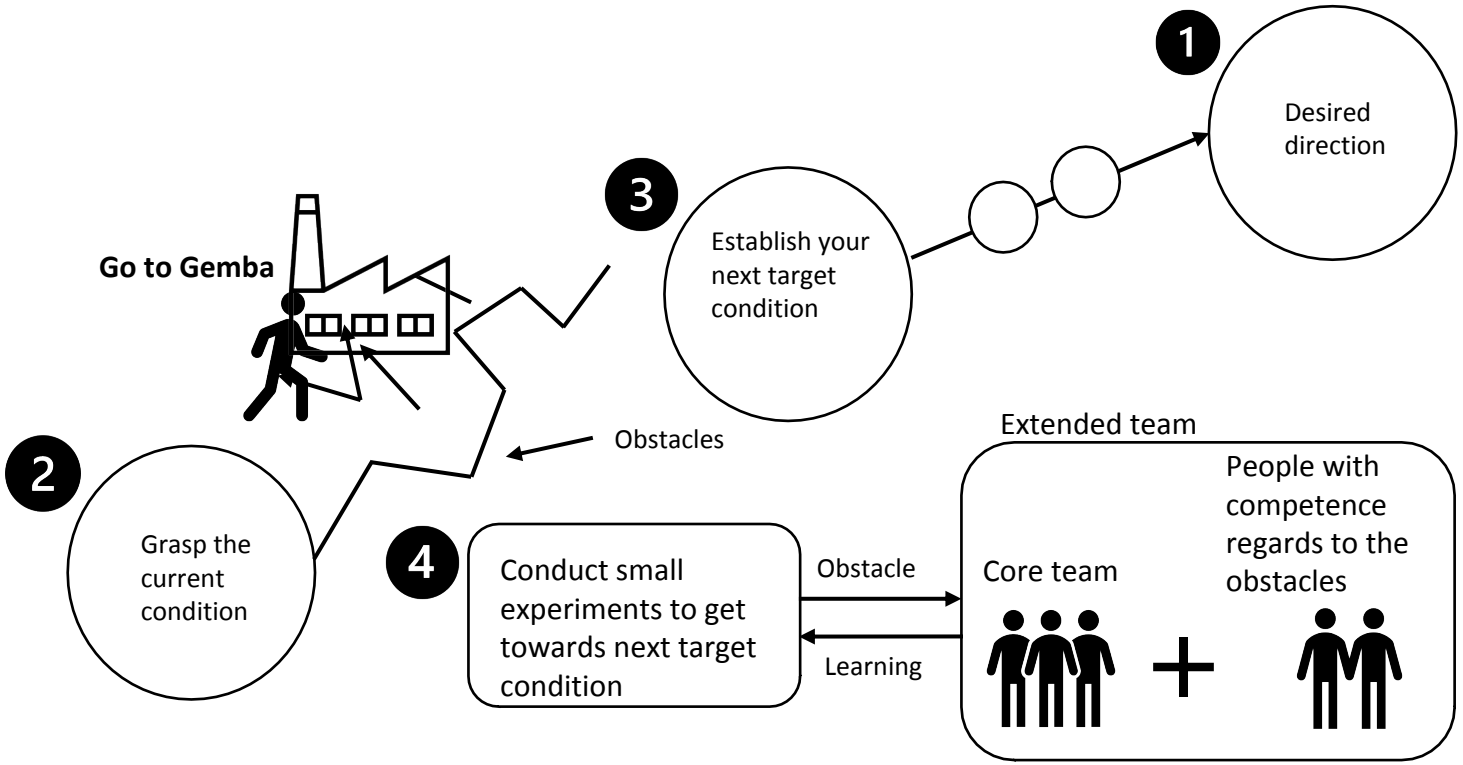

Context and purpose
Diagnosing
Action planning
Taking action
Evaluation and identifying findings

Figure 3


1
Desired direction
3
Establish your next target condition
Go to Gemba
Obstacles
2
Grasp the current condition
4
Conduct small experiments to get towards next target condition
Obstacle
Learning
Extended team
Core team
People with competence regards to the obstacles