Cross-analysis of Transversal Competences in Project Management

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Abstract: This paper presents a framework for project management competence assessment based on participant's performance and contribution in a simulated environment. The proposed framework considers competence assessment through evidences and the participation of different roles. The system enforces the assessment of individual competences by means of a set of performance indicators. A specific case study is presented and the relationship between exhibited transversal competences and project quality is analysed.

1 INTRODUCTION

The European space for higher education is immersed in a substantial transformation process of the organizational, pedagogical and methodological aspects of knowledge transmission (Council of the European Union, 2004). In this changing context, the new educational model focuses on learning and competences' development.

In a constantly changing society, the demands faced by an individual vary from one situation to another and from time to time. Therefore, in addition to possessing the specific basic skills for accomplishing a certain task, more flexible, generic and transferable competences are needed to provide the individual with a combination of skills, knowledge and attitudes that are appropriate to particular situations (European Commision, 2004).

In this new higher education conception, the instructor's role shifts from transmitting knowledge to students to facilitate and guide their learning process (Beltrán, 1999; Navaridas, 2004). Thus, the teaching process must be organized in a more learner-centered approach than classical lectures offer.

This work presents a teaching framework that aims to stimulate the learning of both technical and human skills in project management. More specifically, this study concentrates on the relationship observed between four transversal competences –teamwork, leadership, motivation and results orientation- and the final project success.

The structure of the remaining part of the paper is as follows. Section 2 presents a brief review on related works. Section 3 provides an overview of the learning experience and section 4 is dedicated to present and discuss the relationships observed between the four analysed competences and the final project quality. Finally, the last section discusses some general conclusions and presents future work.

2 BACKGROUND

Competences in project management are correlated to performance on the job and can be confronted against well-accepted standards and improved via training and other development activities. The underlying assumption is that a competency can be broken down into dimensions of competence, as Project Management Competency Development (PMCD) Framework does. In this framework, considered dimensions are Knowledge, Personal and Performance (PMI, 2002). Furthermore, the International Project Management Association (IPMA) created the International Competence Baseline (ICB) consisting of 46 elements for knowledge and experience as well as personal attitudes and abilities for general impression (IPMA, 2006). In addition, the Association for Project Management (APM) developed the APM Competence Framework providing the technical, behavioural and contextual competence elements needed for effective project management (APM,

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2008).

Even though human skills –communication, teamwork, organizational effectiveness, leadership, flexibility, creativity, etc.– are acknowledged as important for project management, the education offered in industrial engineering degrees concentrates mainly on the control aspects of projects, i.e., the technical skills. It is recently that authors have started to discuss how to teach this discipline in higher education. Thus, Pant and Baroudi (2008) argue the necessity of a more balanced approach between technical and human concepts to enhance project management education. Clark (2008) discusses the skills required for an effective project manager, as well as the analysis of four approaches at the M.Sc. level to develop these skills. Barron (2005) discusses the difficulty of learning effective project management skills and suggests that there is a way to teach project management through properly designed assessment. In the same way, Sense (2007) emphasizes that project learning and the learning of behaviours that will lead to success are most appropriately pursued through the creation of a suitable environment.

The teaching and learning of project management has grown in interest and popularity (Berggren and Söderlund, 2008; Ojiako et al., 2011; Reif and Mitri, 2005) and there are some practical approaches to the teaching of project management. For instance, Abernethy et al. (2007) describe a specific experimental approach for information technology students. Authors argue that project activities must mirror the real world for information technology students to learn what needs to be done in industry projects. More recently, Crespo et al. (2011) advocated a combination of theoretical content, individual applied tasks, use of software systems and a strategy of learning by doing in teaching project management. They formally introduce negotiating and virtual team management aspects to different teams from different universities in different locations.

3 METHODOLOGY AND IMPLEMENTATION

The Project and Portfolio Management Learning (P2ML) framework presented in this work is based on the *experiential learning* theory, i.e., learning through action. The following is a list of the main characteristics of the proposed model:

- Students are involved in real-world engineering projects, which provides authenticity and require students to use academic and technical knowledge.
- Students are forced to adopt a more active role since they are the ones who must develop a project within given time and specifications.
- Acquisition of teamwork abilities and human skills, such as leadership, communication or negotiation, are promoted.
- Professional skills that should be deployed by a project manager are implemented in scale.

In terms of the selected method for project management, it was adopted PRINCE2™ (Projects IN a Controlled Environment) (Office of Government Commerce, 2009) as far as it is simple, product oriented and easier to understand for students without any previous experience in neither projects nor project management.

The use of PRINCE2™, even for academic purposes is not new, as it has been frequently reported (Hewagamage and Hewagamage, 2011; Zhang et al., 2012). Authors preferred it instead of the most common standard from the Project Management Institute (PMI) –Project Management Body of Knowledge, PMBoK (PMI, 2008)- because of the students' lack of previous experience. After initial experiences (Ordieres et al., 2011), teachers found that keeping the focus at the products to be developed, instead of using an effort oriented methodology help the most to the learning process, as students always look at product level.

According to the chosen method a multiphase lifecycle is accomplished. The meaning for all the stages established by PRINCE2™ is learnt during the first three weeks of the course.

For the student's learning process, it is necessary to make clear the difference between the different roles of persons who work together on the same project, but with very different responsibilities. In order to do this, and because students from different locations –Universidad Politécnica de Madrid (UPM) and Universidad de La Rioja (UR)- and different backgrounds are involved, they are exposed to different participation experiences by playing three different roles (all of them are the available figures in PRINCE2™):

- **PM:** Project Manager, with management responsibilities. Each project is managed by a team of seven or eight PM. The number of students playing the role of PM was established according to the necessity that all students perform management tasks. It must be noted the short length of the course, just 120/150 hours of student's work (4,8/6 ECTS assigned to the UPM and UR courses, respectively), which becomes short time considering the lack of experience of the students (Warfvinge, 2008).

- **TMg:** Team manager. A PM temporarily assigned to manage Project Engineers (TM), to produce what it was described into the Work Package document (Managing Products processes).
- **TM:** Team member, with engineering tasks development responsibilities. Each project is composed of ten or twelve TM.

The projects provided are basically oriented to learn about the project management methodology as well as to develop key competences as they include reports preparation, video presentation for the project as a commercial product as well as an individual presentation much more technical about their position in the team, the tasks carried out and their self-assessment as this tool is a beneficial for the learning process too (Crook et al., 2012). It is included the drawing preparation if required by the project topic as well as the formal budget estimation, not only for the project itself but also for its implementation.

The authors have chosen the IPMA-ICB framework (IPMA, 2006) as a reference model for competences in project management because of its flexibility and the taxonomy provided. IPMA (2006) defines the four competences studied in this work as follows:

- *Leadership* involves providing direction and motivating others in their role or task to fulfill the project's objectives.
- *Engagement & Motivation*. *Engagement* is the personal buy-in from the project manager (PM) to the project and from the people inside and associated with the project and motivation. *Motivation* of the project team depends on how well the individuals bond together and their ability to deal with both the high and low points of the project.
- *Results Orientation* means to focus the team's attention on key objectives to obtain the optimum outcome for all the parties involved. The PM has to ensure that the project results satisfy the relevant interested parties. To deliver the results required by the relevant interested parties, the PM has to find out what the different participants in the project would like to get out of it for themselves. This competence in project management behaviour is closely linked to project success
- *Teamwork* covers the management and leadership of team building, operating in teams and group dynamics.

In order to support learning and monitoring, information and communication technology (ICT) tools were used. The provided ICT environment was built by integrating some open source tools as it is described in González-Marcos *et al* (2013). Moreover, specific procedures about how to operate, how to do things, how to communicate mandatory information etc., have been developed and learning them as well as the use of the ICT system is the goal of the first module for the course, in parallel with learning about PRINCE2^{TM}.

Subsequently, students will develop a direct relationship between PRINCE2^{TM} theory and operational procedure. This module consumes three weeks and the last activity is an individual assessment that is used as evidence for Project Management Information Systems ability and theoretical knowledge about the method of management.

During the period where the project is being developed, students realize how complex the project management becomes because different effects such as contradictions found between stakeholders, misunderstandings, time pressure, particular motivations, or lack of attention to details. Along this period the students are still learning theoretical concepts for the document structure to be delivered, legal responsibilities, as well as specific techniques useful in daily work. This procedure also shows how increasing complexity and uncertainty call for a more comprehensive inclusion of managerial and leadership knowledge respective to our teaching of advanced project management (Thomas and Mengel, 2008).

Obviously, most of the work needs to be carried out by groups or teams; however, it is based on individual knowledge. Sometimes this individual knowledge is improved because of the discussions about how to perform the work. Thus, students are responsible for their learning as well as the learning of others (Hughes, 2012).

Evaluating the learning process is an essential issue not only for students but also for teachers as they are responsible for the learning process. Unfortunately, there is no agreement on how to integrate different dimensions of learning, knowledge, skills, etc. (Huang & Yang, 2009). Therefore, authors have incorporated two different assessment methods. The first one is a formal knowledge based set of test in different period of time. The second one is a continuous assessment oriented to estimate the project management performance and the contribution of each student to it (Qureshi et al., 2009). This project performance is based on the auditing processes carried out by the Project Board and the Owner's representatives (the teachers) as well as on the competence level gained during the daily work performed.

The auditing process has two different branches. The first one is automatically performed by a web tool developed by the authors. This application collects real-time information about project and students' progress on the Enterprise Program Management Office (ePMO) software used during the simulation. It gathers relevant information about each student's performance in their project activities (project planning activities, documents uploaded, effort allocation, use of the provided communication tools –blog, discussions, etc.). It also looks for measurable mistakes, such as the absence of relationships between tasks, the absence of links between documents and deliverables, improper effort allocations, wrong document codifications, etc. Thus, instructors are able to make periodic reports to better identify mistakes or inappropriate behaviours. In this way, the teachers can more objectively and efficiently monitor and evaluate students continuously throughout the whole course. Furthermore, students were given the right to order an on-line self-audit based on the aforementioned automatic checks.

The second branch asks for a more qualitative but still evidence-based opinion about the products being produced as well as about how the different PRINCE2's themes –risk, communication, quality and configuration- are being managed by the team. To determine the exhibited competence level the answers to different questions are gathered from different forms about products, processes and behaviours. Most of them are Likert scale based and opinions come not only from the producer of the product or responsible for the process implementation but also from different consumers of those products or participants in the process.

The numeric assessment of the different evidences considered as relevant to each competence is carried out after considering, at least, four different roles:

- The self-assessment, as it is always a relevant perception.
- The auditor
- The owner of the product being developed
- User(s) of this particular configuration item or product.

Thus, the competence assessment framework uses some kind of 360-degree overview to different activities inside the project and it collects all these evidences in a weighted integration.

4 RESULTS AND DISCUSSION

Students from two different universities (UR and UPM) were organized around eight projects (1301 to 1308). Each project was composed of seven or eight PM and ten to twelve TM. At the end of the course, more than 450 assessment forms were filled out.

The first step in any multivariate analysis is to graphically represent the individual variables using a histogram or boxplot. These graphic representations are extremely useful for detecting asymmetries, heterogeneity, outliers, etc.

In order to observe differences between perceived PM competences within each project, boxplots were used because they are a way of summarizing a distribution, take up less space than other graphical techniques and they are a quick way of examining one or more sets of data graphically (see Figure 1). The spacings between the different parts of the box help indicate the degree of dispersion (spread) and skewness in the data. A boxplot (also known as a box and whisker plot) is interpreted as follows:

- The box itself contains the middle 50% of the data. The left edge (hinge) of the box indicates the 75th percentile of the data set, and the right hinge indicates the 25th percentile. The range of the middle two quartiles is known as the inter-quartile range.
- The dot in the box indicates the median value of the data.
- The ends of the horizontal lines or "whiskers" indicate the minimum and maximum data values, unless outliers are present in which case the whiskers extend to a maximum of 1.5 times the inter-quartile range.
- The points outside the ends of the whiskers are outliers or suspected outliers.

Comparing the boxplots across groups, a simple summary is to say that the box area for one group is higher or lower than that for another group. To the extent that the boxes do not overlap, the groups are quite different from one another.

Distributions shown in Figure 1 illustrate the different opinion that each team project had about the exhibited competences of their PMs. Thus, for instance, PM team of project 1302 obtained opinions varying from 'strongly disagreement' (Likert scale of 1) to 'strongly agreement' (Likert scale of 5), whereas the other project teams introduced better opinions on the competence level of their PMs (from 'neither agree nor disagree' –Likert scale of 3- to 'strongly agreement', with some exceptions).

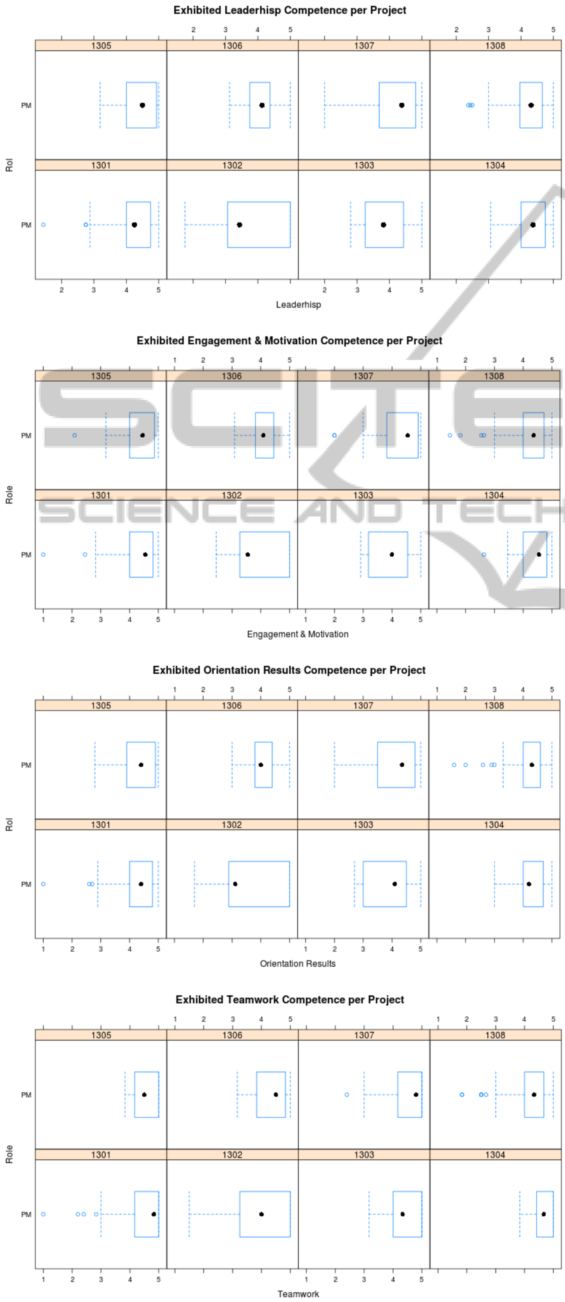

Figure 1: Competence assessment results per project.

In general, teamwork (Figure 1, bottom) was the competence with better assessments. In this case, projects 1304 and 1305 exhibited the lowest dispersions with highest assessments (between 3.8 and 5), whereas project 1302 had the highest variability in the assessments (between 1.4 and 5).

It is worth to mention that the other three competences analysed (leadership, engagement & motivation and results orientation) had very similar distributions per project. Since these three competences were evaluated at the same time by means of the same survey, it seems that the evaluation of each person was based on a global opinion that the assessor had about the assessed person without making any distinction between these competences.

The instructors team established the quality of the project (SCORE) according to the content and format of both management products (plans, business case, project reports, etc.) and specialist products (feasibility studies, engineering drawings, calculations, etc.). In this case, a 5-point Likert scale (from 1 for "very bad quality" to 5 for "very good quality") was used.

A visual inspection of all possible pairwise scatterplots in the analysed variables helps to understand the relationships between the variables. If these scatterplots are arranged in matrix format, the type of relationship existing between the pairs of variables can be understood and the outliers in the bivariate relationship identified. Such diagrams are particularly important for identifying non-linear relationships, in which case the covariant matrix may not offer a good summary of the dependence between variables (Peña, 2002).

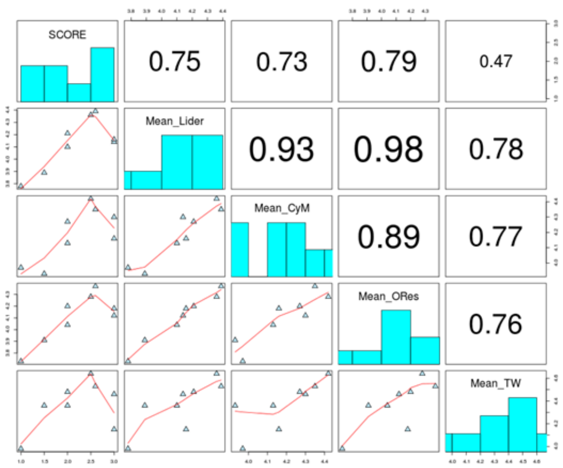

Figure 2: Relationship between project quality (SCORE) and transversal competences analysed.

Figure 2 summarizes all this information and illustrates the relationships between the project quality (SCORE) of each project and the mean value of the assessed PM's transversal competences. The lower triangle of the matrix shows a scatterplot for each pair of variables with a polynomial approximation according to their relationship nature; the histogram of each variable appears on the diagonal; and the absolute value of the correlations with a size proportional to their magnitude is included in the top triangle. From this figure, the following conclusions can be drawn:

- The project quality (SCORE) is positively correlated with the four transversal competences analysed (Mean_Lider, Mean_CyM, Mean_Ores and Mean_TW). However, as it can be seen from the first column of the matrix, these relationships are not perfect linear (red line). Although projects 1304 and 1305 have the highest means for the four transversal competences (points located at the top of each scatterplot), projects 1307 and 1308 obtained the highest SCORES (points located at the right of each scatterplot). That is, large doses of leadership, engagement & motivation, results orientation and teamwork are important to ensure high quality of the project, but they are not the only relevant variables.
- The highest correlation between the project quality (SCORE) and any of the PM's transversal competences analysed is found for the competence named results orientation (Mean_ORes). This result is consistent with the importance that the International Project Management Association (IPMA) gives to this competence: results orientation in project management behaviour is closely linked to project success (IPMA, 2006). In summary, higher quality projects were attained by PM teams that were able to develop project teams focused on results in changing environments.
- Project quality (SCORE) and teamwork (Mean_TW) have the lowest correlation (0.47).
- Although there is a high correlation between the four transversal competences analysed, the strongest relationship is found between leadership (Mean_Lider), engagement & motivation (Mean_CyM) and results orientation (Mean_ORes). This result is consistent with our previous observation related to the evaluation of these competences through the same survey: each assessor evaluated these competences to each person without making any distinction between.

By defining the effort ratio as the relationship between the total number of hours claimed by the whole project team and the total number of planned hours, it is observed a strong correlation (0.83) between this variable and the project quality (see Fig. 3). This result suggests that the lower deviations between planned and actual activity of the project team, the higher final quality of the project.

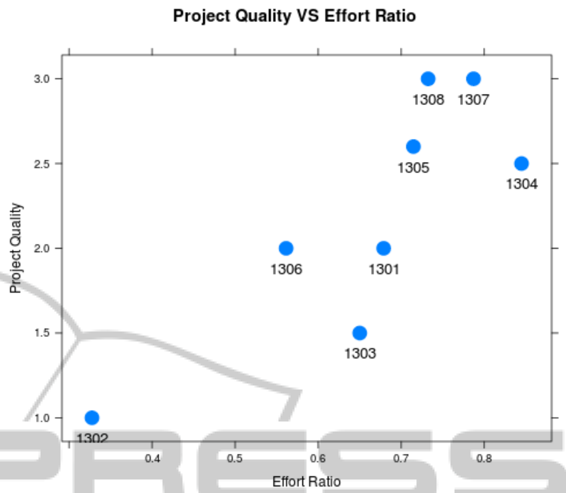

Figure 3: Relationship between project quality (SCORE) and effort ratio.

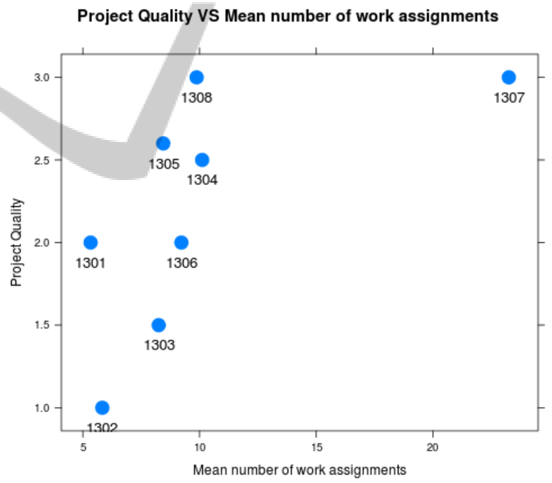

Figure 4: Relationship between project quality (SCORE) and results orientation competence.

Fig. 4 illustrates the relationship between the mean number of work assignments and the final project quality. In this case, the correlation between the two variables analysed is lower. That is, a higher number of work assignments do not necessary mean a better project quality. For example, although the number of work assignments defined in the project 1308 was half of the work assignments defined in the project 1307 both projects had a similar project quality.

Regarding the teamwork competence (Fig. 5 and Fig. 6), it is highly related to both the effort ratio (correlation equal to 0.78) and the size of the project team (correlation equal to 0.85). These results illustrate how the teamwork feeling increases as the estimated effort was close to the actual effort (Fig. 5). The same feeling was identified taking into account the size of the project team (Fig. 6).

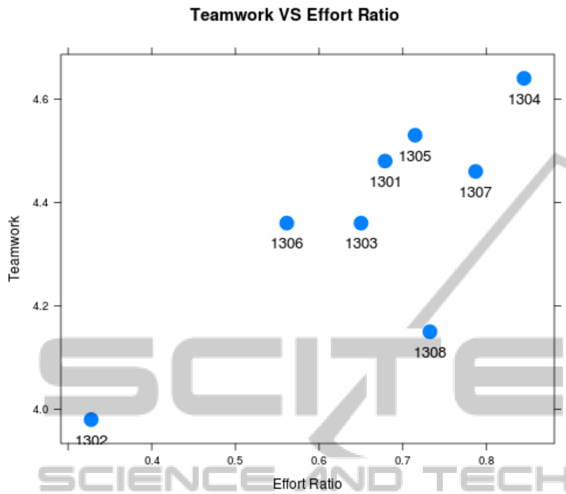

Figure 5: Relationship between teamwork competence and effort ratio.

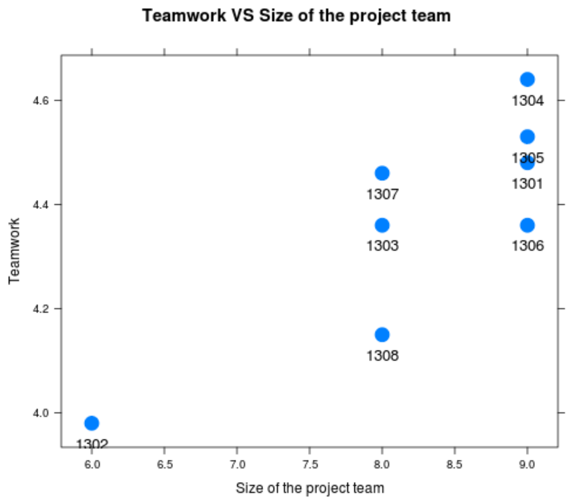

Figure 6: Relationship between teamwork competence and size of the project team.

5 CONCLUSIONS

This paper has presented an integrated framework that allows competence assessment in project management by putting it into practice in a simulation environment. The system is distinguished by the assessment of individual competences by means of a set of performance indicators. The indicators are obtained from both analytical evidence and the opinions of other participants in the simulation in relation to the skills demonstrated by the candidate's specific actions. Furthermore, the system allows obtaining information about the level of demonstrated competences not by the measurement of individual knowledge, but as the result of their use in a simulation environment.

An analysis of the PM's exhibited competences demonstrated the relationship between some transversal ('human') competences and the project success. In the academic course analysed, the strongest relationship was found between results orientation and project success, whereas teamwork did not seem to be correlated with the project quality. The authors attribute the lowest relationship between teamwork and project success to the lower number of pieces of evidence used to assess this competence.

Another interesting result is the strong relationship found between leadership, engagement & motivation and results orientation. Taking into account that these competences were evaluated at the same time by means of the same form, it seems that each assessor used a global opinion about the assessed person to fill out the form. That is, no distinction between these competences was made.

For the future authors look to improve the assessment of these competences by using more pieces of evidence. Furthermore, authors will extend the number of competences assessed by the presented framework as well as to use the collected data for early detection of problems inside the project, and to improve the learning procedure by means of the gathered data.

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