



THE DEVELOPMENT OF CONTINUOUS IMPROVEMENT IN SMES AND THE SUPPORTIVE ROLE OF THE A3 TOOL

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Abstract. This paper focuses on the supportive role of the A3 tool in the development of continuous improvement in SMEs. We performed two case studies at companies where already several students used the A3 tool in improvement projects. Both companies embraced the concept of the A3-method and extended its' use to all improvement projects in the company. Furthermore, both companies developed hoshin kanri to align the various improvement projects. In this paper, we describe what the key elements were of the continuous improvement journey of the two companies. Next, we indicate how principles of the A3 tool supported these elements.

Keywords. Continuous Improvement, SME, Lean Manufacturing, A3 tool, Hoshin Kanri.

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1 INTRODUCTION

Many managers embrace the concept of lean management but are struggling with the development of continuous improvement practices in their companies. Extensive research on the development of lean and continuous improvement in SMEs has been performed by Knol et al. [1] [2] [3]. Based on multiple-responder self-assessments from 33 manufacturing SMEs, they conclude that in the initial stages of the lean journey, companies could improve their lean practices in a bottom up manner with only having additional attention on local success factors such as communication and a learning focus. When lean practices are more advanced, company-wide factors play an important role: top management support, a shared improvement vision, and a supplier link [1]. In another study on the development of improvement routines in the lean journey of companies, they conclude that in the beginning no specific improvement routines are needed to realize some lean practice implementation. More attention for various improvement routines (getting the improvement habit, understanding improvement, leading the way and improvement of improvement) becomes important for more advanced lean practitioners [2]. In a detailed case study of three carefully selected industrial cases, Knol et al. [3] show that a careful balance between lean practice implementation and the development of continuous improvement routines is needed during the development of a company. The study presented in this paper, can be seen as an illustration and an extension of the findings of Knol et al. [1] [2] [3]. Through two case studies we illustrate the logic behind the development of continuous improvement in the companies. We present a five-stage development process which is in line with the findings of Knol et al. [1] [2] [3] but further specifies the key activities in the company. We also show how the A3 tool supports the various stages.

In his book 'Managing to Learn' Shook [4] presents and illustrates the A3 management process to solve problems, gain agreement, mentor and lead, as it is used at Toyota for more than 50 years. The A3 problem solving tool communicates the background, current state, targets, analysis, future state, implementation plan and follow up. Several authors further explain the elements and the logic of the A3 problem solving tool [4] [5] [6] [7]. Oversluizen and Slomp [8] study how students use the A3 problem solving tool in industrial projects and indicate the strength of the tool to structure problem solving and to support communication. Although the importance of the A3 tool is stressed in several books and papers (see e.g. [9]), its relevance for developing continuous improvement in companies is not gaining attention in the scientific literature nor in practice. This paper fills this gap.

In section 2, we will dive deeper in the role of the A3 tool at Toyota. Therefore, we interviewed Isao Yoshino, one of the first managers of John Shook at Toyota, also mentioned in the acknowledgments of Shook's book. Yoshino was highly involved in the education of managers at Toyota and taught them to use the A3 tool. Through this interview, we broaden the meaning of the A3 tool. At Toyota, it is more than a logical sequence of PDCA activities. Section 3 presents the continuous improvement journey of two industrial cases. Students used the A3 method in industrial projects at these companies. See Oversluizen and Slomp (2019). Section 4 discusses the logic behind the development of continuous improvement in the companies and, furthermore, indicate the role of the A3 tool. Section 5 presents major conclusions of our study.

2 THE USE OF THE A3 TOOL AT TOYOTA

The A3 tool has been used at Toyota for many years. It was a means to communicate in a time without computers. Deming, the promotor of Total Quality Control (TQC) at many Japanese companies, introduced PDCA-thinking at Toyota which also has been incorporated in the A3 communication at Toyota. Masao Nemoto, a strong promotor of TQC at Toyota and mentor of Isao Yoshino, was a strong supporter of creating the link between A3 and PDCA. He recognizes the elements of the A3 problem solving tool 'as the order in which presentation of QC improvement projects is made'. But, as he indicates, it is more than that. 'It is also the order through which improvement activities are conducted. In other words, you can follow this order to engage in your improvement activities and then follow the

same order when you make your presentation' ([10] pp.155). An A3 is, according Nemoto, the ideal format for giving a presentation of 10 minutes ([10] pp. 16).

In order to gain a deeper understanding of the use of A3 at Toyota, we inter-viewed Isao Yoshino, who was visiting our university several times in 2017-2019. This interview illustrates how at Toyota it is linked to organizational de-velopment. Here, we summarize this interview by clustering Yoshino's sayings in several topics. We will refer to this clustering in our discussion in Section 5. The text has been approved by Yoshino.

Isao Yoshino is a 40-year Toyota leader (14 years of which was in the U.S.) and a former NUMMI training manager based at Toyota HQ in Japan. In 1979 and 1980, he was in charge of the Manager Development Program ("Kan-Pro" in Japanese) for all the managers at Toyota headquarters. In 1983, he was assigned to the manager of a newly established training section for NUMMI's shop floor leaders. During this time, he hired John Shook and other staff members from within Japan to develop a hands-on training program for American shop floor group & team leaders who travelled from Fremont, California to Toyota City to learn the Toyota Production System. In June 1984, Yoshino and his team started training American shop floor leaders for three weeks at Toyota's plant. Yoshino has held management roles at Toyota in research, human resources, corporate planning and production control, and manufacturing. He retired from Toyota in 2006. Yoshino is currently a lecturer at the Nagoya Gakuin University and travels internationally to teach and speak about Toyota leadership, hoshin kanri and coaching.

2.1 The use of A3 at Toyota

A3 is already used for many years at Toyota. It started as a problem-solving tool. Dr. Deming introduced PDCA at Toyota which gave more structure to the A3. People liked it so much. They extended it further for other purposes. It is now very common in Toyota.

A3 is also used for proposals and for status-update reports. A3 is a very useful tool to convey your idea or plan and to share it with others, so that everybody of the group is at the same page. It is a communication tool. It serves organization-al learning in Toyota. It is an organization tool. I don't think that PowerPoint can have the same impact.

A3 is not an order of the management. Sometimes it comes from a subordinate, they know everything. Managers do not know everything. So, subordinates may start with an A3. They may expect that the manager gives a good advice. A perfect A3 is not needed. It may just be memo to review.

2.2 Targets

Sometimes targets should come after the analysis. But in general, I agree with your sequence in the introduction. A target is what you want to attain. You must set the target regardless of the analysis. It is a serious problem. If you set the target after the analysis, then you may get scared, and be too careful. The target depends on what you need, for instance zero defects, or what the current result is. The target is your challenge. Not realizing the target means that the problem is not completely solved yet. It may be the start of a new project.

I always search for the target in an A3. Without a target, your document is nothing. 'Where is your target' is often my first comment. You must put it some-where. Sometimes it is difficult to specify an indicator for the target. But that is no reason for not being clear about the target. You must think about the target and an indicator. An indicator may not be perfect, but you must select one. As long as the challenge is clear and measurable, it's fine.

2.3 Development of people and the organization

A3 is a very powerful tool to develop people. Without A3, only verbally, it is very difficult. Misunderstanding can happen. A boss can better give you advise, when you have an A3 in front of you.

For groups it is even more important. If you have ten people and they discuss the same A3, then they are focused to the same goal. I have been in meetings without A3, and the discussion went everywhere. With an A3 you can share your target. It strengthens the understanding of the own goal. It also helps to make faster decisions. All key points are on the A3 – everybody can see it.

2.4 Training and coaching

A3 is just a tool. Training is needed to use this tool in an effective way. It is about 5S. If you are good in 5S, then you can sort out unnecessary information and arrange important things in your A3. You must understand that you cannot handle everything. The limited space of an A3 is a great opportunity to learn how to distinguish necessary and unnecessary things. The more experience, the better people apply A3.

I don't care if I am not perfect when I write A3. Everybody has its own opinion. It reflects your thinking. It is a good tool to show to your boss or subordinate. My advice, if you write something, put what is on your mind on paper. So simple as possible. Then you can improve. Don't try to be perfect.

The elements of A3 are important for problem solving, but I like an easy way of thinking about A3. If coaches take the elements of A3 too serious, then employees will not use A3 too openly. It is good that employees try. Coaches must give them trust. Then the A3 will gradually improve.

2.5 Hoshin and A3

There is a clear link between Hoshin and A3. Hoshin is the way to come to shared goals, action plans and timing. A3 is a tool to show hoshin, to communicate about it. At Toyota, we periodically review A3s. A3 is a very important tool to check if Hoshin works well.

3 THE CONTINUOUS IMPROVEMENT JOURNEY OF TWO INDUSTRIAL CASES

This section presents two industrial cases of SMEs where the continuous improvement journey developed for several years. The companies are both partner of the HAN Lean QRM Centre (HLQC) and regularly get students from the minor World Class Performance (WCP) performing improvement projects in the company. Both companies currently participate in some (applied) research projects of the HLQC.

3.1 Case 1

The first company is a manufacturer of instruments for soil and water research. It employs around 150 people. The company has a component manufacturing department as well as an assembly department. The manager of both departments became enthusiastic about lean management several years ago and has initiated various lean projects. The company started their lean journey around 2012 and was initially focused on performing waste reduction projects. Students of the minor WCP participated in several of these projects and introduced the A3-method. The company adopted the A3 method for their own improvement projects. Along with the use of the A3-method, performance management has been developed in the company. There is now a better understanding of what to measure and how to measure. There was also a need to coordinate the various lean initiatives. In one of the first years, the manager therefore made an 'objective-tree' to create linkages between the local student projects and the more strategic objectives of the company.

However, during the lean journey the manager recognized that using the A3-method and applying the 'objective-tree' was not enough. He felt that more common focus was needed to gain more synergy in the company. It was not always clear for everybody whether an A3-project really contributed to the company goals. Therefore, the company started to experiment with Hoshin Kanri. The manager and the team leaders made an overall Hoshin document, which they called the A3-compass. This overall

document described the ideal state (true north) and the medium-term goals and actions per team. This supported the communication about improvement in the company substantially.

The company also invested in gaining a clear improvement structure. Team leaders are trained to support the employees in improvement activities. Employees are getting more and more involved. By setting up a daily stand-up meeting and structurally using the Hoshin document and the A3's for communication, the company moves in the direction of a learning organization. About two years ago, the company hired a recently graduated student to become the lean facilitator.

Currently, the operations manager, who is responsible for two departments, experiences the need that also other departments, such as sales and product development, start with a lean and continuous improvement journey. Key problems in his department come from these other departments.

3.2 Case 2

The second company is a manufacturer of paving tiles. It employs around 500 people spread over 4 production sites. The production process is quite simple but asks for a detailed configuration for producing tiles of high quality. For four years the company is actively using lean methods to improve their processes. This was especially initiated by a new, lean-minded, director of operations. He stimulated the setup of lean improvement projects. He also attended, together with the operations managers of the production sites, several lean workshops organized by the HLQC.

The company became an enthusiast user of the A3-method. A new project now only starts if there is an approved A3 proposal, a champion and properly selected team members. If appropriate, a student from the minor WCP is also assigned to a project. Although the company is happy with all lean projects, they also recognized difficulties. It is hard to close the PDCA-circle. The Check of the PDCA is often not done, which subsequently leads to fuzzy insights in the results and contributions of the project to the goals.

Another important problem was the lack of overview: there were (too) many A3-projects running in the company without a clear focus. To handle this issue, the management of the company decided to start with Hoshin Kanri and constructed, with the help of the HLQC, an X-matrix which aligns strategic objectives, departmental goals and improvement projects. The X-matrix, now in use for two years, is helpful for selecting the improvement projects to be done in the next year.

The company experiences the change towards a lean culture as challenging. The company hired several minor WCP students after they finished their study. They perform as lean facilitator and help the employees in their lean journey. In some cases, middle managers not able to adapt to the lean philosophy had to leave the company. The company recently started with a leadership-training for middle managers.

The director of operations is part of the management team. He was able to convince his colleagues that lean management and continuous improvement are a strategic choice and need to be adopted in the whole organization. Following this strategy in the other departments, however, is another issue.

3.3 Stages in the continuous improvement journey of the two companies.

We interviewed managers, and some other employees, in the two companies to understand how lean thinking got deeper rooted to the core of the companies. In the analysis of the interviews, we used the qualitative case analysis method of context mapping [11]. This resulted in a mapping of related topics concerning the integration of continuous improvement in the companies.

Figure 1 summarizes our findings. We first looked for situations, events and measures that determined the continuous improvement journey of both companies and put them in time order, as far as possible

(middle part of the figure). Next, we defined the logic of continuous improvement development in the companies, and probably in more SME companies (left part of the figure). Finally, we identified the role of the A3 tool in the continuous improvement journey of the companies (right part of the figure). The left and the right part of the figure are explained in section 4.

The lean and continuous improvement journey in both companies started with a manager who embraces the lean philosophy. The initial focus of both managers was on the reduction of waste and the realization of flow in processes. They involved employees in improvement projects and experienced enthusiasm and performance results. However, they also experienced that improvement projects do not automatically lead to new projects. Without other measures, the lean and improvement drive would weaken. The managers of both companies recognized the need to develop improvement routines. They stimulated the development of performance management and, furthermore, initiated hoshin kanri in the company in order to streamline and link the various improvement projects within their departments. Subsequently, both companies hired a lean facilitator to support employees in the development of improvement projects. The facilitators can be seen as the carriers of improvement routines. The managers of the companies also experienced the need to develop their own role, and those of other managers, in the company. Instead of just being the boss, managers recognized their role as lean coaches, stimulating their employees/managers to search for improvement opportunities which supports the company performance. Subsequently, they experienced the need for training of their team leaders and other managers working under their responsibility. Finally, leadership training and attracting new managers with lean knowledge was seen in the company as being essential for the creation of a sustainable continuous improvement culture.

How do successful companies develop Continuous Improvement?	What happens in the company?		What is the supportive role of the A3 method of problem solving?
1. Lean focus on flow and waste.	A change agent embraces the Lean philosophy – problems become clear		A3 problem solving method embodies the Lean philosophy
2. Development of continuous improvement routines	Developing performance management	Hoshin Kanri – developing the compass of the department.	A3 problem solving method is based on PDCA and requires data. The A3 tool furthermore supports communication.
3. Role development (facilitator and manager)	A facilitator supports improvement routines	Managers become lean/improvement supporter and provide direction	The A3 tool provides information for coaches as well as managers. It helps them do fulfill their roles.
4. Attracting and developing managers.	Management training at various levels of the department		The A3 tool can be used in management training
5. Extending the scope of lean/CI (other departments and the supply chain)	Top management embraces the concept of Lean/CI and takes care of its development in other departments and in the supply chain		The company Hoshin-A3 gives direction. Managers have their own hoshin A3 which support catch ball.

Fig. 1. The development of continuous improvement in the companies

4 DISCUSSION

Looking carefully to the development of continuous improvement in both companies, we recognize a pull mechanism. There is a key driver: the wish to develop lean and continuous improvement practices in order to gain performance advantages. This driver is, initially, only embraced by one, or a limited number of change agents. Their first attempt to implement lean and continuous improvement in one department has led to an implementation process that can be broken down into five stages, where each stage asked for the next one.

In the first stage, flow and waste reduction receives attention within the company and lead to some performance results. The enthusiasm and the goodwill factor of the manager, the initiator of the lean

movement in the company, is essential. The focus on flow and waste creates understanding of the problems in the company. The A3 tool, as used by the students in the companies, is helpful to structure the various improvement projects. Furthermore, lean knowledge is integrated in the various elements of the A3 method, helping to solve the problems. See Oversluizen and Slomp [8]. In both companies, students supported the spread of the required lean knowledge in the company.

Although projects were successful, managers of the company experience difficulties to hold the improvement drive. It is not obvious to start new projects after the end of other projects. Also, the enthusiasm goes down in the course of time and the goodwill factor probably deteriorates. This is a risky situation. In our experience, several SME companies get lost in this situation and then decide to stop their lean journey. The A3 tool may help to overcome this stage: PDCA is the basis of the elements of the A3 tool and defining a follow-up project or activities is key. Students doing A3 projects in companies, however, find it difficult to specify clear follow-up projects. See Oversluizen and Slomp [8]. This difficulty may be because of a lack of experience. Another reason may be the absence of clear direction for improvements in the company.

The second stage, developing continuous improvement routines, can be seen as an answer to the difficulty to decide for follow-up improvement projects. In this stage, management takes care of the development of performance management and hoshin kanri. These are essential elements for the development of meaningful improvement routines. Performance management gives the information of the current performance and the discrepancy from the norm. It gives an important trigger for improvement. Hoshin kanri provides the required direction of improvement. Communication (catch-ball) is essential for making hoshin kanri work. Using the A3 tool asks for performance data and is furthermore an important support in the communication about improvement projects. So, the use of the A3 tool by students in both companies, asked for and supported this stage.

Performance data and hoshin kanri support required actions for continuous improvement but do not offer the knowledge and ability to perform the improvement activities. This triggered managers to develop the role of lean or continuous improvement facilitation and to rethink their own role. This can be seen as the third stage of the continuous improvement journey. The managers in both companies attracted a lean facilitator, responsible for supporting continuous improvement, bringing lean knowledge and supporting employees to do the required analysis and development work. In the first stage, this role was fulfilled by the managers themselves. Consequently, they also had to rethink their own role. Based upon the needs of the continuous improvement process, they developed their roles towards being the supporter of improvement projects, creating the required conditions, and the leader which initiates or supports the development of new improvement projects which are linked to the needs of the company. The A3 tool is a good support in this third stage: it becomes easy to understand for a manager to see what is happening in the improvement projects, how they are linked to the needs of the company (background element of the A3) and what follow up is needed (follow up element of the A3). It is interesting that students experience, in their industrial project, these elements of the A3 as most difficult. Managers have a task in this. The A3 also helps the facilitator in his coaching task. It is easy to recognize where support is needed, which element of the A3 required more effort.

Although the roles of facilitator and manager are important, the real work within continuous improvement must be performed by the workers themselves and organized by team leaders and middle managers. The facilitator and manager in both companies recognized the need for training of the team leaders and middle managers. Without some training it becomes difficult to coach and to lead. The fourth stage in the continuous improvement journey is the lean and continuous improvement development of team leaders and middle managers. They must embody the culture of continuous improvement on the shop floor. They also should feel ownership and the ability to realize improvement projects. Both companies initiated training for their managers. The problem solving A3 can be used in the training, since it inhabits lean as well as continuous improvement elements.

Currently, lean and continuous improvement routines are well integrated in the operations function of both companies. The operations manager in both companies now experience the need to extend the scope of lean and continuous improvement to other departments, such as sales and product development, in order to further improve the performance of the operations department as well as the whole company. This is not easy without having a champion in these other departments. In our experience, this is a major problem in many SMEs, a reason why a successful lean operations manager may leave his company. The company wide development of lean and continuous improvement is the fifth stage in our model. Companywide hoshin kanri is important to support this state. Hoshin A3s for all managers may further support the alignment of improvement activities between the various department.

The five-stage model (left part of figure 1), is derived from the two cases and is in line with the findings of Knol et al. [1], who show that initially attention is needed for local success factors and later for the more company-wide factors. The model also fits the findings of Knol et al. [2] with respect to the development of improvement routines.

We explicitly mentioned the role of the A3 tool to support the various stages in the development of continuous improvement in a company (right part of figure 1). As Yoshino mentioned, see section 2 of this paper, it has served organization-al learning in Toyota and, therefore, can be seen as an organization tool. The key elements of the A3 tool which require attention at companies where it is used (i.e. mentioned in section 2 (clear targets, development of people and the organization, training and coaching, the link with hoshin kanri), all relate to the improvement routine of 'getting the improvement habit', which is, according Knol et al. [2], the most important routine to focus on while developing an organization.

5 CONCLUSION

Based upon two case studies, this paper presents a five-stage model for the development of continuous improvement in a company. The model is consistent with the findings of Knol et al. [1] [2] which were based on data from cross-functional self-assessments among managers of more than 30 companies. The pull character of the five-stage model is probably the key for the successful implementation of continuous improvement: a strong focus ('getting the improvement habit') and a pull of activities/stages starting at the work floor, the place where value is created.

It is hard to overestimate the possible role of the A3 tool in the five stages of continuous improvement development. In our experience, managers of partner companies who embrace the concept of lean and continuous improvement, are enthusiastic about the use of the A3 tool and have adopted the tool for all their improvement projects. In this paper, we indicated what the strengths are of the A3 tool in each of the five stages. It is interesting to note that value of the A3 tool in the five stages show a balance between the focus on lean knowledge and continuous improvement principles. This balance is a key element in the development of lean company (see Knol [3])

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