

TEACHING STUDENTS IN PROJECT MANAGEMENT – A SURVEY FROM A PROJECT SEMESTER

Katharina HELTEN¹, Miriam SPILLMANN¹ Duygu BRANDSTETTER², Udo LINDEMANN¹

¹Institute of Product Development, Technische Universität München, Munich

²Center of Social Skills and Management Trainings, Technische Universität München, Munich

ABSTRACT

At most universities, the curriculum of mechanical engineering still focuses on teaching “hard” subjects such as mechanics, material sciences etc., even if soft skills as well as process knowledge become increasingly important in industry. In 1996, the TUM Munich therefore established a tutor system. The participating tutors run through a special coaching and one leads a group of approx. twelve tutees afterwards. During the first semester the groups meet weekly to get both input from the tutor about specific soft skills aspects, and to prepare presentations by themselves and to participate in didactic exercises. In the second semester the tutees take part in a team project of about ten weeks in that they are asked to design a small technical system. They face some constraints (e.g. money), but mostly choose their procedure on their own. For most of the tutees it is the first time they take part in a “professional” team work. By observing the students during their project semester, this paper analyses to which extent the tutees are aware of the importance and the elements of project management, and apply them in practice. Main aspects of the analysis are the general project characteristics, the project run, the project organization and human factors. Based on the observation several suggestions are made to improve the current tutor system.

Keywords: Project management, design education, Tutorensystem Garching, student team project

1 INTRODUCTION

The ability to manage projects efficiently becomes more and more important [1]. Universities therefore need to offer appropriate courses to teach the required competences. So far education mostly bases on frontal lessons and exercises, only rarely student projects are integrated. If specialized in this field, some institutes offer lectures about project management (PM). But the competences and main elements of project management are seldom combined with technical tasks that would give the students the possibility to practice PM. Therefore the TUM Munich has initiated 15 years back a program that is meant to teach often cited soft skills to students of different ages in form of a tutorial system – the Tutorensystem Garching. Within this program, the students get coached in terms of important soft skill aspects such as communication, presentation and time- and self-management. Prepared with these competences, they take part in a team project during the second semester, see section 2.1.

The presented research wants to analyze to which extent the project itself is representative for the industrial requirements of PM, and to which extent the students apply the knowledge about soft skills and PM during the second semester.

2 STATE OF THE ART

2.1 Tutorensystem Garching

Founded in 1996, the Tutorensystem Garching trains students in social and methodical competences, apart from the technical expertise they gain in the traditional curriculum. Approx. 15 students of advanced semesters (tutors) are responsible for a group of approx. twelve first year students (tutees), see figure 1. The program takes one year, divided into one semester of training and one project semester. The tutors are coached by trainers and supported by research assistants. They learn in seminars about skills such as communication, presentation, self- and time-management. During the

first semester they teach the tutees specific soft skills aspects in a weekly tutor lesson. Apart from getting lectures, the tutees have to prepare certain topics by themselves and participate in didactic exercises in these lessons [2] [3].

During both semesters the tutors experience PM automatically since they have to manage small “projects” by themselves, e.g. planning of the team project, doing marketing activities and organizing a lecture series. The project semester is organized as a contest. All teams have to deliver a design that fits the same problem definition. The project takes about ten weeks. The teams can spend a limited amount of money and must manage their (working) resources and competences. They can ask for support in the workshops of the faculty. The tutees have to organize themselves as a team, i.e. the tutor is no longer the “leader” of the group. The group itself names project and team leaders as well as other positions before the project. In the year the paper refers to the students had to design small traction engines that competed against each other.

With respect to the research about PM in this paper, it has to be emphasized that the students are trained and sensitized for necessary skills in the first semester. In contrast, engineers in industry normally do not get such an introduction before starting a project. Also the teams have the possibility to come together as a team for a long period without time pressure. Therefore it is assumed that they are relatively highly sensitive towards soft skills.

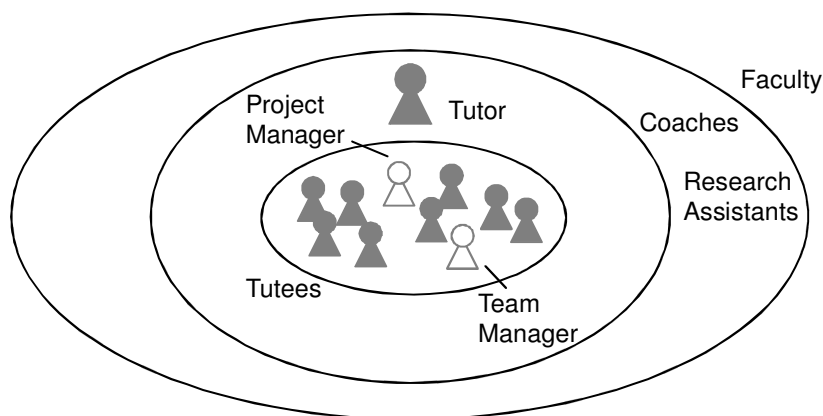


Figure 1. Scheme of the Tutorensystem Garching

2.2 Project management

Due to an increasing number of projects in industry, PM and efficient processes become more and more important. According to Madaus [1] the generation and the practice of better management concepts is essential to assure competitiveness on national and international markets. A project is characterized by its uniqueness and its novelty. The novelty requires an interdisciplinary team, specifically composed for this purpose. The conditions and the tasks are single and specific with defined targets in terms of time, money, and men power. PM tempts to decrease the risks and uncertainties by an appropriate planning, organizing, executing, controlling, and closing of the project [1], [4], [5], [6], [7].

2.3 Project management education

The challenge of universities is how to teach PM under study conditions. Ojiako et al. [8] state that apart from the classification of important elements to teach, the design and the way of delivery of the contents need a discussion. In a survey they asked students of a PM module to assess their experiences. The related questionnaire includes aspects such as critical thinking, self-management of time, communication and interpersonal skills. Their results underline the absence of softer parameters in actual PM education concepts. The authors e.g. propose to allow more project-based modules. An example of a train-the-trainer approach is given by Stoyan [9]. In a program called “PM for allTM” students do the full teaching of previously selected topics. Part of the course is roll games and group work as well as a small project. The ongoing question is whether universities must prepare students by teaching different methods, or whether it is more important to sharpen their minds for processes and challenges in industry [10]. Altogether most literature focuses on teaching PM in study modules of the same, but do not indicate how to combine its elements with the traditional curriculum and its subjects to get a higher sensitivity towards the importance of PM in different areas.

3 SURVEY APPROACH

The teaching of soft skills and the evaluation of its success cannot be assessed through exams and questionnaires. The development and the application of these skills must be observed “in practice” under real conditions. For this purpose two competing student teams of almost the same size (11-12 tutees) are selected by coincidence. They are observed during their team meetings, i.e. noting the project status as well as comments. Moreover, they are asked to share their virtual communication with the authors. Hence a qualitative method is applied, based on social research. The aim is to get a qualitative understanding of the team and project work. It is of utmost importance that the teams do not get disrupted by the survey and have no advantages or disadvantages.

PM is slightly addressed in the context of different topics during the first semester. But the Tutorensystem is mainly associated with the teaching of soft skills. The tutees are only basically informed about the focus of the analysis to learn more about what they understand and actively integrate in the project semester.

4 RESULTS FROM THE SURVEY

4.1 Characteristics of project management

The student project matches with the main characteristics of a project. The duration of the contest is limited to approximately ten weeks. Moreover, the students only have limited resources at their disposal. The amount of spent money must not exceed 150 Euro and finally the team composition and therefore the working capacity are fixed. The contest rules offer clear targets at the beginning and the contest is realized only once in this way. In contrast to the definition of a project, there is no interdisciplinary work since the contest is only accessible for mechanical engineering students. Contrary to project teams in industry, the team is sampled long before, without taking into account the challenges of the later contest. I.e. their individual competences are not considered for the selection. Although the team in a whole is formed by coincidence, the team members name people’s responsibilities by themselves before the project semester. I.e. the members have in mind the performance and the capabilities of other members when they vote for certain persons.

4.2 Run of the project

The project is started by a project purchaser, in this case the faculty. The tutors generate the framework of the whole contest. This includes the general idea and especially the formulation of the rules. The contest goals can be assessed as “smart” (specific, measurable, attainable, realistic, timely). Nevertheless, the different team members have different goals for the project. Interestingly, the members do hardly communicate these goals and do not transform the officially formulated goals in terms of contest rules into their own ones. Therefore they are hardly able to judge whether the project is finished with respect to the contents. Missing is also the formulation of a team mission as well as an agreement on the way of working together.

The project gets only partly planned in terms of time and resources. Some teams do at least a time planning, but do not strictly follow their own plan. The seldom observed time planning of the projects is accompanied by no control of the current status. Hence the teams realize late or never whether their time management is sufficient – whether they need to speed up or whether they could use saved time for other tasks. A reason might be that they do not realize the contest as a project, e.g. because it is a relatively small task. Possibly they start already with a rough project plan that later fails, because they cannot estimate the duration of the tasks. This could lead to first disappointments with respect to the plan. Altogether it seems that they do not monitor appropriately the project status, including the shifting of capacities.

In addition to the time and their working resources, the teams have to calculate their expenses and keep in mind the maximum limit. In contrast to industrial projects they only have to consider the material costs since their men power is not charged. The missing sensibility towards cost limits is shown by the fact that some teams compensate their exceeded costs by external money what is not possible in real projects.

Even if the evaluation of the product for the first time is said to be attractive for engineers, the testing phase is not planned and integrated by the groups. The tutees have an immense faith in their designs. It shows that (at the beginning of their studies) students have no idea about the importance of this phase

in industry. For companies it is a crucial phase that need to be run appropriately, e.g. to avoid failures at the customer. Especially safety related questions are seldom addressed by the teams.

Some of the contest rules change during the project time. The observation of the teams shows that the tutees are in general not very well informed about the current status, in some cases at least the project leaders do. When misunderstandings appear during some of the meetings, it seems as if sticking to the rules is nothing the students presume of such importance that an immediate clarification is needed. Moreover, they rarely take the chance to clarify questions within the surgeries the tutors offer. Hence it does not become clear during the project that requirements or the like change during the design phase and need to be integrated.

The teams do not or hardly know about the designs the competing teams have chosen. Some of the teams are quite surprised about the possible designs at the contest itself. This observation is related to the fact that the students do not analyze the “market” appropriately. An initial good idea is followed without taking into account other mechanisms or variants. Existing products are not sufficiently assessed, e.g. by disassemble them to understand the underlying principle. It seems as if the students do not learn so far how important the analysis of design alternatives and the understanding of existing products are for further developments. The evaluation and selection process is not executed systematically and without referring to certain criteria. Rarely the teams argue with the contest rules as limiting factors. Although they have a final presentation, they do not have to show the product to a “customer” and sell it, or to justify their decision and the final outcome in front of a steering committee. This is a difference to industrial projects. The teams do not have to fear further consequences such as losing jobs or market share.

The contest itself represents kind of a “sub-end”. Afterwards the students have to deliver a report about their work before getting the credits. They cannot experience the day of the contest as the final. Only some of the teams do meet afterwards to “finalize” the project. Some of them reflect the project run. If the documentation was required already for the day of the contest, they could end with the project more clearly. Currently the project ends with the delivery of the final report what the tutees mainly sense as documentation. The tutees seem to be not aware of its importance, especially in forms of showing the current project status and working forms. In future, generic forms and templates could be provided to sensitize.

4.3 Project organization

The faculty as well as the program (especially the tutors) can be considered as the line organization. The teams themselves are project organized because they do not have further duties within the system, i.e. to work for the faculty. But they have to attend lectures and seminars. Similar to industry several tasks need to be done at the same time, e.g. lectures, exercises and seminars. During the project they can use their competences and improve them at the same time. The students learn to manage their own time, for the “project” and the “line”. It needs further investigations whether this experience helps to better manage tasks during their further studies.

The team responsibilities are named or elected before, at least the positions of project and team leaders. As shown above the team is not composed with respect to certain competences. In contrast to industry, the team had the chance to decide on these responsibilities. Since the students have no idea about project structures in industry, they do not see the need for further responsibilities and the specification of certain positions. The project also shows that several persons take over some tasks if they feel that the assigned person is not performing well.

Even if the position of a team and project leader is established within all teams, their tasks seem not to be clear. In contrast to industry, the leaders did not have to argue or motivate for the given tasks. As in industry, some resources are fixed, and others need to be organized (rooms, workshop). In all teams the project leader moderates the meetings, and some of them feel responsible for time schedule and costs. Some project leaders care for the delivery of all mails to the members, or for the complete information on an online platform. Interestingly no discussions about the leaders’ competences arise. Most of them are involved a lot in the design work, and probably had time problems or problems to act as a neutral moderator. Moreover, the elected leaders might bring important competences with them, but they hardly have more experiences in project leading as other team members.

4.4 Human factors within the project

As shown above, the tutees only partly integrate the contents they learned during the first semester (about self- and time-management, moderation and presentation, etc.). E.g. the team meetings are moderated mostly by the same person (project leader) and focus on organizational issues. Rarely an agenda is used - a topic that is clearly addressed during the first semester and trained by all of the team members. Also addressed is the ability to give feedback and to self-reflect. The students do not assess their team performance and problems. At maximum one team states that the roles within the team have changed during the project.

The teams show a cross-linked communication, i.e. every member communicates with everyone. But this leads to communication problems, especially since they did not agree on communication rules (also addressed in the first semester), and the discussions are often not moderated.

During the project both extrinsic and intrinsic motivation are addressed. The students are extrinsically motivated by the credits they get, but are also intrinsically highly motivated by the challenging task and the team work.

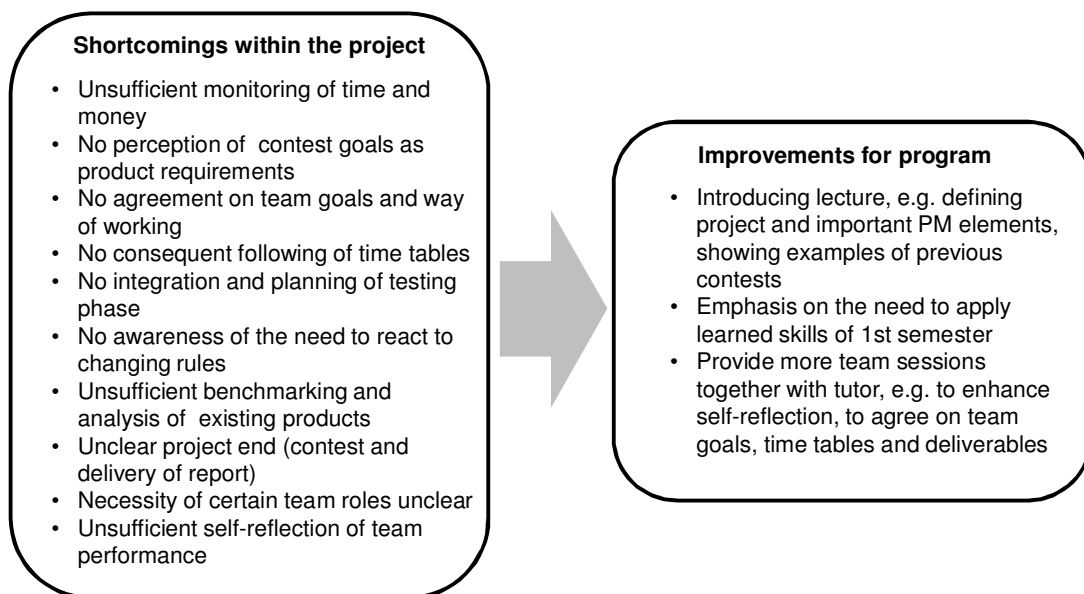


Figure 2. Overview of shortcomings and improvements for the program with respect to PM

4.5 Implications for further improvements

It seems to be necessary to emphasize the need to apply the knowledge of the first semester during the second one. The tutor could be more involved as an observer during some of the meetings in order to give a feedback on the work. The tutor could also moderate a discussion in that the tutees have to reflect and conclude about their behavior. They could commit to certain aspects they would like to improve for the rest of the project and results they want to achieve. Such sessions would underline the importance of self-reflection. Or the tutees should hand over a project plan to the tutor as if s/he was a customer. This would sensitize for the aspects time, costs and resources. If the students knew about important roles within a project they would probably select differently.

In preparation for this the faculty needs to prepare a short introducing lecture about PM. Necessary theory can be linked to the subjects of the first semester and to design examples of previous years. I.e. the level of complexity needs to be similar to the current tasks to show the need of certain steps already within small projects. The lecture will give insights in important key competences and responsibilities related to PM.

The lectures and the preparation need to cover the topic of documentation. The final reports so far show that several groups have not understood the structure of a project. They need to be aware of the problems an insufficient documentation will cause. Especially design ideas and their evaluation need to be comprehensible even after the project.

The faculty of electrical engineering offers a similar program. In future both could be combined to create a more interdisciplinary context. This would show the students the challenges of different backgrounds in diverse project teams.

5 SUMMARY AND OUTLOOK

In order to teach students the increasingly important competences of soft skills, the Tutorenprogramm Garching was established. Through the course of one year students are taught specific aspects of soft skills and have to apply them in a team project. This paper analyzes to which extent the project is representing important elements of project management. Main characteristics could be proven, such as the uniqueness of the project, the limited resources and a defined schedule. Moreover, the authors examined to what extent the students apply the soft skills and related knowledge about project management within the project. Main shortcomings could be shown, e.g. the students do not monitor sufficiently the run of the project in terms of money and time. Moreover, they tend to underestimate the importance of the contest rules as requirements and do not agree on own goals. Further they analyze insufficiently the market and existing products. Initial ideas are not examined in detail to have further improvements. The teams do not integrate a testing phase, a crucial phase for industrial development projects. Team roles need to be clarified and the level of self-reflection needs to be increased.

To further improve the program the organizers need to emphasize that the soft skills coaching of the first semester is essential for the project and should be integrated and experienced as much as possible. The tutor could attend more meetings to moderate self-reflection phases, to answer questions related to project management and to motivate the students to agree on dates, goals, etc. In addition, an introducing lecture should be designed that gives a short overview of important PM elements by means of examples from former years.

REFERENCES

- [1] Madaus, B.J. *Handbuch Projektmanagement - mit Handlungsanleitungen für Industriebetriebe, Unternehmensberater und Behörden*. (Schäffer-Poeschel Verlag, Stuttgart, 2008).
- [2] Baumberger, G.C. and Lindemann, U. Skilling engineering students softly: a review on the education program "Tutorensystem Garching". *International Engineering and Product Design Education Conference Delft*, Netherlands, 2004).
- [3] Nißl, A., Ponn, J. and Lindemann, U. The Tutorensystem Garching: Education on social competences for engineering students. *International Conference on Engineering Design ICED05 Melbourne*, Australia, 2005).
- [4] Bea, F.X., Scheurer, S. and Hesselmann, S. *Projektmanagement*. (Lucius&Lucius, Stuttgart, 2008).
- [5] DIN69901. *Projektmanagement - Projektmanagementsysteme*. (Beuth, Berlin, 2009).
- [6] Lock, D. *Project Management*. (Gower Publishing Limited, Aldershot, 2007).
- [7] Mantel, S.J., Meredith, J.R., Shafer, S.M. and Sutton, M.M. *Project Management in Practice*. (John Wiley&Sons, Hoboken, NJ, 2007).
- [8] Ojiako, U., Ashleigh, M., Chipulu, M. and Maguire, S. Learning and teaching challenges in project management. *International Journal of Project Management*, 2011, 29, pp. 268-278.
- [9] Stoyan, R. "PM for all" - Intensive small group teaching in leadership and PM, for many students at low cost. *International Journal of Project Management*, 2008, 26, pp. 297-303.
- [10] Woodward, J.F. Project management education - levels of understanding and misunderstanding. *International Journal of Project Management*, 1983, 1(3), pp. 173-178.