



HAL
open science

Lessons Learned from Toyota Kata Implementation in the Norwegian Construction Industry

Eirin Lodgaard, Maria Flavia Mogos, Natalia Iakymenko

► To cite this version:

Eirin Lodgaard, Maria Flavia Mogos, Natalia Iakymenko. Lessons Learned from Toyota Kata Implementation in the Norwegian Construction Industry. 7th European Lean Educator Conference (ELEC), Oct 2021, Trondheim, Norway. pp.365-372, 10.1007/978-3-030-92934-3_38 . hal-03771938

HAL Id: hal-03771938

<https://inria.hal.science/hal-03771938>

Submitted on 8 Sep 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License



This document is the original author manuscript of a paper submitted to an IFIP conference proceedings or other IFIP publication by Springer Nature. As such, there may be some differences in the official published version of the paper. Such differences, if any, are usually due to reformatting during preparation for publication or minor corrections made by the author(s) during final proofreading of the publication manuscript.

Lessons learned from Toyota Kata implementation in the Norwegian construction industry

Eirin Lodgaard¹, Maria Flavia Mogos¹ and Natalia Iakymenko²

¹ SINTEF Manufacturing, Enggata 40, 2830 Raufoss, Norway

² SINTEF Community, Strindveien 4, 7034 Trondheim, Norway
eirin.lodgaard@sintef.no

Abstract. Successfully completed construction projects with regards to quality, time consumed, and cost are the main concern focus of the construction industry. Thus, there is a growing attention to continuous improvement programs dealing with the streamlining of material and information flows and the minimization of waste in all processes at a construction site. Unfortunately, many companies are struggling with this, and the continuous improvement programs fails. Drawing on an action research case study involving a leading Norwegian construction company and their key suppliers, this study aims to identify enablers and inhibitors influencing the implementation process of a specific continuous improvement method – Toyota Kata. The aim was to learn from the implementation process to avoid pitfalls and to know what to solve, increasing the likelihood of success. The case is a housebuilding project where the case companies collaborate on common improvement tasks. Main enablers identified is the importance of having a common area for collaboration between actors in a value chain to solve common problems and application of a systematically approach ensuring learning and lasting improvement. The main inhibitors are lack of culture for CI and Kata is not a part of a management system such as Lean Construction, enabling to involvement of the entire workforce in the CI process. The results of this study can help managers and practitioners to address the identified enablers and inhibitors, paving the way for successful implementation of Kata.

Keywords: Continuous Improvement, Toyota Kata, Lean Construction, Enablers, Inhibitors, Action Research.

1 Introduction

The intense competitive situation is forcing the construction industry to continuously improve production performance enabling to sustain their competitiveness. The construction industry is characterized by high variability, cost/delay overruns poor performance with high level of production waste and unsafe working environment. To overcome this, implementation of Lean Construction and with continuous improvement (CI) philosophy at its core is seen as a valuable approach to create value and eliminate waste at the construction site [1]. CI includes application of a standardized problem-solving

approach, targeting the elimination of waste and the improvement of quality in all the systems and processes of an organization.

Lean approaches such as CI, 5S, visual management, and the minimization of lot sizes and set-up times span across several industrial environments. However, approaches such as the takt and Kanban are best applied in environments with higher degree of repetitiveness, higher volumes, and rather stable customer demand [2]. For instance, the calculations of takt time are based on average sales rate. With relatively stable customer demand, this average will give a reasonable number to work with. But if demand varies each week, the sale rate figures will not be as meaningful. This is particularly the case of project-based industries such as the construction industry. Thus, the Lean Construction strategy was developed, based on the main lean principles in lean for the manufacturing sector [3], and having the CI philosophy at its core [4].

Even though CI has been known for decades, companies often achieve significant improvement only in the short run. One of the methods applied within the field CI is Toyota Kata (Kata) with the aim to achieve sustainable benefits through the development of a culture of CI and learning at all the organizational levels [5]. Kata combines systematic improvement and coaching methods, emphasizing the leaders' role as a facilitator and that interdisciplinary teams should move into an experimentation and learning zone when solving problems. It provides a standardized approach for managers and supervisors to support, guide and demand the improvement work.

Similar to Lean, Kata should be implemented, tested and adapted to the environment where it is applied. However, apart from very few studies [6], there is little research on the application of Toyota Kata in the construction industry [7]. To guide the investigation, we adopt the following research question: *What are the enablers and inhibitors of effective Toyota Kata implementation in the construction industry?*

2 Continuous Improvement

CI is a central principle regardless of the type of management system the company has chosen to apply [8], including the Lean Construction management system [1]. There are several CI definitions and one of the most common is: *"CI is a continuous stream of high-involvement, incremental changes in products and processes for enhanced business performance"* [9]. Consequently, CI is based on incremental improvement through the active participation of the company's entire workforce [10].

The implementation of CI as a part of a management system is not a straightforward process. Today, many companies often find their CI program in a fledging state and it is of high importance to know what aspects they need to consider when implementing CI with the entire workforce [10]. To avoid pitfalls, it is of high importance to understand the enablers and inhibitors of a successful implementation process. Due to their existence or absence in the organization, enablers and inhibitors can act as catalysts or on the contrary restrain of the implementation process.

One of the main reasons why many companies fail with the implementation of CI is the lack of top management commitment and involvement [10]. Unfortunately, all

managers do not acknowledge the importance of their own commitment and involvement in succeeding with sustainable CI [11].

Another important factor is the independence of the contractors working at the construction site and of the supply chain actors [12]. This complicates the CI process and points the importance of having a management strategy to involve all the partners in the CI.

The knowledge and thorough understanding of CI is of high importance [13]. One of the pitfalls is too much focus on what CI methods to apply alongside the underestimation of the human factors.

Motivated people who are actively involved in the CI in their daily work, is one of the key factors in succeeding with sustainable CI [14], as confirmed by recent studies [10, 11, 15]. A study by [15] shows the importance of teamwork and involvement as a common practice that is needed alongside knowledgeably about the approach and the issues to be improved by the team.

Another important factor is that the CI process is embedded in the culture, so that the systematic problem-solving comes naturally to the workforce. It means that the companies have to thoroughly reflect on how to organize for the integration of CI for the entire workforce [10].

By applying a CI method for problem solving and an effective learning process, companies can gradually reduce waste, the number of defects and the repair costs at the construction sites. Main benefits of applying a systematic approach include constantly inserting incremental improvements in the companies and their value chains, minimizing the amount of product defects and achieving better efficiency [16].

Important factors also include having knowledge about what available CI methods to apply and especially, having the required competence to apply the chosen method so that people can contribute in a proper way [11]. This is also perceived as a motivation factor [17].

A study by [18] emphasizes the need of tailoring the CI methods and developing a framework for the construction industry, as it has been done in the manufacturing industry. Another study from the construction industry has shown that certain CI methods from other industrial sectors have been found useful without having to adapt them, for instance the Deming's cycle [16].

3 Toyota Kata as a Method

According to Rother [5] leading people to implement specific Lean solutions like assembly cells, Six Sigma tools, Kanban, etc. will not make companies continuously improving and competitive. Rather, it is important to teach people to sense and understand the situation and react to in a way that moves the organization forward. This is what Kata is about – behavioral routines and habits that are practiced daily.

Kata refers to two linked behaviors: improvement Kata and coaching Kata [5]. By consistently practicing Kata routines, they become habitual for employees and the organization. The improvement Kata is a four-step routine for working toward a goal in a systematic way: (1) Understand the desired direction, (2) Grasp the current condition,

(3) Set the next challenge, (4) Run small experiments (PDCA – Plan, Do, Check, Act). To ensure that improvement happens, and that people internalize the CI process, coaching Kata is used, where coaches teach people by guiding them in making improvements in processes.

Research on Kata implementation in construction is limited. Tillmann et al. [19] and Casten et al. [6] report on their efforts on Kata implementation in construction projects. However, Tillmann et al.'s report on Kata application is limited – the work stopped at the problem identification. Casten et al. stated that the main inhibitor to Kata implementation in construction is the “specificity of work area preparation”. What that means is that in a manufacturing environment the production process flow is reliable, predictable, and understandable for everyone involved. This makes it relatively easy to evaluate and continuously improve the process. In construction, on the other hand, even a small change like the size of the crane instantly introduces variability into the operation. The authors state that even after years of effort to balance and control the workflow and implement lean practices, they find work area conditions the most challenging to stable and reliable workflow. In these conditions, the improvement Kata will likely be constrained by the conditions of the construction environment, according to the authors.

In addition to this inhibitor specific for the construction industry, Michals et al. [7] found following Kata implementation inhibitors: lack of direction and environmental preparedness (i.e. lack of solid understanding of target condition and current condition), lack of value stream mapping, and lack of coaching Kata meetings. Among the Kata enablers, the authors distinguished three: collaboration, learning and CI.

4 Research Design

This study is part of an ongoing national research project concerning performance improvement and operations at a construction site. The involved companies are the entrepreneur and three of the main suppliers in a housebuilding project in Norway. The purpose of this study was to explore the enablers and inhibitors of implementing a CI method – Toyota Kata. The aim of implementing Kata at all the involved companies was to strengthen the collaboration and learning process between them when addressing causes of inefficient flow in a joint housebuilding project.

According to these criteria, the action research as part of a case study investigation was identified as a suitable approach. The action research had a focus on developing knowledge in action and was a collaborative research between the partners in the housebuilding project and a Norwegian research institute. Data was generated through the researcher's active involvement and the process of inquiry during the application of the cyclical action research process - diagnosing, action planning, action taking, evaluation and identification of findings [20].

Five workshops, semi-structure interviews, formal and informal meetings were conducted during the research period of one and a half year. Field notes were taken through the entire research period including observations, experiences, results and reflections, which helped in understanding the Kata implementation process and the behavior of the involved personnel.

5 A case of Toyota Kata implementation

This section will briefly present the case companies involved in this study and the Kata implementation process during the action research. The research involves actors in a housebuilding project including following case companies: the entrepreneur, supplier of steel-reinforcement, supplier of concrete, and the supplier of formwork. All companies have a standardized system for internal deviation handling and customer complaints. In addition, the supplier of steel-reinforcement has prior experiences with Kata. A senior adviser from the research institute had the role as the Kata coach in the implementation process at the case companies. The role of the coach was to assist the involved personnel from the case companies with advice and guidance on the implementation.

A one-day workshop was organized where representatives from all companies received training on the Kata methodology and the principles of behavioral routines and habits that are practiced daily. Thereafter, a Kata game was conducted with the workshop participants, so they could understand the importance of being led by a coach, and of approaching a goal in a systematic way through the plan-do-check-act cycle. One of the important goals of the game was to learn that failed attempts also provide important insight which can help you reach the goal.

The next step was performing an extended value stream mapping (VSM) on a pre-defined housebuilding project facilitated by the coach. A mandate for this process was prepared including the delimitation of the VSM to a concrete process that involved all the case companies – the 'in situ' (at the construction site) casting process. The aim of the VSM was to grasp the current condition (step 2 in the Improvement Kata) - to create a common understanding for all the case companies of types of production wastes at the construction site. Four VSM workshops were conducted with the case companies and the results were presented at a subsequent workshop that resulted in an agreement on two specific problem areas. This study presents results up to the step 4 in the Improvement Kata - run small experiments and learn from the step-by-step process through the PDCA cycle.

6 Results and discussion

Right from the beginning of this study, the case companies were planning to go from a culture based on a firefighting approach to problems, to a proactive improvement approach based on continuous learning from experiments and mistakes. This is a good starting point, and an important enabler of a successful application of a CI method.

The aim for the extended VSM was to create a common overview over the situation for the casting process including identification of problems area creating an inefficient flow. This was seen as a good starting point regards to the step 2) grasp the current situation and step 3) set the next challenge. This statement is in line with existing literature when implementing Kata [7]. It emerged in the discussions while working with the VSM that there was a common opinion that a large number of deviations occur

every day at the construction site and adjusted in a reactive manner instead of proactive with identification and elimination of root causes – a firefighting approach.

Another important factor revealed during the VSM activities is that the suppliers indirectly sustain the firefighting approach by correcting defects created by the customer in order to please the customer. Many of the suppliers' problem areas were related to: i) the customer changes the plan close to the delivery date, and ii) the lack of a smooth process for the delivery of goods at the construction site. One of the suppliers reported that the customer had changed the plans 12 times during the same day and claimed that this was the entrepreneur's routine approach. Consequently, the supplier's internal production process had to undergo several changes, to adapt to this fire-fighting approach. It appears that the project partners please the customer at the expenses of their internal processes and original production plans. Surprisingly, only few of the entrepreneur's identified problem areas addressed the suppliers. This discovery was surprising to everyone and strengthen their opinion about a strong customer focus affecting unnecessary problems for the suppliers.

It was also revealed that the implementation of the CI method was not self-driven. The manager's commitment and effective leadership are crucial to implementing and performing CI as reported in existing literature [7, 10]. One of the manager's re-marks indicates that he was unaware of this: "Contact me if our dedicated team does not show up for this. If so, I will ask them to do it." The implementation of CI has to be integrated into the management system, to involve the entire workforce and generate lasting improvements [10]. The concrete supplier feared their personnel's lack of trust in the Kata implementation due to their failed attempt to implement Lean Construction as a management approach in the past.

An effective Kata implementation requires both knowledge about the method and the skills to perform Kata in the correct way. Although Kata teaching and training was provided during a workshop, an appropriate Kata competency also requires learning by interaction and experiences. The participants from the case companies were not used to systematic problem-solving methods and related learning process. Nevertheless, they saw the necessity to apply a systematic approach in order to change the firefighting culture. Furthermore, it appeared that they appreciated the coach helping with advice and guidance on Kata implementation. This is in line with [10]. Coaching is particularly useful at achieving that the participants become actively involved.

Lastly, the empirical findings also include the importance of having a common meeting place where the customer and the suppliers collaborate on streamlining the flow at construction sites. A common meeting place, our workshops, encourages the participants to spend time on making lasting improvements for both the customer and the suppliers.

7 Concluding remarks and further work

The objective of this study was to identify enablers and inhibitors of effective Kata implementation. To this end, the authors conducted an action research study in collaboration with value chain actors in a housebuilding project.

The first conclusion drawn for this ongoing study of Kata as a CI method, reveals that the focus on CI ought to be increased in the future as a means to stay competitive in the housebuilding sector. Undoubtedly, implementing an unknown method as Kata it is not a straightforward process, especially when the organization lack a culture for CI and a firefighting approach is a common working mode at the construction site.

One of the enablers identified in this study was the fact that the common meeting area created by the Kata implementation process motivated the value chain actors to address common problem areas, enabling lasting improvement. A coach assisted the involved participants with encouragement and guidance on applying the unknown method. To change from a firefighting approach to a systematic approach the value chain actors are dependent on each other, and a common CI method that is used collaboratively can be an enabler.

Unfortunately, an inhibitor is the lack of a management system integrating Kata as a CI method into the organizations and their value chains, with only a limited possibility of achieving this after the end of the research project. This conclusion is in line with [10]'s study, which highlights that the management commitment and involvement is an essential factor when embarking on CI.

This study supports earlier research literature, but also extends the knowledge about influencing factors. However, our findings cannot be generalized. The results from action research should be regarded as indicative only, since they reflect the experience of the people involved in the implementation process. Therefore, future research should compare the findings in this research with findings from other studies of Kata implementations in the construction industry, to increase their external validity.

Acknowledgement

The current research was funded by the case companies and Norwegian Research Council, through the research project "Increased competitiveness for in-situ casting of concrete constructions".

References

1. Bajjou, M.S., Chafi, A.: The potential effectiveness of lean construction principles in reducing construction waste: an input-output model. *Journal of Mechanical Engineering and Science*, 12(4), 4141-4160 (2018).
2. Buer, S.-V.: Investigating the relationship between Lean Manufacturing and Industry 4.0. Doctoral Thesis. Norwegian University of Science and Technology. 2020.
3. Koskela, L., Ferrantelli, A., Niiranen, J., Pikas, E., Dave, B.: Epistemological explanation of lean construction. *Journal of Construction Engineering Management*. 145(2), 04018131 (2019).
4. Netland, T.H., Powell, D.J.: *The Routledge companion to lean management*. Taylor & Francis (2016).
5. Rother, M.: *Toyota Kata: Managing people for improvement, adaptiveness and superior results*. McGrawHill, New York (2009).

6. Casten, M.H., Plattenberger, J., Barley, J.M., Grier, C.: Construction Kata: Adapting Toyota Kat to a Lean Construction project production psSystem. In: 21st Annual Conference of the International Group for Lean Construction, IGLC (2013).
7. Michals, E., Forcellini, F.A., Fumagali A.E.C.: Opportunities and barriers in the use of Toyota Kata: A Bibliographic Analysis. *Gestao da Producao, Operacoes e Sistemas*. 14(5), 262-285 (2019).
8. Dahlgaard-Park, S.M.: The quality movement - Where are you going? *Total Quality Management & Business Excellence*. 22(5), 493-513 (2011).
9. Ljungström, M., Klefsjö, B.: Implementation obstacles for a workdevelopment-oriented TQM strategy. *Total Quality Management* 13(5), 621 - 634 (2002).
10. Garcia-Sabater, J.J., Marin-Garcia, J.A.: Can we still talk about continuous improvement? Rethinking enablers and inhibitors for successful implementation. *International Journal of Technology Management* 55(1), 28-42 (2011).
11. Lodgaard, E., Ingvaldsen, J.A., Aschehoug, S., Gamme, I.: Barriers to continuous improvement: Perceptions of top managers, middle managers and workers. *Procedia CIRP*,41,1119-1124 (2016).
12. Bajjou, M.S., Chafi, A., En-nadi, A.: A comparative study between lean construction and the traditional production system. *International Journal of Engineering Research in Africa* 29, 118-132 (2017).
13. Meiling, J., Backlund, F., Johnsson, H.: Managing for continuous improvement in off-site construction. Evaluation of lean management principles. *Engineering, Construction and Architectural Management* 19(2), 141-158 (2012).
14. Bateman, N.: Sustainability: the elusive element of process improvement. *International Journal of Operation & Production Management* 25(3-4), 261-276 (2005).
15. Patil, B.S., Ullagaddi, P.B., Jugati, D.G.: An Investigation of factors impelling effective and continuous improvement of Indian construction industries quality management systems, In: IEEE-International Conference on Advances in Engineering, Science and Management (2012).
16. del Solar Serrano, P., del Rio merino, M., Saez, P.V.: Methodology for continuous improvement projects in housing constructions. *Buildings* 10(199), (2020).
17. Lodgaard, E., Johannessen, L.P.: Shop floor teams and motivating factors for continuous improvement. In: Wang, K., Wang Y., Strandhagen, J., Yu, T. (eds.) *IWAMA 2018 Advanced Manufacturing and Automation*, vol. 484, Springer, Singapore. (2019).
18. Delgado-Hernandez, D.J., Aspinwall, E.M.: Improvements tools in the UK construction industry. *Construction Management and Economics*, 3, 965-977 (2005).
19. Tillmann, P., Ballard, G., Tommelein, I.: A mentoring approach to implement lean construction. In: *Proceeding IGLC-22*. (2014).
20. Coughlan, P., Coughlan, D.: Action research for operation management. *International Journal of Operation & Production Management*. 22(2), 220-240 (2002).