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APPLYING KAIZEN IN A PROJECT-BASED LEARNING ENVIRONMENT

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ABSTRACT

"Kaizen" is a lean manufacturing tool that is used to improve quality, productivity and culture in different environments. The idea of Kaizen is to apply small, daily changes that result in major improvement over time. Roughly translated to English, Kaizen means "good change" and it can be considered as a framework for continuous improvement.

This paper focuses on changes and possibilities of Kaizen in "theFIRMA" that is a project-based learning environment in Turku University of Applied Sciences, Finland. TheFIRMA operates like a real company that concentrates on ICT-related customer assignments and R&D projects. The mission of theFIRMA is to offer interesting project-based learning opportunities for the students as well as to create benefit to the customers when digitalizing their operations. Most of the customers are local small and medium-sized enterprises (SMEs).

The volume of the project portfolio of theFIRMA has grown significantly during the past few years. Accordingly, there has been a growth in the number of customers and students, which has increased complexity and caused challenges with resourcing and scheduling. In this paper, Kaizen is presented as one of the tools that can be used to develop the learning environment's operation towards more efficient and reliable state. The paper describes both the changes Kaizen has already produced in learning environment and possible future implementations.

KEYWORDS

Kaizen, R&D learning environment, CDIO, ICT, Project-based learning
Standards: 6 and 8

INTRODUCTION

"TheFIRMA" is a project-based learning environment, located in Turku University of Applied Sciences (TUAS) in Finland. TheFIRMA operates in the Information and Communications Technology (ICT) unit of TUAS and thus, concentrates mainly on ICT-related projects. TheFIRMA operates like a company, doing customer projects for local SMEs with students

as its main personnel. Students work in the customer projects learning by doing and earning credits from their work. The goal is to build long-term customer relationships, where a satisfied customer is familiar with theFIRMA's way of working and students can provide solutions to the various needs.

Besides the student-run atmosphere suitable for the involving continuous improvement, theFIRMA has also the other key element for successful implementation of Kaizen: the actual need for small changes. When theFIRMA was founded by merging several learning environments together, best practices were naturally preserved. After founding the learning environment in 2015, there has been a major growth in both student and customer project amounts. This has brought up two main issues: resourcing and scheduling.

The Kaizen approach can be used to improve both employee (students of theFIRMA) and customer satisfaction. Kaizen philosophy states that all employees are active sources of improvement initiatives. Allowing students to make suggestions about their own working environment and processes, they are more likely to engage in theFIRMA's operation for a longer period of time. Reducing waste, or "muda", eliminating too complicated processes, or "mura" and avoid the overburdening, "muri", usually lead to more proficient project work. This reduces the number of mistakes and elevates the working atmosphere as well as customer satisfaction.

THEFIRMA'S OPERATION AND MANAGEMENT

TheFIRMA's projects mainly consist of web development, software requirement analysis, database design, digital marketing assignments and different testing activities. These assignments form a wide selection of challenges for students to develop their knowledge, skills and attitudes. Project tasks are completed in teams and more experienced students will act as project managers or senior team members and mentor the junior team members. Thus, everyone learns both working-life-relevant social skills and improves their technical knowledge.
Students are encouraged to be self-driven and active and so usually teachers are in consulting and mentoring role. The team carries the project from planning to end-user training, thus following the CDIO path in conceiving, designing, implementing and, in some cases, even operating.

Operations of theFIRMA are overseen by the personnel of TUAS. There are currently four members of staff who are responsible for theFIRMA's operations in strategic or operative level and have a part of their working time allocated to this purpose. In addition, other teachers participate in R&D projects as mentors. TUAS teachers, project managers and project engineers are ensuring that the projects get a good start with proper allocation of students, and from then on most of the responsibility is handed to student project managers.

The student project managers are responsible for ensuring that the projects meet their deadlines, that the customers know how the project is proceeding and that there are enough resources, especially students with right skill sets, available for the tasks. Student project managers report systematically about projects' progress to the staff members and to student CEO, who is head of theFIRMA's students. The student CEO has the knowledge about theFIRMA's financial and resource situation and he makes sure that the daily operations run smoothly. Together with the TUAS staff, student CEO and student project managers form theFIRMA's management team.

Currently there are four student project managers in theFIRMA, each of them managing several projects simultaneously. They are part-time employees of TUAS, as the idea is to award the most successful and hard-working students with responsibility and employment. In other words, while studying according to regular curricula and earning credits, student project managers are getting paid from their work in theFIRMA. Being responsible for customer communication, project planning and team leading provide the skills that are not usually available for the second or third year bachelor students through regular courses. To ensure equality and to guarantee a possibility for partly paid position for as many motivated students as possible, new student CEO and student project managers are recruited annually.

Most of theFIRMA's students are project team members, who are earning credits from their work. Students can complete their work placement, do optional studies, substitute appropriate courses or write their thesis in theFIRMA. The goal is that the student's skills are developing constantly and that each new project gives him/her a new set of skills and knowledge.

Since the operations of theFIRMA are student-oriented, the whole idea and working customs of theFIRMA are based on continuity and constant changes in human resourcing. Students are finishing their work placements or project studies, graduating or leaving for student exchange. Student project managers are holding one position for a year and then most likely heading towards graduation and working life. This kind of atmosphere has both pros and cons. First, there is a good chance for motivated students to climb up in theFIRMA's hierarchy. Second, it is easy to develop new good practices in the operation, because there are always new and fresh view available. On the other hand, it might be hard to maintain these practices, if there is no one to watch over them. Furthermore, changes in the project teams could have negative effect on customer satisfaction, if the changes are not systematically carried out. There is also a risk that the frequent changes in working environment will make the atmosphere seem disorganized and rushed, which might eventually lower the ability to manage all the projects.

These risks and development areas create a need for systematic project processes, which consists of learning and quality processes (Määttä, Roslöf & Säisä, 2017). For theFIRMA, quality policies and tools or philosophies have to be flexible and easily graspable, since students are not full-time employees. Also, there needs to be a chance for quick, small changes that can be implemented by anyone. Since its founding in 2015, theFIRMA's rapid growth has required the management team to focus also on quality issues. The best practice has proven to be continuous improvement, or "Kaizen".

KAIZEN

Kaizen is a Japanese term phrased from two words. It translates to mean change (kai) and good (zen). Roughly, it stands for continuous improvement, which is the main philosophy in theFIRMA. It is one approach to continuous, incremental improvement and based on the philosophical belief that everything can be improved. This means that even if there is a process that seems to be running fine, there is still something that could be done better. Following the Kaizen philosophy result in continuous efforts to improve, which will result in small changes over time. These incremental changes add up to substantial changes over the longer term, without having to go through any radical transition. This approach can be more employee-friendly way to institute the changes that must occur in any working place as the business grows and adapts to its changing environment. (MindTools, 2018.)

Japanese Masaaiki Imai introduced the term Kaizen in the 1986 in his book KAIZEN-The Key to Japan's Competitive Success. Originally the idea was developed in Japan after the Second World War, when the country's industry was rebuilt with the support of foreign manufacturing advisors, like William Edwards Deming. Since its breakthrough in western world on 1980's, Kaizen has suffered some criticism during the 21st century. Although many industrial companies have trusted its philosophy, it has not proven to be the right approach when facing the rapidly changing and globalizing, technological world. (The Economist, 2009.) This is quite understandable, as the philosophy relies on small changes that increment during the longer period. Kaizen is not probably at its best on large corporations as the only quality philosophy. On that scale, it needs some other tool by its side, that concentrates on more swift and major improvement. One example of this kind of application is Modular Kaizen, introduced by Duffy (2013), that allows both planned, fast changes and continuous improvement.

Kaizen has many underlying principles, which may vary a little depending on the point of view. However, the themes of these principles are the same. The human resources are a company's most important asset; processes must evolve by gradual improvement rather than by radical change and improvement must be based on a quantitative evaluation of the performance on different processes (The Economist, 2009). Finally, the work needs to be standardized in order to eliminate Muda, or waste, which means the activities that do not add value to work processes (Suárez-Barraza, Ramis-Pujol & Kerbache, 2011).

Behind these principles is the idea that all of the organization's personnel should take part in improvement process. People who do the work every day are the ones who have the knowledge, so they should also be the problem solvers. Leaders, on the other hand, should be more like coaches. Their job is to create an environment in which innovative thinking and learning, as well as the implementation of the employee ideas, can thrive. (Dyer, 2016.)

IMPLEMENTATIONS OF KAIZEN IN THEFIRMA

Mainly, theFIRMA's improvement methods follow the principles of Kaizen, although there has not been an official declaration that this philosophy is the one that is in use. However, the operation and internal improvement are tightly linked with each other as the operation is under constant development. For some employees (students of theFIRMA) it could be frustrating or confusing if the improving actions would be labelled with the word Kaizen, since it can be seen only as burdening extra work. On the other hand, naming the improvement methodology with actual term could make it more systematic and communal.

Internal development in student-run environment

TheFIRMAs student-oriented approach lowers the internal hierarchy and creates an atmosphere that encourages students to be self-driven and active, as emphasized in CDIO standard 8 (CDIO, 2004). The staff members of TUAS are not in any actual teaching role when working in theFIRMA, but rather in a mentoring or coaching role. This situation makes it easier for any student, not just for the management team members, to point out improvement ideas. As the Kaizen philosophy states, it also creates an environment for hatching and implementing ideas.

Working atmosphere is the key element when considering Kaizen for the improvement philosophy. It is vital that everyone in the working environment takes part in improvement, therefore it is essential to have an actual platform or situation for sharing these development ideas. The communication between the project teams, the management team and the staff of the TUAS is working properly already at the moment. The project teams have frequent internal meetings and in the weekly management team meetings the student project managers report about the projects to TUAS staff and student CEO. Both occasions are suitable moments for the students to bring up new ideas and improvement targets. There are also more unofficial online communication channels in use, where all the students of theFIRMA can discuss with each other.

In addition to those frequent meetings, there are bigger development events twice per year. These development days partly fulfill the characteristic of "Kaizen blitz". Kaizen blitz is an organized event, kind of a formal problem-solving workshop designed to make specific and measurable improvements. These events can be very effective at solving specific problems and they can also demonstrate the power of continuous improvement, as the resulting improvements are measurable or can be clearly seen by different levels of the organization. (Dyer, 2016.)

Unlike the ideal Kaizen blitz, theFIRMA's development events do not take several days, but one or a half working day. Otherwise the idea is the same and the goal is to get as many students as possible to participate, not just the student management team. Based on the issues and ideas presented on these events, the management team creates a task list and divides the actions to be taken. If possible, these improvement tasks are often handed back to the students that came up with them, so they have the opportunity to have an influence on the change. Task lists are reviewed in the management's weekly meeting sometime after the actual event and the team checks how the ideas are proceeding in practice.

Growth creates a need for improvement

Both major and minor issues with resourcing and scheduling are tightly linked with each other. When considering a new customer project, the student CEO or staff members must first figure out if there are students available who could actually do the project. Even though there would be students with right skills or desire to learn them, they might be already taken by other projects or they are too busy with regular courses. On the other hand, there might be a free student who is not aware of a suitable project that is seeking an employee. Because most of the students in the projects are awarded with credits, the project needs to be motivating and also teach the project team new skills. There is no point in doing five similar video editing projects in a row.

After the human resourcing comes the question about the new customer project's scheduling. In most of the cases the project deadline is set so that there surely are capable students with enough time for the learning and implementing the project. Sometimes though, for the reasons described in *TheFIRMA's operation and management*, the project team needs new students. This recruitment process, even if it is short, might have an effect on keeping up with the deadline. Changes on the team and possibility for not meeting the deadline can lower the customer satisfaction. The process of figuring out who is going to do the project, managing it and the time frame in which the project can be accomplished takes a lot of unnecessary time.

Premises and online tools support the learning

Since aforementioned problems are the most apparent, there have already been several improvements implemented regarding them. For example, student project managers have listed their projects and deadlines to an online service and divided their available time to between the projects. The online service is convenient in this case, because staff members or the student CEO can check the management's resource situation even during a customer meeting. Online version of the timetable is not always the best option, though. During the autumn 2017, best practice for marking daily office hours for student project managers proved to be X-marks on a whiteboard. Every student in the office can see when the student CEO or student project managers should be available.

Ongoing projects, their statuses, deadlines and resource needs are controlled both with physical Kanban-board on whiteboard and on online platform. Idea of the physical board is that any student or visitor is able to see the different code-named projects' statuses with one glance. Figure 1. shows that visualizing things often makes them more real, so when some project status is marked with an alarming red, it is the last wake-up call for the student project manager responsible for the project. Luckily, this rarely happens. Online service is more useful for the TUAS staff members, who are not present at theFIRMA's office all the time. They can see which projects need more students and which are concluding soon.

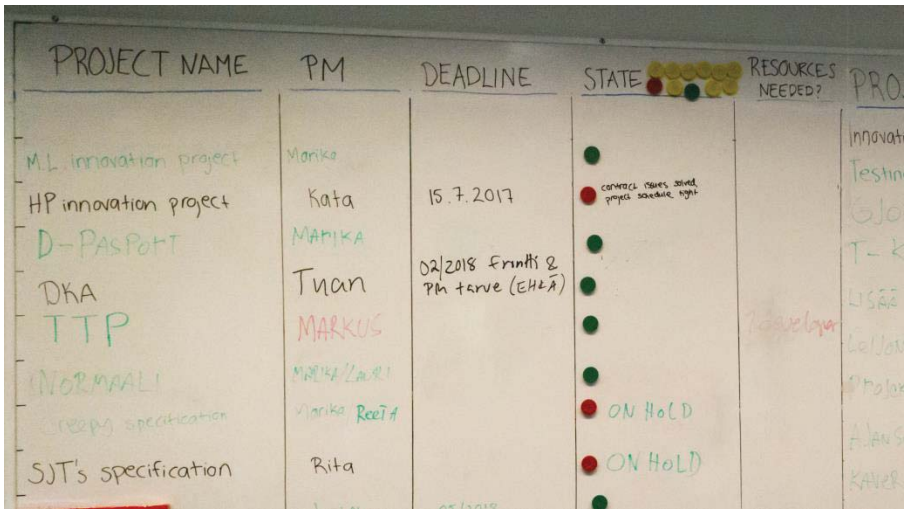

Figure 1. Visual project management board in theFIRMA. Project names are coded, since various visitors visit the office.

Although theFIRMA's office locates inside the school building, it does not have a common classroom's layout. Figure 2 shows that office layout is built with the ideal team work opportunities in mind, and it supports the learning process as stated in CDIO Standard 6 (CDIO, 2004). There are places for internal and customer meetings and desktops are organized so that people working within the same project or field, such as programming, are sitting near to each other. The management team also have places near to each other. There are no walls between workspaces, the only exception is the customer meeting area which has medium height sound proofs around it. This kind of layout makes the communication fairly easy, and there are still opportunities for quiet workspace. With the goal of theFIRMA being to transfer knowledge from a student to another, it is only practical that they are seated

close to each other. Students are responsible for the layout, so they can adjust it as they see best fit.

Figure 2. Students working in theFIRMA's office. TheFIRMA's brand color is blue, which inspired the students to brighten up the office by painting one wall blue.

Engaging environment and atmosphere

One part of resourcing is trying to engage the students in theFIRMA for a longer period. They can start their career as a trainee or through the optional project studies, but the goal is that they keep doing projects and gaining credits also after that. According to a text-book career path, the student comes in to theFIRMA through optional project studies, then stays for the work placement and then gets hired for the student project manager or student CEO position. This path does not always actualize, though. During his/her career, the student's skills widen and develop from junior to senior level. They are completing their studies while working in theFIRMA and graduating with actual experience on ICT customer projects. In order to engage students, theFIRMA has to have new and interesting projects, a supportive atmosphere and a chance to make an impact. Balancing between studies and growing responsibility in theFIRMA can lead to waste of overburdening, muri. It is caused by lack of training, unclear instructions and unreliable processes (Lean Manufacturing Tools, 2018).

In theFIRMA, there has been several actions towards an engaging and non-burdening environment. For example, the orientation process has been developed with small steps. Previously, no one was responsible for introducing the general customs for the new students in theFIRMA. This led to a situation where the orientation of the new students was inconsistent – or lacking. First step was to create an introduction checklist that the student CEO uses to ensure that all of the necessary things have been told to new employee. Second step was systematic, three-day long introduction period for new trainees. During that time, new trainees familiarized themselves to the most used tools and software of theFIRMA, as well as to the basic working customs. The latest improvement has been that all of the information from the previous introduction checklist is now stored in the online environment, that all students of theFIRMA have access to. The material was both created and peer-reviewed by students themselves. All these steps support each other and together they

create a successful start for the new student, who does not need to wonder what to do or whom to speak to.

The goal of the proper introduction is to ease student's adaptation to theFIRMA and its working customs. Team spirit building is done both in official occasions, like the project team meetings, and more unofficial occasions, like office gaming or other common events. All these events are organized by students themselves, usually by the student CEO and student project managers. Unofficial team building activities have a positive effect on the working atmosphere, which is one important element in engaging students. Little things, such as having lunch together or the weekly Friday board game night, could make a significant difference.

Productive platform for Kaizen

Besides the atmosphere and adjustable processes, continuous development fits well with theFIRMA due to the skillful students available. Besides the customer projects, students are constantly learning new skills on school courses. One student might have some idea for visualizing the data while in the project management class, and another student in theFIRMA might be able to program a tool for the visualization with ease. It is not a common situation in an organization, that the developer for the idea and the one implementing it sit next to each other in the office. With the backup help from the teachers, it is possible to develop small software for internal use that can have a great affect for example to the student CEO's work load.

Cycle of the students from a role to another within theFIRMA is a productive platform for Kaizen. For example, a new student CEO can pick up where the previous left off and continue improving processes further. Whether the students are just starting in theFIRMA or climbing up in the internal hierarchy, they spot the improvement needs there where previous employee saw only a properly functioning process. Since the majority of the responsibility is given to the students, they have also the opportunity to fulfil these improvement ideas. This enables the operation to be under constant development and progress.

FUTURE POSSIBILITIES OF KAIZEN IN THEFIRMA

Since theFIRMA has succeeded in creating an atmosphere where its employees can actively take part in continuous development, the next step is to standardize improved processes. In theFIRMA, standardization stands for a formal and stable process, which can be used in various parts of its operation. Ironically, for the same reasons that continuous development is possible in theFIRMA, the standardization is quite hard. Usually developing processes takes some time, since the customer projects have to be prioritized over internal development. This means that the time between idea and finished implementation can be long, and the developer for the idea has moved on to new tasks or does not have time to oversee the standardization. Active movement from tasks to another is vital for internal development, but hard for standardization. The less management effort or time is needed for standardization, the more likely standardization succeeds.

Muda refers to non-value adding activity or process, which is a physical waste of time, resources and eventually money. Muda can be divided further into seven wastes, but they are not covered in this paper. Mura, on the other hand, is the actual root cause behind those wastes. It refers to waste of inconsistency and unevenness in processes. For example,

measuring operation on monthly basis, can lead to rushing in the final week and then starting the next period slowly with no focus on meeting targets (Lean Manufacturing Tools, 2018).

Kaizen's goal is to minimize the waste in processes. Issues with standardization in theFIRMA originates from the waste in processes and on daily activities. Part of the already limited working time is consumed by muda, thus getting rid of the waste in daily activities is one of theFIRMA's future improvement areas. In time, it will free time for the customer projects and help the atmosphere feel less rushed. Other important part of this is getting rid of the mura in project management. There is sometimes a slow start to the projects, that should be avoided at all costs. This will require more systematic project management plan and good requirement and timetable specifications right from the start of the project. Proper communication and systematic training into these practices will help avoiding muri and decrease the risk of overburdening.

To make processes worth developing and standardizing, the improvement should be somehow measurable. Currently, the customer feedback is the main measuring way of the quality of the operation. Positive feedback and processes that led to it should be highlighted in weekly management and project team meetings. Collecting of the feedback should be more systematic and they could be stored in some general database, where both students and staff members would have an access. Other measurement actions could be clear and transparent status reporting for all theFIRMA's students, showing the improved situation a year ago and the current situation.

CONCLUSION AND DISCUSSION

In this paper, Kaizen was examined as the continuous development philosophy for the project-based learning environment theFIRMA. The environment itself creates a fine platform and atmosphere for Kaizen, since it is student-driven by the support of coach-like teachers. In theFIRMA, Kaizen has already provided several improvements, and for example annual Kaizen blitz -like development events are organized multiple times per year. Despite the actions towards more efficient working environment with less waste, there are still processes left to improve. Since students are working in theFIRMA mainly part-time, their time is valuable and should not be filled with waste.

CDIO Vision states that the gap between engineering education and real-world demands on engineers should be closed (CDIO, 2004). TheFIRMA is following this vision by encouraging students to widen their skills through customer projects. Kaizen in theFIRMA ties the education and working life even closer together, as students can actually see the results of their own internal development and learn to take actions towards even more efficient working environment.

In conclusion, student-driven environment both enhances the implementation of Kaizen philosophy, but it also brings up issues that might make the improvement, especially the standardization, more difficult. This has been identified, and development for that area is in progress. In addition, in the future the measurement between the change and result, such as customer feedback, should be more transparent, for example if some changes are made, do they have an effect on customer or employee satisfaction. In the spirit of Kaizen, there will always be something to improve.

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BIOGRAPHICAL INFORMATION

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