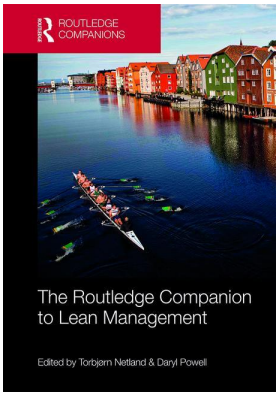

The Routledge Companion to Lean Management

Torbjørn H. Netland, Daryl J. Powell

Lean Schools

Publication details
https://test.routledgehandbooks.com/doi/10.4324/9781315686899.ch38
Jan Riezebos
Published online on: 28 Dec 2016

38
LEAN SCHOOLS

Jan Riezebos

Introduction

Lean challenges the way we have looked at our processes and suggests taking a view from another perspective, i.e. through the lens of customer value. If we would like to apply lean to improve educational systems, a first step is to rethink customer value. Schools should identify what aspects of customer value have to be considered for a process that provides educational services, and to specify the customer requirements and constraints for the delivery of these services. Next, process descriptions of current and desired state have to be constructed, various types of waste have to be identified and eliminated, and flow has to be realized through the use of pull. Finally, an improvement cycle has to be implemented that aims at continuous improvement using a plan-do-check-act approach (Womack and Jones, 1996).

The term lean has been introduced to distinguish the approach taken by Japanese car manufacturers from the traditional mass-production approach of Western car manufacturers. Key terms of the lean approach are:

- respect-for-human (Sugimori et al., 1977; Riezebos et al., 2009),
- customer value instead of shareholder value (Emiliani, 2004),
- long-term instead of short-term strategy (Hines et al., 2004),
- flow efficiency instead of resource efficiency (Modig and Åhlström, 2014), and
- pull instead of push (Hopp and Spearman, 2004).

Lean has been applied in all kinds of processes and environments, including product development, supply chains, engineering, construction, food production, industrial services, public services, and healthcare. Applications in the field of education have been lagging behind and are still limited (Radnor and Bucci, 2011; Balzer and Rara, 2014). However, the potential for using lean improvement tools for educational processes is undoubted (Flumerfelt, 2008; Balzer, 2010; Schierenbeck, 2012; Emiliani, 2013). Therefore, it seems there is a large gap between the potential and realization of lean implementations.

In this chapter we explore the application of lean in education, particularly schools (primary and secondary education). We discuss whether the gap between the potential and the actual realization of lean might be due to the areas of education that have been involved so far in lean

improvement projects. We classify projects of lean within primary and secondary education that are referred to in the literature and show what areas of education have been involved. This brings forward several challenges and opportunities for the application of lean in schools. Next, we focus on specific challenges of using lean in schools. This chapter is accompanied by an illustrative case study of a lean school.

What Constitutes a Lean School?

Education is essential to society. It challenges us to be curious, creative, to learn from the past and train ourselves in new areas, and prepare for the unknown future. In our modern society, schools are formal institutes to provide the service of education. They not only offer formal curricula and processes that help the students to acquire knowledge, competences, and an attitude that is required in order to continue their careers, but also provide an environment that facilitates learning in social interaction between students and staff. However, we should be aware that public or private schools are not the only providers of education. Some people acquire the same knowledge or skills without attending school. The processes that they have developed to acquire this knowledge or skills are equally important to study. However, in this chapter we will focus on the formal processes used in schools to provide education as a service.

Customer Value

The first question we have to address is what the intended customer value is of the educational service offered at the school. Related questions are whether students should be considered as customers or as a products of the educational process. This question has received a lot of attention in literature, but from a service operations perspective (Van Looy et al., 2003; Katzan, 2008) it is more important to understand that a customer might have various roles in a service process. It is important to distinguish between phases of the process:

1 service specification and selection;
2 service provision and transformation;
3 evaluation (quality control); and
4 benefiting.

Both the customer and the service provider will have a role in specifying the service to be offered to the customer. In some cases, the customer (i.e. student) just selects from a standardized portfolio of service offerings, while the service provider has designed the standardized service offerings according to external criteria from stakeholders such as government, higher education, labor market, etc. In other cases, the student is offered much more freedom in specifying what to learn, when to learn, how to learn, and where to learn. Program and intended learning outcomes may be designed as "tailor-made."

In operations management literature (e.g. Askin and Goldberg, 2002), the different options are denoted as *make to order* (MTO) and *engineer to order* (ETO). MTO organizations offer standardized services and start these services in general according to a predetermined schedule as soon as a batch of customers has entered the system. ETO organizations first construct (i.e. engineer) a specific process based on the demands of the customer. In order to avoid too much variation, these organizations frequently try to modify one of the available standard designs or apply a previously made design. ETO results in more variation of customer orders in the service provision process, which makes it more difficult to organize it efficiently. Operations

management literature denotes this field as high mix, low volume, while the MTO field could be considered as high volume (per standardized process), low mix. Applications of lean in the field of high volume, low mix have been extensively described in the literature, primarily due to the origins of lean in the automotive industry. However, the variation in cars that are being produced in the same process is much higher than the variation that we nowadays intend to serve in schools. Hence, lean developed toward the high-mix, low-volume area over recent decades. A customer of a car specifies a perhaps unique configuration of modules. The car is being produced according to this specification in the same production line as other cars. Lean therefore offers methods and tools to facilitate mixed-model production lines and other types of high-mix, low-volume production.

The role of the customer (student) in the phase of service provision and transformation is both an active and a passive one. Active participation in the service provision and transformation is essential in learning. The idea that students learn just by being provided with inputs (i.e. knowledge, tests, etc.) in a specified sequence (like an assembly process of a product) denies fundamental characteristics of learning processes, which are based on exploration, building upon previous experiences and knowledge, while an open and safe environment, interaction, and motivation are essential preconditions.

Passive participation of students in the service provision and transformation is also present in educational processes within schools. For example, in most schools a student will receive a schedule that specifies when and where the modules or tests that she should take are offered. Otherwise, she will receive information about what material to study in order to prepare for an exam. Hence, the student is in general not involved in selecting the learning method (what and how to learn), nor the module and assessment schedule (when and where to learn). This prevents the students from being in control of the speed of learning, the social environment where learning takes place, the type of assignment that motivates or challenges his or her learning process, and so on.

The third phase of a service process is denoted as evaluation or quality control. In lean systems, evaluation of progress during service provision is considered to be of more value than just end-of-process quality control. The main reason is related to the possibility of providing feedback to previous stages in the process and feed forward to subsequent stages of the process. Note that this feedback is not directed toward the student, but the student will hopefully benefit from the feed forward that is provided to the not-yet-completed stages of the process. Next to this, it might be necessary to involve a customer actively in order to decide on adapting the specification of the intended outcomes or process for that specific customer. Based on intermediate measurements of progress in the intended transformation the customer may decide to change the desired service specification. In order to take such a decision, it might also be necessary to involve other stakeholders (e.g. parents, student counselors, teachers, etc.). However, it is an important active role of the customer to be involved in the adaption of specifications based upon the intermediate evaluation of service provision.

The final phase of a service process is when the customer benefits from the service. Note that this stage may already start when the customer enters the first stage of the process. The benefits from learning are gathered when one recognizes and specifies the desired intended learning outcomes and realizes that the gap with current knowledge and competences can be bridged by participating in the service provision. However, benefiting will in general continue after finishing school. The knowledge and skills acquired will hopefully be useful for further individual development. Further, the learning experience will also help to broaden the social network and increased access to resources or jobs that are valued by the customer. Some of these benefits will only become realized after some time, which makes it more difficult to measure. However, they should be included in specifying the customer value that customers (students) experience as a consequence of selecting the service of a specific school.

Educational Services

The second question we have to address is how lean schools will provide customer value in a more effective and efficient way. The focus in education is on delivering services that enable the student to learn a set of subjects at a specified level, master a set of skills, and acquire desired competences. As a result of this, customer value is enhanced by offering these services at the right time, in the right amount, in the right location, and at the right quality level. This is where we should start asking the question about what educational services should be distinguished in a school system.

In fact, there are numerous services offered and organized in a school. They may or may not add directly to the customer value as experienced by the students. Thus it might be wise to use a categorization of services. Literature on service management (e.g. Grönroos, 1994; Storey and Easingwood, 1998) makes the distinction between core services, facilitating services, supporting services, and augmented service offerings. Core services consist of the bundle of intangible services that are offered to meet the direct requirements of the customer, i.e. the main reason for the customer to ask for the service. In an educational context, the core services relate to learning, teaching, training, and assessment. Facilitating services are necessary to provide the main core service that is of value to the customer, i.e. without the facilitating services the core services simply can not be delivered. Think of program specification, course syllabi, classrooms, IT systems that support the primary processes, and so on. Supporting services are offered on the side to attract customers or to be distinctive on the market. The augmented service offering consists of admission, accessibility, interaction, and customer participation in provision of the service product.

We have performed a literature review in books and papers on lean in education. We limited our attention to books and papers that have the words "lean" and "education" in the title, abstract, or keyword list, and included studies of all types of educational institutes. Most studies that we found focused on colleges and none on primary education at all. Therefore, the results may not directly be transferable to all types of educational institutes, but give us an indication of what type of improvement projects have been undertaken and published by authorities in the field, and how these projects can be classified in terms of service characteristics. All cases or references to lean implementations in the education area have been classified in Table 38.1 using the classifications mentioned above.

From Table 38.1, we conclude that 75 percent of the lean improvement projects that have been described or mentioned in literature concern service activities in schools that are characterized as either facilitating, supporting, or related to the augmented service offering. It is remarkable that only 25 percent of the case studies have been published on the use of lean improvement tools for the core value-adding activities in education, as it is here the real value-adding activities can be found. This conclusion is in line with previous findings on the focus of improvement activities in the related field of total quality management (Koch and Fisher, 1998).

Case studies that apply lean in the core educational process discuss projects to improve course design or program design through emphasizing responsiveness, process design, and communication with the customer. These case studies demonstrate that it is possible to apply lean to core educational activities and processes. The lean improvement tools that have been used to improve these core educational processes have mainly focused on identifying customer value, processing redesign to reduce waste, and improving responsiveness by more frequent communication with the customer. Examples of the tools used are quality function deployment, visual controls, value stream maps, root cause analysis, standard work charts, and load smoothing. Less attention is given

Table 38.1 Analysis of lean in education projects referred to in literature

Source	*Number of cases referring to educational service of type*			
	Core	*Facilitating*	*Supporting*	*Augmented offering*
Balzer (2010): University of Central Oklahoma	0	7	2	3
Balzer (2010): University of Iowa	0	6	1	0
Balzer (2010): University of New Orleans	0	1	0	0
Balzer (2010): Bowling Green State University	0	0	2	2
Balzer (2010): University of Scranton	0	0	0	1
Emiliani (2004)	3	1	1	1
Emiliani (2005)	10[1]	0	0	0
Jankowski (2013)	0	1	0	0
Knight et al. (2000)	5	1	0	0
Radnor and Bucci (2011)	2	7	0	1
Stratton et al. (2007)	1	1	0	0
Thirkell and Ashman (2014)	0	2[2]	2[2]	2[2]
Waterbury (2011, 2013)[3]	2	3	3	27
Ziskovsky and Ziskovsky (2007)	3	1	0	0
Total (percentage)	**25%**	**30%**	**10%**	**35%**

Notes

[1] This is the number of cases that the author reports, but they have not been described in detail in this paper.

[2] The authors do not actually describe these cases, just refer to two or more cases in each of the non-core fields.

[3] The list of projects of Waterbury is made available for this chapter by the author and available upon request.

to the analysis of actual data that may help to improve processes for either the currently enrolled students or the next group.

Case studies that have applied lean to the facilitating services of a school describe, for example, facilities for disabled students, improved scheduling, placement services for work-based learning, and student enrollment for electives.

Case studies on supporting services are not found very frequently. The cases that we found in the literature listed in Table 38.1 focus mainly on housing facilities and sport accommodation for both students and staff.

The last category of augmented service offering is very well connected to the core and facilitating services, but is not considered to be delivering primary value to the students, i.e. it is experienced as it allows interaction with service providers, provides access to the core and supporting services, and communicates to the customers and their environment what service quality is being provided and acquired by the customers. Cases on lean in education that have been described largely address services in this category. Examples are admission and interaction with prospective students, communication with students and parents, enterprises, and government. Other services in this category focus on maintenance of resources (i.e. hiring and managing new staff) and administrative processes for accreditation.

Challenges and Opportunities for Lean Schools

This section addresses questions that should be addressed when using lean in schools, i.e. process descriptions, realizing flow, and establishing a culture of continuous improvement. These questions

are considered to provide both challenges and opportunities for using lean more effectively in schools.

Process Descriptions

This question is how to describe processes and identify value-adding activities within the process. Lean suggests using value stream mapping as a tool to describe both the current state and the future state of a process (Rother and Shook, 2003). Value stream mapping uses a scheme that describes the process over time from the viewpoint of the flow unit (in schools this may be the student who flows through the process) by using symbols that describe:

- activities (both active and passive),
- movements,
- waiting,
- decisions,
- systems, and
- information flows.

For all these process elements, data is gathered to describe the essential characteristics of the activity. This data may concern the resource usage, cycle time, batch size, scrap rate, etc. The information flow describes the connection between the process and the control system that monitors the process flow. This includes the information sent to customers on the progress of the process, as well as the communication between several actors in the process in the form of feedback and feed forward.

Alongside the process elements, the average (observed) time spent in these activities or stages is also listed as the net time required to perform the value-adding part of this activity.

There is no doubt a need for a process description tool that enables communication among various stakeholders and actors in the process and helps to identify areas for improvement. However, based on the actual experiences we have with using this tool, we noticed that there are various issues that make the tool less applicable in the context of educational processes, especially if these processes concern the core services provided.

First of all, the process boundaries need to be defined. This is a decision of the team that describes the process flow. It should take into account the whole process of value creation for which the process has been designed and installed. However, many value stream maps just focus on a small part of the whole process without giving proper attention to the actual value being created. The effect might be that the redesign of the process focuses too much on inefficiencies within the narrowly defined process while losing sight of the elements of the process that result in ineffectiveness of the process.

Second, process descriptions in value stream maps tend to be very detailed and complete. The many details might cause a loss of sight on the main flow of the process. Discussions on process improvements might get stuck on changing some details or may even be prevented by first focusing on a correct presentation of all details. This is the problem of (the absence of a proper level of) abstraction. Abstraction is a modeling decision that needs to be taken prior to designing a value stream map and should relate to the primary objective of the process map visualization. It lists what flows need to be considered beforehand and what flows associated with the process can be neglected. An example is the decision to ignore the flows associated with energy or waste in the value stream map of a process. This is not to say that these secondary flows are not important to analyze, but it prevents losing sight of the primary process of value creation.

Third, descriptions of elements in the process vary in the level of aggregation. Aggregation is a modeling decision as well and concerns a statement beforehand on what time unit to use and how to round up or down toward this time unit. For example, it is no use specifying the time spent on one process element in a whole number of days, while another element is expressed in seconds. Aggregation decisions mean that all process elements are treated in the same way. A more detailed analysis of the same process in a later stage of the lean transformation may use another level of aggregation. As long as the level of aggregation is used all over the same map and is in line with the main objective of the analysis and redesign, this is no problem at all.

Fourth, value stream maps should add information flows to the regular process maps. These information flows describe and visualize the amount and type of information that is shared between participants (actors) in the process. These flows may be stored in systems like logbooks, data warehouses, spreadsheets, and so forth. It is important to identify this type of storage and retrieval system, as well as when and for what purpose (decision) the information is used. It is hence important to focus the description on recovering these aspects instead of trying to be as complete as possible. Ineffective information flows (too late, too detailed, outdated data, too many handling steps between data gathering and usage) might point toward improvement areas. Inefficient data-related activities might also be analyzed. However, most important is a focus on the requirements put in by the process itself, i.e. to use an approach that specifies data requirements for controlling the process based on providing the required customer value, i.e. on the decisions to be taken during the process by resources and participants.

Fifth, the timeline in a value stream map shows two sides of the coin with respect to the time spent on the process: the total time spent on each activity, as well as the value-adding time of that activity. This timeline results from the analysis of the various parts of the process, i.e. all data gathered on the process elements. However, some warnings on the construction and use of this timeline are in place. Lean provides tools to make a trade-off between quality, time, and cost. Quality concerns the value delivered to the customer, cost concerns the inputs and efforts made by the service provider (which may include efforts of the customer who actively participates in the delivery of the service). Time expresses how much time a customer needs to either wait or actively participate between the start and end of the process in order to acquire the required service. Lean improvements focus first of all on resolving a possible gap between the quality offered and the required quality. Next, a possible gap between the time needed and the required time is addressed. Finally, a possible gap between the actual cost and the minimal costs given the required quality and time is also addressed. If lean is used to address these performance criteria in another sequence, bad things will happen. These bad things concern not only customer satisfaction, but also employee involvement in process improvement. Now, the value stream mapping technique aims to describe first of all how quality is being delivered. However, if the improvement activities first focus on the time dimension or even on the cost dimension, then value stream maps are used for the wrong purpose.

This brings us to the last item to discuss regarding the use of value stream mapping as a lean tool in schools: waste elimination. In my opinion, this is one of the least understood concepts in lean improvement projects. Based on my previous comment on the necessary sequence of improvement activities, one should first focus on quality, then on time, and finally on cost. In most situations that I have encountered, quality improvement projects should not start with identifying waste, although waste may be present in the process. Instead of waste elimination, one should first try to enhance quality, i.e. provide customer value that is in line with the customer expectations or requirements. If there is overperformance, this may be considered a waste from the perspective of the service provider. But why first focus on eliminating this waste while there are so many areas where the actual service provided is below what is required?

However, waste elimination is important when time and/or costs need to be investigated. For all activities of students that they complete as part of the process, it is now known whether they contribute to the required customer value or not. Note that some activities, such as short breaks or holidays, may be value-adding as they help the student to process the learning acquired in preceding learning activities or periods. If these breaks are too long, they become waiting times and diminish the learning gains acquired through the preceding activities. This example makes clear that constructing and analyzing value stream maps in an educational context is not that easy to accomplish. Nevertheless, similar challenges are found in industrial processes, such as, for example, a bakery. Delays between processes are required to cool down, but if these delays are too long, the quality of the end product is lower than required. You won't find this type of example in many textbooks, but the complexity of processes is often more challenging than the examples you encounter in these textbooks. Value stream mapping may still be used both for educational as well as industrial processes, but the resulting diagrams may look more complex than the ones found in textbooks. We conclude that value stream mapping is a valuable lean tool that may be useful when improving processes, but only if used appropriately.

Realizing Flow

When redesigning and optimizing a process, lean focuses on realizing flow (Modig and Åhlström, 2014). It might be difficult to apply the concept of flow to schools (Waterbury, 2008), but think of learning as a process that needs time in order to achieve the desired outcomes. Part of this time might be value adding, another part may be considered as waste. For example, if you are taking driving lessons at a driving school, a minimum amount of time between lessons may be required in order to prevent fatigue, but if these times become to extensive or irregular, effectiveness is reduced. The same holds true for the waiting time between applying for an examination time slot and the actual examination. Realizing flow means that a process is being redesigned such that the flow units (students, products, etc.) do not have to wait unnecessarily long, so they can learn at the pace that is optimal for them and hence learn most effectively. Distractions, i.e. activities that require attention and disturb the learning, should be avoided. The same holds true for unnecessary set-up changes, movements, repetitions, scrap, etc.

In practice, organizations have to find a balance between realizing flow efficiency and realizing resource efficiency, as depicted in Figure 38.1. Traditionally, most organizations tend to focus on resource efficiency, as the resources (e.g. teachers, doctors, call center operators) are more permanently present in an organization compared with the individual customers in a process (students, patients, callers). Their longer presence and the power they have gained within the organization come with the costs the organization makes to employ them. Both effects cause a tendency to focus on resource efficiency, even where this may lead to a lower service to the customer in terms of timeliness, effectiveness, or quality.

Some organizations have to provide a flow efficient process without bothering about resource efficiency at all. Think of ambulance services, fire workers, hotels, prison labor, etc. Characteristic of such processes is that labor is available and waiting to start the process as soon as a new demand arrives. In the meantime, they may find other activities to perform, but these activities will be postponed as soon as a request to start the process is being made.

Lean aims to realize flow by moving both systems toward another extreme where they will encounter less waste and hence more efficiency. However, lean has to deal with the effect of variation in processes that circumvent the realization of both types of efficiency. Variation in processes may be encountered through the time needed to perform activities, which may fluctuate over time or differ per student or resource. Processing time variation includes set-up time

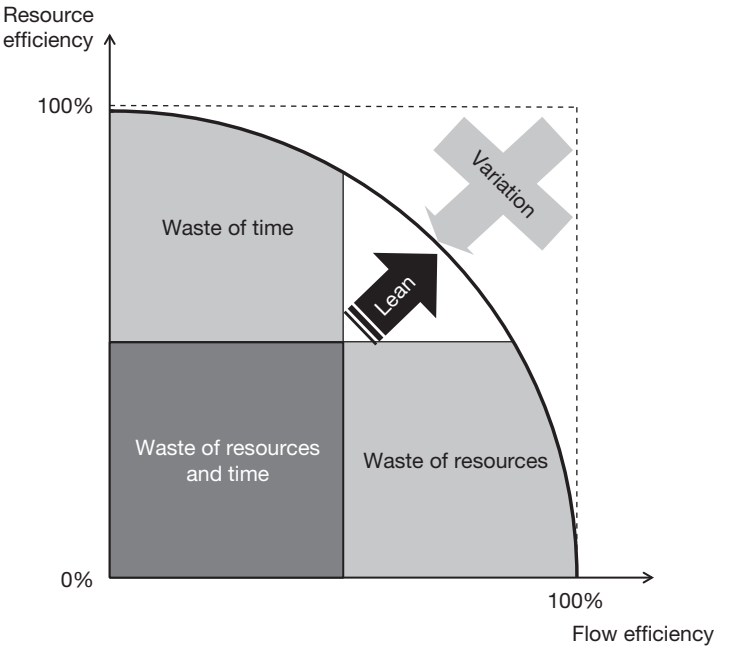

Figure 38.1 Flow and resource efficiency

Source: Modig and Åhlström (2014).

and non-availability of resources or flow units over time. It may also occur due to routing variation between flow units in the process. This routing variation may be caused by different specifications for the flow units (mixed-model production), or by quality problems (scrap and re-entrance at a previous processing step). Variation in processes may also be caused by an ineffective control of the processes, for example by batching requests and handling them together. The waiting time that the elements in the batch faced before they were processed differs due to this control policy. Large batches cause additional problems when errors are made that are only detected after completing the whole batch. Finally, variation may be caused by fluctuations in demand or supply. This type of variation affects processes through the availability of resources. It may take some time for a resource to become available for a next flow unit after completing a previous one. This cycle time of a resource is a type of set-up time that normally would be done offline (i.e. without the next flow unit being present). However, in case of peak demand, this time affects process variation and performance. The same holds true for temporary non-availability of supplies over time.

Lean attempts to increase flow and (if necessary) resource efficiency through reducing the effect of variation by buffering against or eliminating the causes of variation. Keep in mind: first flow efficiency (time), as cost (resource efficiency) comes last in a lean approach.

Culture of Continuous Improvement

Essential in a lean system is a culture for continuous improvement. This culture should be enhanced and valued by both students, staff, and management. Lean schools should be characterized by an open culture where every participant is invited to help improve the school. Typical lean tools, such as *kaizen* events, day starts, 5S policy, *poka-yoke*, *andon*, *kata*, and quality

enhancement help to establish such a culture. However, these terms are not very well known in lean schools, although some have been implemented using different names.

Kaizen events are perhaps the best-known lean tool for continuous improvement (Imai, 1986). These events involve a team of participants who focus during a relatively short period of time on a typical process that needs improvement. The event is well-prepared: workshops to support the improvement process on, for example, A3 charting (Shook, 2008) and data analysis are offered alongside the event, while the multidisciplinary team addresses the issues and suggests improvements. In schools, similar systems focusing on improving core educational activities, such as assessment and teaching, are peer review teams, internal program audits, etc. However, schools may learn from the typical lean approach of very short and focused improvement events through kaizen.

Day starts among staff members are typical for most schools. In a lean context, these day starts may need a different set-up. Lean suggests a very structured set-up of these day starts in order to focus on improving a small set of process steps. The team takes responsibility for the process improvement and supports each other. Hence, it is not about socializing and sharing nor solving problems that have popped up.

Schools use a 5S policy to organize their processes and activities in a very efficient way, i.e. through a well-organized educational environment (Netland, 2015). This may impact the classrooms, virtual learning environment, offices, etc. Materials that do not contribute to the learning process or that are not being used by teachers or students should be removed from the learning environment. Menu buttons or news items in the virtual learning environment that are not adding value should be removed or moved to another location. Websites that offer materials that are outdated should be removed. 5S projects should be done in a systematic way, as the effect of a one-time exercise is not adding to a culture change at all.

Poka-yoke (Shingo, 1989) aims to prevent systematic errors. These errors might become clear through an analysis of the process. In schools, these errors may be found in all types of services. Errors when filling in forms might easily be identified, but student outcomes that are considered to be systematic underperformance might also be easily prevented by specific poka-yoke solutions. Poka-yoke tools are often developed with the team that identified the issue. They are typically easy and quick to implement, i.e. not very sophisticated or demanding in investment.

In an industrial assembly process, the andon (Shingo, 1989) provides authority to line employees to signal quality issues they encounter and if necessary even stop the whole line. Signaling may show the other employees that an urgent problem has been identified and asks for a solution. The andon signal is not provided in order to blame someone, but to share responsibility in identifying and solving problems and in the end prevent customer dissatisfaction. It is this culture of shared responsibility in identifying problems and developing solutions that is often lacking in school organizations. Andon is just a tool that cannot easily be copied to a school system. However, the underlying principle of shared responsibility for identifying and solving problems instead of blaming a specific participant in the process (whether it is the student, parents, management, support staff, or a single teacher) should be the basis of a culture for continuous improvement in lean schools.

Kata is the pillar of real management support to drive improvements in lean systems. Kata is a specific type of coaching using Socratic questions. Rother (2009) describes five steps of this coaching approach toward continuous improvement:

1 identify the ultimate target or challenge for this process;
2 identify the actual condition;
3 specify what obstacles are to be solved first in order to move toward the target;

4 define the first intermediate target to move to in the direction of the target; and,
5 identify the plan-do-check-act cycle for the first step.

The kata process requires a supportive environment that helps the problem owner to identify the answers on these five challenges. This is not to say that the environment (e.g. the management) knows the answers, but that they are able to support the problem owners to find the answers. In lean schools, coaching is often interpreted as a staff-to-student educational instrument or a management-to-staff tool to develop teachers. In kata, coaching is used to improve the system by prioritizing and addressing problems encountered in the process that prohibit an effective process. Hence, coaching may be provided by any participant in the process in order to support problem owners to work on improving the process. Thus, students may be trained to support teachers in improving the core educational service provided to them, management may be trained to help support staff in identifying solutions, etc.

Quality enhancement is the last aspect of a culture of continuous improvement in lean systems. Quality enhancement is much more effective in increasing the quality of processes than quality assurance. This is also recognized in educational processes (Betters-Reed et al., 2008). However, terminology in educational quality systems is sometimes quite confusing. For example, an interesting and valuable tool for quality enhancement in the context of core educational services is known as "assurance of learning." The essence of assurance of learning is to use data from student outcome assessment to improve the core educational process. The approach is propagated by the Association to Advance Collegiate Schools of Business International (AACSB) in their standard for educational quality (Riezebos, 2015). For example, student outcomes (such as presentations, essays, homework assignments, written exams) will be assessed (resulting in a grade for the student), but may also be used for an assurance of learning evaluation where a team of peers reviews the student outcomes on some specific identifiers for one of the selected learning gains. If the peer reviewers are dissatisfied with the average level achieved or think the variation is too large, this will have no consequences for the grades of the students for the whole module (which take into account a set of learning outcomes). However, it ought to lead to adaptations in the set-up of this module or preceding modules in the program in order to improve on this specific learning objective.

The Future of Lean Schools

We have shown that literature on the application of lean in schools has mainly referred to applications related to service activities that are characterized as either facilitating, supporting, or concerning the augmented service offering. It is remarkable that only a limited number of case studies have been published on the use of lean improvement tools for the real value-adding activities in education: instruction, assignments, and feedback.

Future research in the field of lean schools should use a broader scope of application areas where lean has been applied in the past. If researchers are not able to identify application areas in the core educational process, the relevance of lean in schools will diminish and so will the interest of educational professionals and administrators, notwithstanding the high potential of process improvements in this area.

Future research within the lean schools field might also reconsider the terminology used for other lean improvement tools, such as batching, pulling, quick changeovers (SMED), etc. It is better to broaden the scope of lean improvement activities using terminology and tools that are accepted in both primary and secondary education. Moreover, future research might enrich educational improvement approaches such as assurance of learning. It is all about a data-driven

approach to improve the core educational process; hence there is a promising future for practice-based research on lean schools.

Case Study: Lean in Bærland Primary School

This case study is an extract from Netland (2015). It is used with permission of the author.

Bærland Primary School in Rogaland, Norway, has 35 employees who teach about 300 children from first to seventh grade. Since 2012, the teachers and staff at the school have learned about what lean can potentially offer a public school. They have agreed on two main objectives for their lean implementation: 1) increase the learning output by providing pupils more time for learning and teachers more time for teaching; 2) improve the working environment for the teachers by creating a more attractive working environment at the school and removing "time thieves" in administration. So far, Bærland Primary School has focused primarily on three lean practices:

1 5S workplace organization;
2 continuous improvement; and
3 standardization.

Lean School Practice 1: 5S Workplace Organization

5S (sort, set-in-order, shine, standardize, and sustain) is about maintaining an organized workspace. As a school is a public place with many users, 5S is a challenge for all users of the shared resources. Bærland uses tape markings and visual instructions ("one point lessons") to keep the school in an orderly state. The school has also implemented a solution for not accumulating material and waste over time: when a thing is not used for a while it will be marked with a date and moved to "The final resting place?," a physical place where unutilized objects are kept for a few days before being removed if not claimed.

Lean School Practice 2: Continuous Improvement

Every day, all Bærland employees gather for a five-minute morning meeting. These meetings focus on operational tasks and enable quick problem solving. The employees also hold weekly improvement meetings in front of visual team boards showing key performance indicators. Improvement suggestions and complaints are raised using post-it notes. In addtion, the school experimented with value stream mapping (for the development of local curricula) and A3 thinking for efficient communication.

Children also take part in improvement activities. At the school "class councils" have been replaced by "class improvement meetings" (from the fourth grade onwards). These meetings take place in front of visual improvement boards. The school has already implemented more than 1,200 improvement suggestions. The aim is simple: getting a little better, every day.

Lean School Practice 3: Standardization

Through standardization, Bærland Primary School tries to agree on some common practices for teaching (for example, how to start and end a class effectively), with the ultimate objective of

increasing the quality of education. Teachers are encouraged to share best practice with one another with the purpose of improving the overall learning experience for the pupils. The point is to make the "desired standards of teaching" clear so one can apply them and improve the quality of teaching by experimenting with deviation from them. Admittedly, standardization is not an easy sell in a school environment, which is why Bærland allows time to discuss and learn rather than forcing it.

References

Askin, R. G. and Goldberg, J. B. (2002). *Design and Analysis of Lean Production Systems*, New York, John Wiley and Sons.

Balzer, W. K. (2010). *Lean Higher Education: Increasing the Value and Performance of University Processes*, New York, Productivity Press.

Balzer, W. K. and Rara, T. (2014). Why is the broad implementation of lean higher education failing? In: *2nd International Conference on Lean Six Sigma for Higher Education*, Arnhem.

Betters-Reed, B. L., Nitkin, M. R. and Sampson, S. D. (2008). An assurance of learning success model: Toward closing the feedback loop. *Organization Management Journal*, *5*(4), 224–240.

Emiliani, M. L. (2004). Improving business school courses by applying lean principles and practices. *Quality Assurance in Education*, *12*(4), 175–187.

Emiliani, M. L. (2005). Using kaizen to improve graduate business school degree programs. *Quality Assurance in Education*, *13*(1), 37–52.

Emiliani, M. L. (2013). *The Lean Professor: Become a Better Teacher Using Lean Principles and Practices*, 2nd edition, Wethersfield, CT, The CLBM, LLC.

Flumerfelt, S. (2008). Is lean appropriate for schools? [Electronic version]. In: Flumerfelt, S. (ed). *White Papers*, Rochester, MI, The Pawley Lean Institute, pp. 1–6.

Grönroos, C. (1994). From scientific management to service management: A management perspective for the age of service competition. *International Journal of Service Industry Management*, *5*, 5–20.

Hines, P., Holweg, M. and Rich, N. (2004). Learning to evolve: A review of contemporary lean thinking. *International Journal of Operations and Production Management*, *21*(10), 994–1011.

Hopp, W. J. and Spearman, M. L. (2004). To pull or not to pull: What is the question? *Manufacturing and Service Operations Management*, *6*(2), 133–148.

Imai, M. (1986). *Kaizen: The Key To Japan's Competitive Success*, New York, McGraw-Hill Education.

Jankowski, J. (2013). Successful implementation of Six Sigma to schedule student staffing for circulation service desks. *Journal of Access Services*, *10*(4), 197–216.

Katzan, H. J. (2008). *Service Science, Concepts, Technology, Management: A Guide to Service Science for Academicians and Practitioners*, Bloomington, IN, iUniverse.

Knight, P., Aitken, E. N. and Rogerson, R. J. (2000). *Forever Better: Continuous Quality Improvement in Higher Education*, New Forums Press.

Koch, J. V. and Fisher, J. L. (1998). Higher education and total quality management. *Total Quality Management*, *9*, 659–668.

Modig, N. and Åhlström, P. (2014). *This is Lean: Resolving the Efficiency Paradox*, Stockholm, Rheologica Publishing.

Netland, T. H. (2015). A Norwegian primary school is experimenting with the use of lean management principles to improve both learning and teaching. *Planet Lean, The Global Network Journal*, pp. 1–7.

Radnor, Z. and Bucci, G. (2011). *Analysis of Lean Implementation in UK Business Schools and Universities*, A Report by AtoZ Business Consultancy, pp. 1–74.

Riezebos, J. (2015). Assurance of learning as a lean improvement tool for higher education. In: Antony, J. and Albliwi, S. (eds), *Third International Conference on Lean Six Sigma for Higher Education*, Edinburgh, Heriot-Watt University, School of Management and Languages, pp. 76–85.

Riezebos, J., Klingenberg, W. and Hicks, C. (2009). Lean production and information technology: Connection or contradiction? *Computers in Industry*, *60*(4), 237–247.

Rother, M. (2009). *Toyota Kata: Managing People for Improvement, Adaptiveness and Superior Results*, New York, McGraw-Hill Education.

Rother, M. and Shook, J. (2003). *Learning to See: Value Stream Mapping to Add Value and Eliminate Muda*, Cambridge, MA, Lean Enterprise Institute.

Schierenbeck, C. (2012). *Fixing Higher Education*, Wiesbaden, Springer.

Shingo, S. (1989). *A Study of the Toyota Production System: From an Industrial Engineering Viewpoint*, Boca Raton, FL, CRC Press.

Shook, J. (2008). *Managing to Learn: Using the A3 Management Process to Solve Problems, Gain Agreement, Mentor and Lead*, Cambridge, MA, Lean Enterprise Institute.

Storey, C. and Easingwood, C. J. (1998). The augmented service offering: A conceptualization and study of its impact on new service success. *Journal of Product Innovation Management*, *15*, 335–351.

Stratton, T. D. Rudy, D. W., Sauer, M. J., Perman, J. A. and Jennings, C. D. (2007). Lessons from industry: One school's transformation toward "lean" curricular governance. *Academic Medicine*, *82*(4), 331–340.

Sugimori, Y., Kusunoki, K., Cho, F. and Uchikawa, S. (1977). Toyota Production System and Kanban system: Materialization of just-in-time and respect-for-human system. *International Journal of Production Research*, *15*(6), 553–564.

Thirkell, E. and Ashman, I. (2014). Lean towards learning: Connecting lean thinking and human resource management in UK higher education. *International Journal of Human Resource Management*, *25*(21), 2957–2977.

Van Looy, B., Gemmel, P. and Van Dierdock, R. (2003). *Services Management, an Integrated Approach*, 2nd edition, Harlow, Pearson Education.

Waterbury, T. A. (2008). *Lean in Higher Education: A Delphi Study to Develop Performance Metrics and an Educational Lean Improvement Model for Academic Environments*, Capella University.

Waterbury, T. A. (2011). *Educational Lean for Higher Education: Theory and Practice*, Lulu.com.

Waterbury, T. A. (2013). Project list till Oct. 2013 (private communication).

Womack, J. and Jones, D. T. (1996). *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*, New York, Productivity Press.

Ziskovsky, B. and Ziskovsky, J. (2007). *Doing More with Less: Going Lean in Education—A White Paper on Process Improvement in Education*, Lean Education Enterprises. Available at: www.leaneducation.com/whitepaper-DoingMoreWithLess.pdf (accessed July 2016).