PROJECT TIME BOXING AND MILESTONES AS DRIVERS FOR OPEN DESIGN PROJECTS

Christian TOLLESTRUP
Aalborg University, Department of Architecture, Design & Media Technology

ABSTRACT
The Curriculums and programs in Problem Based Learning (PBL) utilizes the project-format in a team based setting for rehearsing the competencies of applying the design-oriented skills and knowledge learned in courses and workshops. If the project period is self-organised, there is a tendency to start out with low speed and push the workload forward because the deadline is far out in the future. When approaching deadline the workload intensity increase creating an asymmetric effort over the project period (9-11 weeks).
So how can we create a sense of urgency in longer project periods, not just workshop format, that would help a team of design students to engage and drive the project from the start to achieve more and get further in developing their projects? - Without interfering with the content and development of the project it self, but helping the team to move forward and become focused in their project development. This paper discusses the effect from students participating in a time-boxed project module with five milestones for 2nd.MSc semester in an Industrial Design Engineering program. The semester evaluation, the process reports and supervisor perspective is very positive and that the structure, strict enforcement and rolling project management responsibility in a group work setting really helps them drive the project forward with high motivation. The main challenge lies in the balance between loading the teams with too many challenges and just providing them with enough structure to create the sense of urgency that fuels motivation and sparks ideas.

Keywords: Milestones, time boxing, sense of urgency, open projects.

1 INTRODUCTION

Design processes can be difficult to navigate and manage due to their complexity [1], unpredictability and open ends [2] If the design engineering problem is more open, the ill-defined nature of the wicked problem [3] will also add the difficulty of planning activities and creating the drive and sense of direction needed, especially in the early phases of innovation and product development – as engineers sometimes refer to as fuzzy front end [3].
In an educational setting where many of the prerequisites, expectations and conditions from the real world are suspended, it can be very hard for a group of students to push hard and work dedicated from the very beginning of the project period. There can be a tendency to push the workload forward because there ‘is plenty of time’ and they may not have developed and scoped the project yet, creating a fuzzy perception of what they are doing. This general phenomenon of postponing the work of a study until deadline is closing in is called procrastination [4] and is not exclusive to group based project work at universities. But open theme projects where students have to frame and define their project on their own and the fuzziness in beginning of the design and development process contributes to the lack of factors pushing the group.
Brainstorming and ideation sessions in a workshop setting use the mechanisms of time boxing to create a sense of urgency that may spark creativity and speed up the process ([5]. The time framing adds pressure in the sense that the participants must perform at this instant. At the same time the limited time allows for participants to just let go and focus on the task at hand, because of the facilitated format where ‘disturbances’ are eliminated. If successful the state of creative flow is achieved [6].
But in longer projects (10-20 weeks) the workshop format is not sufficient to support the development process. So when graduate design engineering students are to learn and demonstrate how navigate and manage their own projects, how can we support their process without taking control of their projects?

In the Industrial Design Engineering curriculum of a Problem Based Learning (PBL) University the 2nd.MSc. project period has been redesigned after a curriculum revision in 2012 and has served as basis for testing new large-scale time boxing with six milestones in a 10-11 week project period (15 ECTS). At this stage in the Master program part of the learning objectives is that the students demonstrates the ability to plan, execute and reflect on the design process with a very high degree of interdependence, including researching, scoping and defining their own project focus and content within very broad theme.
At the same time the project period is relatively short, the project topic and approach is open and complex with a need for rapid development, test and decision and evaluation in a high pace if an acceptable result is to bee achieved.
This paper outlines the project management tools, process, intermediate deadlines and explicit expectations that have been implemented in order to achieve the needed propulsion and drive in the project groups from the beginning of the project period and maintain the sense of urgency throughout the project period.

2 METHODS

The project period is broken down into six phases that follow a prediction of the expected process, following the key learning objectives for the project module. The students need to demonstrate the navigate and execute a rapid design and development process where they elicit and identify user needs and transform these into a market description, from which potential key stakeholders can be identified and a design brief created. A concept for a coherent solution is developed, and key aspects are developed further in details including manufacturing, construction and production aspects, always with a clear link to the essential insight into the user needs.
The forecast is contradictory to the unpredictable nature of an open-ended process with multiple iteration, thus it only serves as a guideline, not a strict and fixed format. The content of a Milestone that describes the expected outcome and current state of the knowledge build in the project at the current stage. The project is pitched and presented at the end of each phase.

2.1 Milestone structure

The Milestones (see Table 1) are not meant as fixed goals and the only scope the project group should work on in the phase. There are a couple of important additions; firstly the project groups are encouraged to work ahead, or at least take future Milestone content into consideration for the current phase. Secondly project groups are encouraged to start the ideation from the beginning of the project period to avoid an exclusively analytical approach, but maintaining the abductive reasoning characteristic for Design Thinking [7].
That means that the project group can be working in parallel with content designated for several Milestones during a phase, which also naturally occur at any iteration that involves content from previous phases.
The time allocated for the six Milestones phases are not the same. In first three Milestones are only one week each with the intention to both set a fast pace from the beginning and the fact that a five days work period is easier to overview and break down than two-three weeks. It also provides a faster framing and scoping of the project since the first three Milestones are closely related to the contextual setting and objectives for the project. To some extent the idea of having deliverables in sprints from SCRUM [6] and focus on task break down is transferred to the larger project scale with the Milestone content and presentation as the deliverable.

2.2 Presentations

Each Milestone ends with a presentation session where all groups present their project status. This is not new in it self within the Industrial Design Engineering curriculum, where midterm status seminars have been implemented from the beginning in 1997 when the program began.
In an attempt to increase the pressure, and thus sense of urgency, several new initiatives are implemented. Firstly, the responsibility of the presentation is rotates in the group, so only one person gives the presentation for each Milestone. Secondly senior students, guest professors, alumni, etc. are invited to the sessions to give feedback. Having new people in the audience each time means that the group cannot rely on the audience to ‘know’ their project in advance, thus the presentation much be accumulative and represent the project at the given stage.

Students are asked to divide their presentation time into two separate sections. They are given three to five minutes for a pitch, with the focus on 'selling' the idea and convincing the audience that their project is relevant, interesting and worthwhile pursuing.

Table 1. Overview of Milestones

Milestone	Content	Time available
One	***Client & Need*** Identification of user-organization or representative (the Client) and description thereof. Identification, description and verification of needs (think observations, interview, research-data, etc.)	One week
Two	***Market and Business Concept*** Business plan to broaden from specific need to general market need (this includes development budget and target prices). Market description (size, type, segmentation, etc.) Sales and marketing strategy – light reflections on where and how to sell and market the to-be-proposed product/service.	One week
Three	***Organisation and Design Brief*** Proposed solution for network and /or organization of the solution (actor-network and for services also service map or offering map – see Servicedesigntools.org for inspiration) Design Brief as basis for product/service design concept phase. Must include target production cost/unit.	One week
Four	***Product/Service concept*** Overall concept description/visualization Highlighted features, functions, aspects that meet the needs and demands from design brief. Main challenges in production and manufacturing (product parts) and main challenges in implementation (service part).	Two weeks
Five	***Details*** Detailed exemplary dives into several aspects such as (choice depending on solution, and should be argued): construction, production, technology (template for this may be used), assembly, form, operations (e.g. buttons/dials), use of product, etc. Key chosen aspects should be supported by exemplary calculations, experiments/models and analysis of these.	Two weeks
Six	***Handing in reports*** Clear summarized description of proposed solution linking exemplary dives goes into the Product Report and the highlighted process description with main investigation, development and reflections goes into the Process Report	One to one and half weeks

The underlying principle being that there is no point in having great ideas if you cannot convince other people (potential investors, stakeholder or your manager) that it is interesting and worth pursuing.
The second section of the presentation is a project status, where the focus shifts to process, methods, current challenges and future actions. The underlying principle being that the project group needs feedback and advice on their approach to the project.

3 ANALYSIS

Looking at the level of procrastination it is experienced as significantly less than previous semester projects, but a direct comparison is difficult to make, since the project theme and approach vary. But there are three different sources of data to allow for some comparison to the experienced difference when comparing this five tight defined Milestone & Pitch structure with a 'normal' two to three status seminar structure used on other semesters in the Program. First interviewing the Supervisors, second source is the official Semester evaluation and third source is the reflection chapters in the Process reports by the Project groups.

3.1 Supervisors experience: faster framing and longer in the process

Since 2012 a total of four supervisors has been involved in executing the project module, with one supervisor acting as co-supervisor for all groups. This supervisor is also involved in numerous other programs and can therefore compare this project module to other modules also operating with Milestones-like seminars. In a direct comparison to a project module in an Entrepreneurial Engineering Masters program with only three and more loosely defined Milestones he describes the difference in the following way.
One of the main differences is the strict enforcement of the tight schedule with high pace and high expectations. This effect is evident in the precision of their description of their project during the Milestone presentations and the work they do from the beginning of the project. They simply get further in the development process. (Rephrasing of Poul Kyvsgaards statement during Milestone at Entrepreneurial Engineering, December 2014).
As another supervisor points out the short deadlines between the first three Milestones forces a faster framing of the project, including the opportunity to reframe. (Louise Møller, February 2015).
So seen from supervisors' point of view the Milestone and time-boxing is forcing a faster framing of the project and allows for the group to get further in the development process compared to previous projects.

3.2 Students direct evaluation: pace & challenge

The student steering committee and the main coordinator do an official semester evaluation after each semester. This includes evaluation of course modules, physical setup and the project module. Looking at the comments regarding the project module in 2012, 2013 and 2014 provide a relatively coherent feedback from the students on the structure of the Milestone as a mean to improve the pace in the design process.

- *"Milestone, important exercise. Good with many Milestones" (2012)*
- *"The push which the supervisors have given have really had a great impact on the process" (2013)*
- *"Length of the milestones have worked great" (2013)*
- *"A very good structure - A nice change and challenge - Good with the milestones, pushing you forward", "It has been stressful, but it was nice to challenged." (2014)*
- *"The project period has been really exciting and the milestone structure has been super motivating"(2014)*

In these evaluations the main feedback themes are on the structure and pace provided by the Milestone structure and content and the challenge of the Pitch presentations done by the Project manager.

3.3 Process reports demonstrate better process understanding and management

During the three seasons several projects have been forced to make significant changes or complete new problem statements (Problem Based Learning context) during the projects. Most of them have done so within the first two Milestones (representing two weeks), when the presentations at the Milestones did not convince the audience of the relevance of the need or the approach to solving it. An example of this is the Aphear project from 2013 [8], where the group started out with the scope of

addressing the need for consuming less water. After the second Milestone where the group was not able to frame the need in a relevant setting where they could engage the problem from a design angle they completely changed the project in phase 3 and achieved a very fast turnaround catching up with the other teams at Milestone three (see Figure 1). This was partly due to the group already knowing the approach from the previous two weeks, but also because they were already working at a high pace, not postponing the workload.

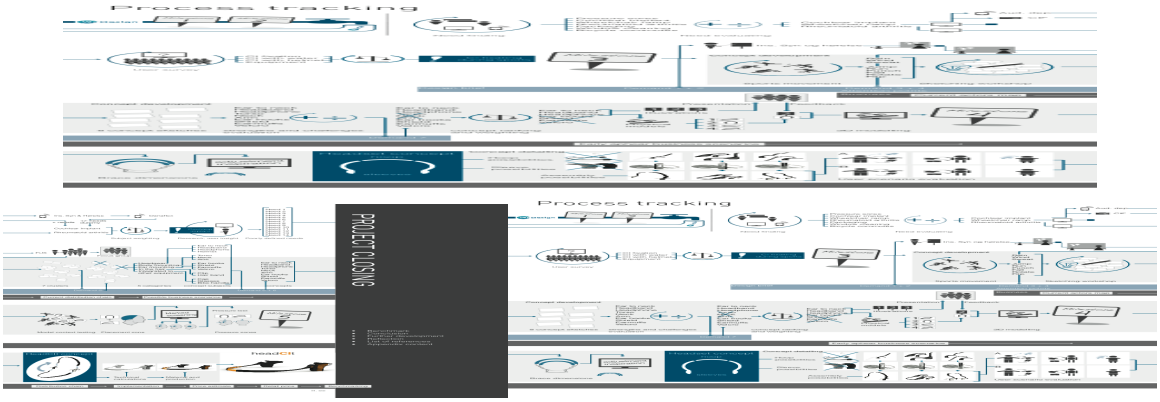

Figure 1. Process illustration from Aphear project Milestone one to three

In another project the group describes the experience of the Milestone structure and the relation to the fuzziness in this way:

"As the project started out with a bracelet monitor and ended with an alarm system, the group has gone through a lot of different features and functions to either aid the design, product or the business model [….] Amongst the group it has become clearer to spot when the process is slowing down and the passion for the project is dissolving and how to steer clear of these situations.

It has also been useful to complete the assignment of project managers as well as being responsible of presenting the project each milestone. This has returned both practice in presentation skills as well as confidence and a higher level of ownership and insights in the project and solutions" (Group Five, 2014)

It also indicates that they have gained a greater understanding and awareness of maintain pace and energy in the project. Furthermore the rotating role of presenting at the Milestone seminars also seems to have increased their individual sense of ownership.

However not all groups have taken ownership of the content needed to be filled into the Milestone structure as Group Two states in their process report in 2014 [9]:

"They have functioned as a good guideline, but as a planning tool, they have not functioned optimally during this project."

Thus indicating that the structure might set a stage and an incentive for pushing forward in the project, but it does not provide enough in terms of planning.

"The intention of integrating SCRUM might have worked better if the project manager (scrum master) had not been exchanged every milestones, due to their individual way of managing the project. It requires a lot of resources to integrate a new method into the project work and as the project came closer to the end, the method was pushed aside." [10]

This indicates that the rolling role of project manager and presenter at the Milestone, not only allows the individual members to increase ownership, but it also creates variance and unevenness in the way the project is managed.

4 DISCUSSION

Even with an almost entirely positive feedback from supervisors and students, there are some interesting parameters to continue experimenting with and some key unresolved issues. First of all there is the balance between pushing and pulling the students forward to avoid procrastination, one aspect of this is the balance between control over the project and supporting the group, another is the balance between encouragement and high standards that challenges students performance level.

The balance between controlling the design process on behalf of the groups (pull) and supporting them through structure, frames and intermediate deliverables must be related to the learning objectives for

the project module (push). The students at 2nd M.Sc level must be able to navigate a design process by choosing the appropriate methods and procedures and reflecting on their outcome and relevance to the problem. This is means that the specific approach and choice of methods, decision and evaluation on project content and direction is the group responsibility with the presentations for new audiences at the Milestone seminars provides the group with a possibility to make a reality check on their own assumptions without supervisors' interference. So far the project module has been executed with a very clear distinction regarding the responsibility and ownership of the project content and specific approach being the group's responsibility. This mainly pull approach with supervisors exercising a 'hands-off- principle will not change due to the learning objectives.

The other aspect of balancing encouragement with high explicit expectation to performance on both process management, presentations and pitch and developing new innovative solutions with a sound business perspective. This balance is more fluent and more difficult to manage explicitly and there is a risk of creating too much tension between the current state of students' capability and expectation of future state. So far this gap has not been too big as the evaluation and feedback shows. As an example of the gap is the case of only single group member at each Milestone is giving the presentation provokes a lot of anxiety, but as feedback and reflections in the reports shows the experience both instills confidence and allows all group members to take ownership of the project. The encouragement is provided in the form of supervision that focuses on supporting the student to make decisions, but not specifying which decisions to make.

5 CONCLUSION

Setting Milestones in a project is not new in it self, but a combination of a rigor strict enforcement, rolling project management with one person in charge (in a group work environment) and face pace with short time between content driven Milestones and including an accumulative Pitch session provides an effect on the projects and their management.

Supervisors see the effect on the faster framing of project and thus the possibility to develop the proposals further into detail having more time allocated for this part. The students acknowledge that they are challenged individually as project managers to define tasks, methods and procedures that will allow them to achieve the goals for next Milestone, but it enhances their design project management skills and reflection level.

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