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AGILE PROJECT MANAGEMENT LEARNING BY POPBL METHODOLOGY: A TWO-YEAR EXPERIENCE IN MONDRAGON UNIBERTSITATEA

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This paper presents the results from the team-projects carried out by students of the Master in Business Innovation and Project Management of Mondragon Unibertsitatea, according to the POPBL methodology, within a two-year period. The study focuses mainly on aspects related to learning how to use the agile methods, Scrum and Kanban, in practice. Their use, as the basis of project management in a quasi-real environment, led to the identification of areas of interest. The first one is related to the teaching perspective, and the second to the point of view of the learners, most of whom had little or no professional experience.

Keywords: Agile; Project management; Scrum; Kanban; PBL; POPBL

APRENDIZAJE DE GESTIÓN ÁGIL DE PROYECTOS A TRAVÉS DE LA METODOLOGÍA POPBL: UNA EXPERIENCIA DE DOS AÑOS EN MONDRAGON UNIBERTSITATEA

Este documento expone los resultados derivados de la realización de proyectos grupales por parte de alumnos del Máster Universitario en Innovación Empresarial y Dirección de Proyectos de Mondragon Unibertsitatea, en el seno de la metodología POPBL y durante un período de dos años. El estudio se centra principalmente en los aspectos relacionados con el aprendizaje de la utilización en la práctica de los métodos ágiles Scrum y Kanban. Su uso como base para la gestión de los proyectos en un entorno cuasi-real ha permitido identificar aspectos de interés. El primero se refiere a la perspectiva del formador, y el segundo al aprendizaje de personas, muchas de las cuales contaban con escasa o nula experiencia profesional.

Palabras clave: Agil; Gestión de Proyectos; Scrum; Kanban; PBL; POPBL

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1. Introduction

This study is based on a two-year experience developed in the Master's Degree in Business Innovation and Project Management of the Faculty of Engineering of Mondragon Unibertsitatea. Aiming to provide knowledge and skills in the field of Business Innovation and Project Management, as well as Industrial Organization, the methodology is based on the integration of different methodological approaches based on active education, promoting the development, application and implementation of the skills learned. One of the distinctive aspects of the programs offered by MU is the realization of group projects in each semester, according to the POPBL (Problem Oriented Project Based Learning) approach. Participants work in teams to prepare, analyze, solve and present the projects/problems that they are raising, thus learning in a proactive and autonomous way. Thus, the student can achieve results that cannot be achieved by traditional learning (Araz & Sungur 2007).

One of the most interesting aspects of this master is project management, a relevant area of business. That is why through the "Project Management" subject the most relevant approaches are studied in order to acquire capabilities related to the different areas involved in this field. In this context, the agile project management philosophy has been one of the major advances in recent times. As a result of its novelty (Agile Manifesto, 2001), rapid development and expansion it has drawn much attention (West & Grant, 2010). Likewise, this approach offers different methods that, despite their different features, come from the same starting point.

Figure 1: Similarities and differences of Kanban & Scrum (Kniberg & Skarin 2009)

Similarities	Differences	
	Scrum	Kanban
Both are Lean and Agile	Timeboxed iterations prescribed.	Timeboxed iterations optional. Can have separate cadences for planning, release, and process improvement. Can be event-driven instead of timeboxed.
Both use pull scheduling	Team commits to a specific amount of work for this iteration.	Commitment optional.
Both limit WIP	Uses Velocity as default metric for planning and process improvement.	Uses Lead time as default metric for planning and process improvement.
Both use transparency to drive process improvement	Cross-functional teams prescribed.	Cross-functional teams optional. Specialist team allowed
Both focus on delivering releasable software early and often	Items must be broken down so they can be completed within 1 sprint.	No particular item size is prescribed.
Both are based on self-organizing teams	Burndown chart prescribed	No particular type of diagram is prescribed
Both require breaking the work into pieces	WIP limited indirectly (per sprint)	WIP limited directly (per workflow state)
In both, release plan is continuously optimized based on empirical data (velocity / lead time)	Estimation prescribed	Estimation optional
	Cannot add items to ongoing iteration.	Can add new items whenever capacity is available
	A sprint backlog is owned by one specific team	A kanban board may be shared by multiple teams or individuals
	Prescribes 3 roles (PO/SM/Team)	Doesn't prescribe any roles
	A Scrum board is reset between each sprint	A kanban board is persistent
	Prescribes a prioritized product backlog	Prioritization is optional.

In particular two of these methods, Scrum and Kanban (Kniberg & Skarin 2009), are the basis of the management of the POPBL-based learning experiences analyzed in this inquiry. The aim of this paper is not to explain Scrum and Kanban. Nevertheless, so as to facilitate understanding the main similarities and differences are shown in figure 1.

Not many papers on learning agile methods have been published (Griffiths 2005; Devedzic & Milenkovic, 2011; Lu & DeClue, 2011; Cubric 2013) and even less in POPBL contexts where learners may have little or no work experience, making this inquiry interesting for future experiences and research. In this case the problem posed involves all five subjects of the semester. Thus, students, organized in teams, are engaged full-time in a problem resolution for a 3 to 4 consecutive-week period.

The structure of the article is as follows: in section 2 the objectives of both, the POPBL and the research are presented, including an overview of the case studies as well. Section 3 explains the features of the research methodology used. Finally, section 4 gathers the findings and conclusions, whereas the suggested future research topics are discussed in section 5.

2. Objectives of the Research and Case Studies

So as to facilitate the understanding of the case study, it is important to clarify that the main interest of this research focuses on learning the corresponding agile method used. Therefore, under this perspective the POPBL provides the framework for the action, but it is not the center of the research. That is the reason why the general objectives of POPBL are explained first, and then the objectives of the research are described. Finally, the case studies on which this work is based are presented.

2.1 Objectives of the POPBL

As stated in the introduction, the problem-based learning aims to provide the student with other ingredients that cannot be achieved through traditional learning. The configuration of the problem is especially complex in this case, as it poses a multidisciplinary problem: to generate a proposal capable of solving issues related to 5 subjects simultaneously.

Furthermore, problems should be designed so that the conditions under which the work is carried out are quasi-real. That is why aspects such as gaps in the problem definition or limitations of time and/or resources are deliberately introduced as a part of the problem. Thus, problems similar to real work environments should be developed in order to create quasi-real work contexts as it is one of the reasons that originated this philosophy.

Finally, the requirement to use a particular agile method as a means to manage the project is another important point. On one hand it helps to emulate a real situation (i.e., having to work in accordance with the existing method in the organization). On the other hand, the goal is to learn by using the method in practice, beyond the mere acquisition of the theoretical background.

2.2 Objectives of the Research

The aim of the research is to get an insight on learning agile project management methods by their application to POPBLs. Therefore, the research question to which this investigation aims to contribute is "How can agile PM methods be learned in a POPBL context?". Nevertheless, the scope of this inquiry is limited to Kanban and Scrum, managed by groups composed of people with little professional experience.

This research has some other objectives, as described below:

- Make a contribution to the knowledge related to the use and learning of the agile methods.

- Draw valuable findings and conclusions for future experiences and research.

For this purpose a comparative study of two similar experiences was conducted. The projects were performed in similar conditions (i.e. contexts, participant profiles and periods). However, there were some different features, principally the agile approach used and the real or fictitious nature of both, the problem and the client. Section 2.3 shows the details of these two experiences.

2.3 Case Studies

As discussed in section 2.2, the basis for the development of the research consists of the projects carried out in the first semester of the MIP in two consecutive years. These experiences have similarities and differences that offer a chance to develop a comparative analysis. This section analyzes the most relevant characteristics and contents of these projects from the perspective of the research. In order to facilitate understanding, it has been structured as follows:

- Description of the problems posed in each POPBL: overview of the problem, including the objective, the deliverables and the duration.

- Description of the general characteristics of the cases: year, location, unit of analysis, management method used, number of participants and kind of problem posed. The perspective here is twofold: the case study and the unit of analysis.

Description of the problems posed in each POPBL

Problem "F": The objective of the POPBL was to define a competitive product according to the market opportunity given by the teachers. For this purpose, the team previously had to do a market study so as to justify this choice, and deliverables involving all 5 subjects were asked for. The duration of this project was 4 weeks.

Problem "R1": The objective of the POPBL was to design an efficient supply chain involving the company and its customer, as well as an action plan to implement that solution considering the conditions of each end customer. The duration of this project was 3 weeks, and 2 document deliveries involving the subjects were required (intermediate and final), apart from an initial delivery involving the arrangement of the management of the project.

Problem "R2": The objective of the POPBL was to implement an industrial kitchen capable of preparing 3.700 meals a day, including processes to allow the inclusion of people with lesser capabilities. The duration of this project was 3 weeks, and 2 document deliveries involving the subjects were required (intermediate and final), apart from an initial and an intermediate delivery involving the arrangement of the management of the project.

Additionally, all the teams were required to perform a project tracking on a daily basis, using at least the "Burndown Chart" to display the current situation. The documents and information related to this would be available for the teacher responsible of the PM subject at all times.

Description of the general characteristics of the cases

From the perspective of the research described here, there are certain characteristics that must be taken into account considering their relevance. Each case has a different configuration depending on the option that corresponds to each of these characteristics. An overview of the cases involved in this inquiry, the analysis units and their individual characteristics are gathered in table 1. Likewise both, the different characteristics of each case and unit are detailed below.

Table 1: Characteristics of the case studies

	CS1							CS2		CS3			CS4	
Year	1	1	1	1	1	1	1	1	1	2	2	2	2	2
Location	A	A	A	A	A	A	A	G	G	A	A	A	G	G
Unit	1	2	3	4	5	6	7	1	2	1	2	3	1	2
Method	S	S	S	S	S	S	S	S	S	K	K	K	K	K
Participants	6	5	5	5	5	5	5	5	6	8	8	7	8	7
Problem	F	F	F	F	F	F	F	F	F	R1	R1	R1	R2	R2

Year: year of execution of the case study within the period of observation. Options: 1 (1st year), 2 (2nd year).
Location: the MIP is taught in parallel in two locations. Therefore, there are 2 possible choices: A (loc.1), G (loc.2).
Unit: each study contains a number of embedded research units, each one of them performed by one team: 7 units at location A and 2 units at location G in year 1, and 3 and 2 units respectively in year 2.
Method: a specific agile project management method, Scrum or Kanban, was used each year (the same in both locations). Options: S (Scrum), K (Kanban).
Participants: exact number of participants in each team, which varied between 5 and 6 in year 1 and between 7 and 8 in year 2.
Problem: related to the type of problem (fictional or real) and its identification. In year 1 a single fictitious problem for all groups was posed. In year 2, however, a real problem was set out at each location. Options: F (fictional), R1 (real 1), R2 (real 2). R2 was generally defined but each team worked with a different customer.

3. Research Method

Considering the research question ("How can agile PM methods be learned in a POPBL context?"), it is concluded that it is Qualitative, as a deep understanding is aimed, based on data mainly accessed by observing what people do and say (Yin, 2009). Furthermore, the research looks for a profound understanding on how a new phenomenon takes place, identifying key issues and variables. Therefore, it involves an *Exploratory* purpose. By the same token, it explores and explains a topic as well, providing additional information about it, therefore entailing a *Descriptive* objective (Robson 2002) as well. Case Studies are considered to be the best option to conduct the research (McCutcheon & Meredith 1993; Yin, 2009; De Massis & Kotlar, 2014). Consequently it is an embedded Multiple-Case Study composed of four case studies, as detailed in section 2.3. Figure 2 depicts an overview of the case studies.

Figure 2: Overview of the research
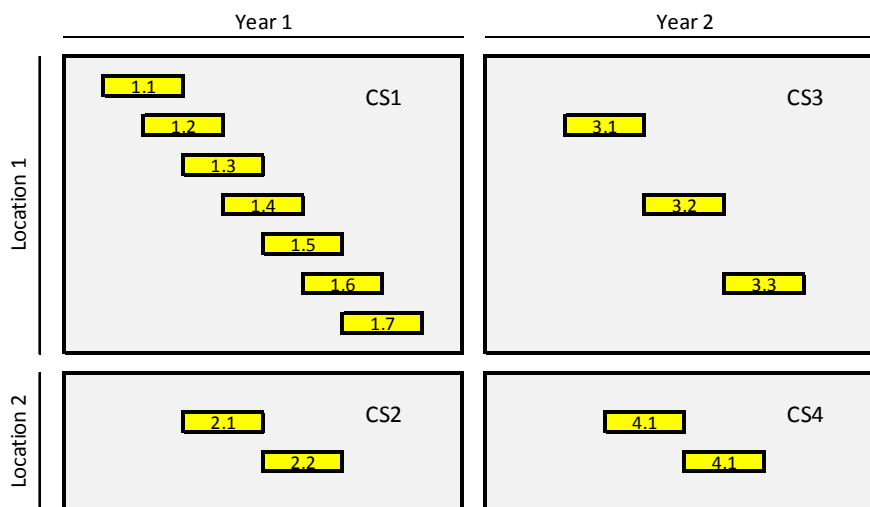
As the study is concurrent with the action and the researcher is a participant, a participative variant of case studies is suitable: Action Research (Gummesson 2000; Coughlan & Coghlan 2002; Easterby-Smith, Thorpe, & Lowe 2002;). Indeed, the participation of the teachers may involve different roles, depending on the case study, the location and the unit (i.e. teacher, tutor, expert). This brings the valuable opportunity to observe the same phenomenon from different perspectives (Stake, 2006; Yin, 2009; De Massis & Kotlar, 2014). Likewise, different sources of information may be used apart from the previously mentioned observation. In this case observation, interviews and documents are used principally, as shown in table 2:

Table 2. Data sources used

Source	Examples of use
Observation	Visits to the location/place the team is working at. Project tracking meetings (tutor of the team). Technical meetings (expert in the field)
Interviews	Formal: generally previously arranged and semi-structured. Informal: random chances, not appointed. Unstructured.
Documents	Surveys (satisfaction surveys of students, teachers and companies). Deliverables (documents with specific scope, to be delivered at certain dates), Monitoring reports (timely information regarding the status of the project), Final report (gathers all the work done by the group), Written personal defenses (very useful in assessing acquired knowledge and individual involvement of students)
Other sources	Oral defenses. E-mails and other communications (source of informal and often "unexpected" information, which can reveal contradictions, uncovering personal perspectives different from the group's, etc).

3.1 Limitations

As explained in section 2.2, this study refers to POPBL application experiences, managed according to the agile project management philosophy. This means that both the results and the conclusions should be interpreted in their contexts, and should not be directly generalized. In particular, the following should be taken into account:

- The framework is a particular interpretation of POPBL approach.

- The agile methods used are Scrum and Kanban. Therefore, extrapolations to other agile Project Management methods must not be directly done.

- The results and conclusions reached in each case correspond to the particular features of that case, especially the method used and the specific characteristics of the problem.

4. Findings and Conclusions

The general conclusion of this research is that the POPBL method has proven to provide valuable results that cannot be achieved by other means. In this specific scenario in particular, the use of the agile methods to manage the POPBL has proven to be suitable for this purpose, as the context created by the problems posed was very similar to the conditions in which a real-world project has to be performed. Indeed, the need for working as a team to reach a demanding result to be delivered by a deadline, defending the work, as well as the fact that the marks of all the team members are involved among other features, shape such a context.

Indeed, the need for working as a team to reach a demanding result to be delivered in a deadline and for defending the work, and the fact that the marks of all the team members are involved set up such a context.

Nevertheless, it was also concluded that an experience involving the participation of 5 subjects over a 3 to 4 weeks period is very complex to design and very demanding from the managerial point of view. Indeed, the learning is conditioned to the evolution of the project. That is to say, the potential for learning can be restricted by the performance of the project. Likewise, it is also difficult to manage from the learners' perspective: on one hand there are many different issues to work on simultaneously, complicating an effective performance. On the other hand, the construction of an efficient team is not easy and even less in such a short period of time and considering their lack of professional experience.

Consequently, some other relevant conclusions emerge from these results, beyond this general view. These conclusions concern the application of agile methods to POPBLs in general, or Scrum or Kanban in particular, as explained below.

4.1 General Conclusions

- There are some aspects that are vital to achieving a successful project, therefore requiring special attention. Taking into account their potential impact on the project, the following factors can be highlighted: the scope and consistency of the objectives, the organization of project monitoring (paying special attention to prevent the project from going out of control), and the capabilities and availability of the teachers involved in the project throughout the project. This last ingredient is of special relevance, and must be considered a prerequisite: if it is not fulfilled, the POPBL will just not work.

- The POPBL allows learning with a depth and realism that is not achievable by traditional teaching. Aspects such as the practical experience gained, the analysis of real problems in quasi-real contexts or the need to make decisions under pressure among others are critical from this point of view. This particularly concerns the agile PM learning, as it is the framework in which the decisions regarding the project as a whole must be made in a timely manner.

- The fictional or real basis of the problem is another important point to take into account when designing the POPBL. There is no doubt that developing a project to solve a real-world situation allows for more realism, motivation and commitment, and even more if there is also a real customer. However, it also entails higher levels of risk and uncertainty. For instance, some problems occurred in the relationships with the companies entailed drawbacks to some of the teams involved in the CS3 (e.g. delays, inaccurate information, communication problems).

  Even if these problems were finally overcome, these kinds of situations not only are hard to handle, but may also become insurmountable in such time-constrained projects. The matter is twofold: on one hand, these real-world situations are very interesting as an experience and the knowledge and capabilities acquired by these means are very worthy, but on the other hand the learning process can be severely disrupted due to external causes over which there is little or none control. Therefore, before the design of the POPBL it is essential to determine the convenience of using a real-world problem considering the specific conditions and requirements of each situation.

- The maturity and/or the previous professional experience of the learners can influence many aspects, both individually and collectively. For example, the understanding of the implications that a theoretically explained concept can entail in real-world situations can be very different depending on the background of the learner. Therefore, the knowledge and capabilities developed through the POPBL can be different as well. Likewise, the

performance of a team may differ depending on the attitudes, maturity levels, etc. of its members.

- Similarly, the levels of direct involvement of each student in each subject are limited and different from one person to other. As the teamwork is one of the pillars of the method, it is not possible (nor the objective) that a person participates equally in all activities. Regarding the use of an agile method the risk is lower because all students are involved in the management of their respective tasks, in the context of the team and the project. Nevertheless, certain risk exists and the supervision of the tutor is essential, especially at the beginning of the project, when configuring the team and the PM methodology.

4.2 Conclusions concerning Scrum and Kanban

These findings concern the agile-based POPBL from a general point of view, but there are also some other conclusions related to learning the specific method used in each project. Thus, from a general perspective it must be highlighted that the capability of the team to create a framework in line with the requirements of the method, and the use of the method in practice, are both learning objectives and challenges. The main reason for this is not a lack of knowledge or understanding, but a lack of know-how or experience. But the acquisition of experience may only be achieved by doing. This fact reinforces the idea that POPBL are suitable means to learn how to use agile methods in practice, beyond the sole understanding of their foundations and features.

In addition to this, there are clear differences between Scrum and Kanban. As these differences have important implications for the use of these methods, it is also necessary to draw particular conclusions for each one of them:

Scrum:

- The method is very clear and includes precise definitions of the different procedures, roles and responsibilities included. Therefore, it is very clear what and how things should be done, including the construction of the team.

- The clarity and completeness of the method makes it easier to fit all the parts that compose the project together, that is to say, the different objectives and deliverables.

- When properly applied, provides an accurate project tracking.

- The main drawback is that all the details and the definition provided by the method may be too rigid. For instance, the need to decompose the work into packages that must be fit in sprints is not always possible. Moreover, depending on the features of the work involved, it may be impossible.

- Due to the lack of professional experience, the learners had problems when facing real-world situations. The management of the group to perform as a team or the difficulties that arose when creating the user stories, when determining the scope of the sprints or when estimating the amount of hours needed to complete tasks have shown the gap between the acquisition of theoretical concepts and their use in practice. All these examples of conditions are required to properly manage according to Scrum.

Kanban:

- The method is more flexible than Scrum. Hence, from the perspective of the design of the POPBL it's easier to manage. As it is not necessary to set the specific tasks to be completed week by week as is the case with the sprints in Scrum, the team has more

freedom to perform the work. Similarly, there are no previously defined roles and responsibilities. Again, the team can decide how to address the organizational side.

- This flexibility may be a strength, but it might also become a threat. A lack of knowledge or experience may lead to severe deviations, the loss of control of the project or even a blockage in the progress. Likewise, when creating the organization for the management of the project, it must be decided how to address this issue. Even if many of the concepts and solutions used in Scrum are also suitable in Kanban, the key is to take or develop an organization suitable with the team and the project as well. Therefore, a real risk exists and a very close and timely supervision is needed to prevent this kind of situations.

- The focus is on the generation of work flow based on a holistic view of the system by influencing the work in progress and the bottlenecks. These are relevant concepts beyond the specific use of Kanban. Therefore, the opportunity for managing these concepts in such a project is worth it, as it can lead to a deeper understanding of their relevance and the acquisition of capabilities to manage them.

- Finally, the problems found when designing the framework and managing the team were very similar to those that arose in the previous experience with Scrum, reaching the same conclusions.

5 Future Research

This research has provided some valuable findings to those interested in learning agile PM methods. However, due to the particular contexts of the case studies these results must be carefully interpreted as certain limitation exist as explained in section 3.1. In addition, some of the findings and conclusions discussed in section 5 require further research. Therefore, some research suggestions are proposed below in order to move forward in this direction:

- As explained in section 5.1, it has been found that the complexity of designing a project with many requirements is difficult, and complicates the organization and execution of the project itself. In particular, the limited duration of the POPBL is relevant from the managerial perspective. In the cases analyzed, even if the students were working full-time on it throughout that period, the project seemed to be too short considering everything that needed to be done. Thus, two additional questions arise in this case: firstly, could the POPBL be arranged in a different way, resulting in a longer but not full-time dedicated project? And, secondly, would it be possible to base the POPBL in less than the current 5 subjects? Hence, further research regarding these issues is needed so as to give an answer to these questions considering their impact on the learning of agile PM methods.

- One of the aspects that have proven to be important is the starting point of each student. Since it is not possible to predict how skilled the students are, it is essential to try to ensure that they reach a minimum level of PM knowledge just before the POPBL starts. Considering that the characteristics of each case have great influence, further research regarding the most relevant options and conditions is needed.

- Another point of special interest is the result of this learning process. Assuming that the acquisition of PM skills is relevant, it is essential to ensure that by the end of the project all the participants have acquired a minimum level in this field in particular. Therefore, identifying the keys related to how to achieve that purpose in a multidisciplinary project performed by group is critical.

- The decision of allowing the teams to develop their own methodology or imposing a pre-stated one is controversial. On one hand, the arrangement of the team and the design of a proper methodology according to the agile method selected is one of the main

difficulties the learners have faced. On the other hand, self-management and independence along the way are some of the features of agile teams. Additionally, the arrangement of the team and the method are the foundations to apply the method, the means by which the learning objectives are reached. Therefore, further research is needed to provide guidance regarding these issues.

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