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CONTINUOUS IMPROVEMENT CHALLENGES: IMPLEMENTING PBL IN ONE UNIVERSITY IN ROMANIA

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Abstract:

What do business and education have in common when it comes to continuous improvements? The answer is Lean Principles. Case studies and implementation challenges from some pilot PBL projects in one university, in Romania, are analysed and described in depth, while comparing the educational experience in the university to the challenges and resistance to change that facilitators in the private sector face inside their own companies. Taking this into consideration and based on qualitative data retrieved from interviews carried out in the private sector and in the educational sector, the authors of this paper will present deep insights that are meant to serve as a basis for understanding the “wicked problem” of scaling continuous improvements like Problem Based Learning throughout the entire teaching organization.

Key words: *Continuous Improvement, Lean Higher Education, Problem Based Learning*

1. Introduction

What do business and education have in common when it comes to continuous improvement? Can higher education institutions also learn from organizations in the manufacturing industry, or do companies only benefit from the knowledge universities pass on to students, without a vice-versa effect?

The answer to the second question is quite obvious considering the fact that a university is also influenced by external factors, not just internal ones (like any organization). Companies, universities and other organizations are not just working together now, but are also more connected than ever through innovations and the use of new tools (Gupta, 2008). It is clear that learning opportunities are also available outside the traditional university spaces, especially with the network-type-model being shaped every day by innovations that come from Industry 4.0 and the Internet of Things. Thomas Baumann states that “innovation in education will be immensely more successful if

lessons learned innovation models and examples from industry are integrated into existing educational systems” (Baumann, Swanger, Saganski, & Saphie, 2016).

Innovation clearly thrives where continuous improvement exists, but how do companies and universities achieve and maintain a certain level of continuous improvement? In the manufacturing industry this level is defined and obtained through Lean Manufacturing Principles. Lean has long shifted from an exclusive manufacturing concept to other industries like construction, textiles, services and others, but it was only in 2010 that the first book on Lean Higher Education (LHE) was written (Balzer, 2010).

Taking this into consideration, the answer to the first question in this paper, regarding the connection between continuous improvement in business and education, is also clear: Lean.

For the scope of this paper we will mention three of the Lean Principles:

- identify what value represents to your customer;
- identify the value stream that leads to what the customer wants;
- bring the above identified value creating process into a flow state (Alkhoraif, Rashid, & McLaughlin, 2018).

It is clear that manufacturing companies and universities are both identifying what value represents for their customers. Where universities are concerned, articles on the importance of developing student's soft skills, not just hard skills, are extremely popular. Value for customers in the manufacturing industry is also clearly identified and documented. It is the next two Lean principles that come about with challenges. If tools and processes in the manufacturing industry that help create that value for the customer are known, when it comes to education, there is no common solution or best practice to scale and bring these methods to a state of flow and continuity. The way to fully implement Lean throughout an entire organization, not just a section or project, is still not applied in practice. There are some case studies and best practices in implementing Lean Principles in higher education and improving certain aspects of teaching or administration, but no clear statement of a Lean University, as there are also few companies that can state that they have implemented Lean Principles to all aspects and processes in the organization. Common tools, like Kanban, Single Minutes Exchange of Die are used by manufacturing companies in order to improve their processes and implement Lean Principles, but not throughout the entire organization (especially in Romania). When it comes to education, however, especially teaching, there is no one single or one combination of methods that all universities are trying to use to improve teaching and implement Lean Principles. There are several methods and approaches that are being tried, Brain Based Learning, Project Based Learning, Problem Based Learning, Design Thinking, but no clear common approach that is being sought by the entire organization, let alone more universities in one country, like you see companies going for 5S Certifications for example and competing on the score with each other.

Teachers and researchers address the needed general guidelines for all organizations to reach this high level of continuous improvement. For example, Kolmos states that “although [...] research provides results documenting the efficiency of problem-based learning, the process of change at the institutional levels all over the world is slow” (Kolmos, 2010).

She points out seven factors needed in order to change to Problem Based Learning:

- governance and educational policy;
- research and political pragmatism;
- change at institutional and individual level;
- leadership;
- implementation;
- trust in students' learning;
- global societies.

This paper will analyse the obstacles and challenges that one Romanian university faced when trying to implement Problem Based Learning as a continuous improvement method, compared to the challenges Romanian companies faced when implementing industry specific continuous improvement methods, both of which align in theory under the above mentioned Lean Principles. By using data from real examples, the authors hope to gain in depth information regarding very specific challenges inside a certain culture, compare them to the industry specific challenges, in order to find and implement a sustainable model for implementing improvement methods throughout the entire organization.

2. Methodology

A case study design based on the implementation of Problem Based Learning (PBL) in one Romanian university, in 2018, was used to describe challenges encountered by using Problem Based Learning as a continuous improvement method in education. Merriam, cited in Ates & Eryilmaz, states that it is a good approach to use qualitative research from a case study design in order to provide a "holistic description and analysis of a single instance, phenomenon, or social unit". (Merriam, 1998) (Ates & Eryilmaz, 2010).

The authors focused on collecting information regarding the teacher's experience with PBL in order to focus on these variables for the development of the first solution model in future papers and to compare the results with the data collected from employees in the manufacturing industry. The qualitative data regarding the teacher's experience was collected for the research through one focus group and one on one interviews with the teachers involved in the project. The pilot project in 2018 was entitled "Student Centred Learning Through Teamwork and Methods like Problem Based Learning". The goal of the project was to prepare the teachers and researchers from one Romanian university in order for them to implement a new way of working in teams, through student centred teaching methods, oriented towards problem solving. This group of teachers specialized in PBL would use this teaching method in their courses in order to facilitate student learning and the development of 21st century skills. A highly trained and experienced international trainer was brought in the university to teach the method and then mentor a group of teachers in implementing PBL for one course, one semester.

Results from eight teachers that tried the PBL approach in classes with engineering students will be presented in this paper. The implementation lasted 14 weeks, so one semester, from October 2018 to January 2019. There was a one-week PBL

training before and some other trainings focusing on other aspects of teaching during the summer of 2018.

Due to some problems on the trainer's side, the mid-project coaching session was cancelled so the meeting of the eight teachers to discuss their challenges came only at the end of the pilot project, during a focus group organized beginning of February 2019.

The data collected during the feedback session was organised into an Excel file containing:

- the teacher's names (which was anonymised with letters);
- course details (number of course and seminar hours / week, number of students, student's year of studies);
- number of student teams and project type;
- partner company (if the case);
- description of PBL implementation;
- challenges with implementing PBL;
- benefits with working with PBL.

The data regarding employee's experience with implementing continuous improvement methods in the manufacturing sector was collected through one on one interviews with continuous improvements specialists or managers from five companies in this sector, nominated in the top 20 most wanted employers in 2019, in Romania, by the company Hipo.

An email was sent to each company and the interviews were conducted online (either on Google Meet or Zoom platforms). The person who conducted the interview also took notes. In some cases, the interviewees agreed to recording the discussion. A semi-structured interview guide with 6 questions was prepared, seeking to:

- identify the continuous improvement methods used;
- identify the person's role in the implementation of the continuous improvement methods;
- identify the degree of successful implementation of continuous improvement methods and Lean Principles inside the company;
- identify the main challenges in implementing continuous improvement inside the company;
- identify the main success factors in implementing continuous improvement inside the company;
- identify how the continuous improvement methods and tools were introduced in the company.

An interview lasted on average about 45-60 minutes, but there were also cases where 2 interviews lasted over 90 minutes.

A total of 7 interviews were selected for this study, from 5 automotive companies. All people interviewed were familiar with continuous improvement tools and Lean principles and all of them heard or learned the tools inside an automotive company (either in internal trainings or external ones with Lean specialists).

The answers and feedback received from the teachers were compared to the following PBL principles extracted from the online courses on the website of the Aalborg Centre for Problem Based Learning in Engineering Science and Sustainability:

- learning should start with a problem;
- learning should be participant directed;
- learning should be team based;
- learning in class will never cover the whole curriculum;
- teams should be interdisciplinary;
- learning should include research.

3. Results

Probably one of the biggest biases with PBL can come from the name, as one of the teacher's stated: "you hear Problem Based Learning and you immediately think of a project or something practical to be done during seminars, not courses". This is why most of the teacher's considered PBL as a challenge given by a company, that students needed to solve after receiving the theoretical knowledge during the courses. This might have been a misleading part of the trainer's course as he presented pictures and examples of the PBL projects solved by students inside a private company and not so much on the approach used during courses or tools implemented there.

One of the attempts in implementing PBL in the university in Romania was a PhD student that tried to help students in the Engineering Faculty tackle some PBL projects by developing a university-private company partnership. The students from the Textile Business Engineering field of study were involved in small improvement projects in a local private company in Romania. They were divided into groups and some assigned a mentor from the company. Each week the students could visit the company and observe the process they were meant to improve. At the end of the semester they had to present the results and improvement proposals to the mentors, teachers and company managers. Although this was a successful project with good results, it was not replicated in the entire faculty, but this example was more like a model for a several teachers that took part in the 2018 pilot project.

One of the teachers (# 5) even split the semester in half, teaching only courses for seven weeks and then working with the students and a partner company in applying that theoretical knowledge. This contradicts the first PBL principle that says learning should start with a problem, however, literature shows that such hybrid models have been used in other universities.

Four of the teachers did not work with a partner company and this led to the question from the other teachers if they had implemented the PBL method correctly or not. However, when using PBL, students can find and formulate their own challenge, or it can be already given by the teacher, or by the teacher together with a company partner, as found in the PBL profiles of universities listed on the Aalborg UNESCO Centre (PBL Profiles, 2019).

One of the challenges identified by teacher #8 in the Romanian PBL pilot project was working with a big group of students (around 100). This was also a big difference compared to the other teachers involved in the project, which worked with groups of 20 to 36 students. Thus, the question emerged if it was even possible to implement PBL for such a big group of students. Even with the class of 36 students, one of the challenges

mentioned by teacher #4 was dealing with the big number of student teams (due to the fact that one team was composed of only 2 or 3 students). The information on some of the PBL Profiles listed on the Aalborg Centre website was not detailed enough as the author could only find the total number of students working with PBL inside the institution, not necessarily in one course. Thus, the question still remained open for the Romanian team. They thought that the information about the total number of students involved in PBL classes or projects would show the extent to which the method was rolled-out throughout the institution and might even show the success of the implementation to a certain degree.

A problem should represent a tool for learning, or as Kolmos states: “a vehicle for learning something new”. Instead of telling students what to learn, problems make students wonder and be more interested in the knowledge they need in order to find the solution. Taking this and the above six principles for implementing PBL into consideration, none of the teams in the Romanian PBL courses were interdisciplinary, but the teachers did try to foster teamwork and collaboration between students. This turned out to be quite a difficult task considering that a lot of students were not used to working in teams. There was one group of first year students, guided by teacher #8, but even teacher #7 stated that her students (third year students) were reluctant to working with colleagues they do not know very well or do not necessarily get along with. This was another argument to the already existing idea that working with PBL is not easier than traditional teaching. Apart from the mental work represented by the attitude and role shifts, a considerable amount of practical work may also be required, depending upon the particular version of PBL implemented.

Coming back to the six PBL criteria, the fact that most of the teachers started teaching the courses in a traditional manner and then focusing on the project, would indicate that the pilot project was not necessarily a good indication of the PBL implementation, but the feedback from the teachers regarding the challenges and benefits they encountered is extremely valuable and important for the third principle in implementing a Lean university: “Bring the above identified value creating process into a flow state”. This paper will now present the ways in which experts in the industry bring engineering-value-creating processes or methods and tools into a flow state and come back to some of the challenges identified by the teachers and also the setbacks identified in the actual steps from the implementation of the pilot project, as these might also be an important variable in rolling out the flow state of PBL or other teaching methods throughout the educational system.

All employees from the private sector that were interviewed were familiar with continuous improvement methods and tools. The most common tools mentioned by the interviewees were: Kanban, 5 Why, Cause and Effect Diagram, 5S and Process Maps. One continuous improvement specialist mentioned Poka Yoke, Cardboard engineering and the importance of Visual Management. One interviewee mentioned SMED and two of the people interviewed mentioned some interest in Agile Principles, but this philosophy seems to be quite new and barely starting in some automotive companies. One of the interviewees that mentioned Agile stated that “you first need to be Lean in order to implement Agile practices”, while the other interviewee that mentioned Agile felt it is not

really suitable for big industrial companies, rather for IT projects or software development companies.

Almost all interviewees had more than 5 years of experience in the field and none of them stated that they feel they have successfully implemented Lean principles throughout the company. Most of them had some successful projects, but they were all still struggling with the mindset of their colleagues which often think “you want me to improve something, you should tell me how to do it”. However, most of the interviewees agree that this is a misconception, as the continuous improvement specialist does not have to be (and often isn't) an engineer or a specialist in the field he is conducting the continuous improvements project. As interviewee number 3 stated: “The coach or Lean Facilitator is a different type of expert with different expertise. The ideas and the essence come from the colleagues. They are the technical experts”. The interviewee also mentioned this is often a plus because it helps keep an objective mindset and not get too involved in the solution. As opposed to interviewee number 1, which did not have too much support and guidance at the beginning of the Lean journey in the company, interviewee number 3 had a one-year internal training abroad. This helped clear the expectations of this new job position from the beginning. “Although people expected me to solve their problems, I made it clear to them from the beginning that my role was neutral and that I was there to offer my support as a facilitator, not as a problem solver”. This is one of the first major aspects that was missing in the PBL implementation: the mentor.

Three out of the five companies interviewed had continuous improvement programmes and structures in place, while the other two companies still work with employees working on improvement projects part time, on top of their main responsibilities in the company (mostly in the engineering and sometimes in the quality department). Six out of the seven people interviewed agree this is not the ideal approach, however it is often the case in smaller companies or some small companies at the beginning of their Lean Journey. The bias of the expert facilitating a continuous improvement project in his / her own field seems quite hard to overcome, at least from what the interviewees number 3 and 4 see in their own colleagues. Coming back to the educational project, no continuous improvement structure was leading the PBL implementation. It was more of a first-time approach for the teachers.

As the authors of the paper were interested in using the insights from the industry's experience and comparing them to teacher's struggle as facilitators, the interviews focused on the interviewee's experience as coaches and facilitators, not as participants in improvement projects. Most of them started out directly as facilitators anyway, except interviewee number 6 and interviewee number 7. Due to time constraints, interviewee number 7 acts as a mentor or champion in improvement projects (pilot ones or big strategic ones). Interviewee number 6 has first participated in various projects and only after switched to a facilitator role in the company.

When asked what were the biggest challenges and obstacles they encountered, 6 out of the 7 interviewees mentioned the lack of real support from the management team. The other interviewee did not state this as the biggest obstacle, but mentioned that it is important to have a common vision and understanding for continuous improvement throughout the company (from managers to blue collar workers). Interviewee number one

stated “it is one thing for managers to say they want to apply Lean principles and a different story to understand what this implies and offer support by trusting the coaches and allocating the needed resources”. Interviewee number three mentioned “the managers didn’t really believe in the Lean philosophy in the beginning”. “It took them about six years to change their mind, but I realised it’s natural, because managers are also people and they have their limitations just like most colleagues have a natural resistance to change. Now it is completely different. Everything comes from the managers. They have the vision and give the direction”.

In fact, when asked about the key elements that led to a better understanding and acceptance of Lean inside the organisation, interviewee number 3 stated that after gaining the trust of the colleagues and the support of the management, “patience and perseverance where the major factors”. Patience in waiting for the results to multiply and for the experience to grow, perseverance because in time colleagues acknowledge the personal effort and the visibility inside the company grows.

With these facts in mind, a new approach to PBL was tried in 2019. A first test was carried out by one of the eight teachers involved in the 2018 pilot project for one class, not an entire course. Although patience and perseverance where key elements mentioned by the continuous improvement experts, interviewee #3 mentioned the importance of small wins too. The class was four-hours long so it was the perfect opportunity to set-up a problem-based lesson in which they had to audit one of the laboratories inside the Faculty of Engineering and still have a safety net to explain or teach in case students feel lost in this new approach. The visiting hours were arranged with the administrator for the laboratory presentation and then the audits. The students first had to define the term quality and what it meant for each and every one of them and then the term quality when it comes to a lab. After identifying what each of them understood from the word and expected, the ideas were refined into bigger groups and then five main points were chosen to consider when evaluating the quality inside a lab. Because of the big number of students, the audit was limited to the conditions inside the lab and the equipment, nothing regarding human resources training and work instructions. In the time needed for each group to go to the lab they would have to agree on a way for evaluating the five general criteria they all agreed would be the most important. For the criteria „organised” some teams decided to give points on a scale from 1 to 5. The teacher (acting as a facilitator, not trainer) helped them agree on the definition for awarding one point or five points and then introduced them to the lab responsible. The teacher encouraged them to ask questions and understand the activities carried out in the lab, without giving any explanation about the activity or lecture. Working and getting information from external stakeholders (outside the class, not necessarily the faculty) was one of the benefits identified by the students working with teacher #4 in the 2018 pilot.

The students were split into groups of 4 or five and they all had to ask questions and give points during the audit, on the audit sheet created by their team. After the five-minute audit they would return to class and share their points and opinions until the next team would do the same. After all teams managed to audit the lab, they shared their cumulated or average results and a discussion was started on what points could lead to

failing the audit or only receiving a report with the faults that needed to be improved. Thus, possible audit outcomes were introduced naturally into the class.

As one of the groups would continue to have classes with the same teacher, they decided to draft the faults-report and carry-out the support in improving the faults during their semester seminars.

When asked about what they felt when being confronted with a challenge they had never before had to complete and had no theoretical knowledge to apply, the student's feelings were mixed. Although there have been a lot of more positive feelings rather than mixed ones or feelings of uncertainty and confusion, it is important to consider the resistance to change that is just as natural to students as it is to teachers and people in the industry. After twelve or more years of being taught in a traditional manner, it might be a very abrupt change for some students to shift to a completely self-directed learning and might feel confused even with a highly skilled facilitator, not to mention a beginner.

When asked if the theory on audits felt easier to understand after the class simulation, 26 students out of 27 answered it was easier and 1 student felt that the simulation didn't influence or help him, but that he generally considers this to be a good idea to solve a real-life problem and then learn the theory.

The results are also interesting compared to the results of the 2018 students, which are split in their opinions. Nine out of 17 students would rather learn by trying to solve problems and challenges, seven students would rather follow a course first and then try something practical and one student believes that students don't have the necessary tools to solve a problem without learning the theory first.

Some of the teachers in the Romanian university implemented a project-based PBL approach, only for the seminars and the majority applied the method to the whole course. As Hendry, cited in Vidal, Castillo & Gomez, states: "despite the fact that the PBL methodology is standardized, its success depends largely on tutors' teaching strategies to facilitate group dynamics and learning rhythms as well as a group" (Hendry, 2009; Vidal, Castillo, & Gomez, 2017).

4. Conclusions

Problem Based Learning has been around for a long time, but it is only recently that Romanian Higher Education Institutions have started to fully adopt and implement PBL concepts into their strategy and teaching. There are various myths associated with PBL, like the need for prior knowledge before students can try PBL, or that PBL can only be applied to certain disciplines. PBL has been used successfully in many different areas like medical studies and engineering, but also in nursing, dentistry, pharmacy, science, mathematics, information technology, computer science, business, cultural studies, languages etc. In Aalborg University all academic programmes offered by the university apply PBL, but PBL was adapted to their needs and requirements.

It is also false to believe that there is only one correct form of PBL, but there are some criteria to be aware of and that specialists recommend, like starting learning from a problem, working in interdisciplinary teams and facilitating rather than teaching. It is true that the curriculum coverage may decrease with PBL, as time is spent in covering also

other important aspects of learning like facilitating the students to work in teams and supporting them in asking the right questions. However, instead of PUSHED knowledge, students develop their skills while searching for information WHEN needed (PULL approach).

The question remains however, how to implement and roll-out this new method effectively inside a change-resistant organisation with so many different stakeholders and variables to take into consideration.

Considering the second Lean principle and student-reactions it is difficult to say if the “correct” value stream that would lead to what the customer wants (21st century skills) is a PBL teaching process or a university-academia-based process. It is clear that this represents what Brown would call a “wicked problem” and that exploring the various aspects of the problem will require more information and a new approach.

The insights from the interviews and additional feedback gathered from the students will represent the base for scalling this Lean continuous improvement approach, by constructing a model where the tool for solving this “wicked problem” is composed by understanding the problem space first and then diving into the solution space.

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