

Pre-study report

Complexity in Engineering R&D Projects

By: Giedre Pigagaite,

Pedro Pablo Silva

Supervisor: Bassam Hussein

Faculty of Engineering Science and Technology

Department of Production and Quality Engineering

NTNU, 2013

Table of contents:

1. Background	3
2. Problem description.....	3
3. Project objectives and scope.....	4
4. Methodology	4
5. Gantt Chart	6
6. Key references	7

Background

Project complexity has been shown to be an illusive subject throughout the years, with many authors like Baccarini (1996), Williams (1999), Geraldi and Adlbrecht (2007), etc. adding new concepts or even redefining the concept. Our previous work tried to consolidate this knowledge and help project managers out there deal with complexity in their projects. The insight gained by dividing complexity into elements (project characteristics that make it complex) and situations (arising from the elements add extra complexity to the project) seems to be very helpful for practitioners trying to deal with complexity. However, the findings still seem to be very general and it is hard, so far, to link them with a specific industry. Projects of engineering R&D are an example of project type that is greatly influenced by complexity. For starters, they are usually very large projects, interconnected with several departments or even companies; which will certainly contribute to the structural type of complexity. Also, they deal with the development of new solutions and products, which is always a bit of a step into the unknown; which makes these projects have a large amount of uncertainty. Both these elements give rise to situations that will make these projects even more complex and have a higher failure rate, however they also are what we have studied closely in our previous work. The knowledge of handling complex situations can be linked with this specific kind of industry, and through this work gain a better insight into how project managers in these type of projects can handle complexity better, leading to better results from them.

Problem description

The framework developed in our previous work allowed us to get a better understanding of how to handle certain situations that arise from specific elements of project complexity. Our results mainly point that to handle higher structural complexity (many interrelated parts) you need a better integration of the project team, and that to handle uncertainty generated situations flexibility and team cohesiveness are necessary. However, these findings are still very general and would need to be more closely applied into a single industry for them to start working in practice.

The engineering R&D industry is the target industry that was chosen for this master thesis, mainly because projects in this type of industry would tend to present high structural complexity and high uncertainty, making it a perfect candidate to apply our previous knowledge. However, much needs to be learned about this industry, which should firstly begin with a small literature review that will let us know what kind of problems and barriers are usually encountered in the industry, and how complexity is contributing to them. Also, there is much to find out about the life cycle of these projects, and the kind of specific situations which would arise in each part of it. This is the basic knowledge to be gotten before we can start applying our concepts into the engineering R&D projects.

With an insight into how these projects work we will move on to the empirical research, which will be the largest part of this work. For this, two companies have been already secured for interviewing: Autronika, and Kongesberg Defense and Aerospace. However, we would like to get a few more interviews in the same industry, to further increase our research samples. The insights we will get from the interviews will let us know specific examples of

situations given for different projects, and what the project managers were able —or not able— to do about it; in a way, how complexity was handled without any specific knowledge about it. Analyzing this information and combining it with our previous knowledge, will let us come up with the theories that will help practitioners handle complex situations in these type of projects. Also, having already known how to handle the situations, it will also be possible to find out what kind of competences a project manager will need to have in order to successfully manage projects in the engineering R&D industry.

Project objectives and scope

The purpose of this thesis can be divided into three parts:

- First of all, to identify elements in engineering R&D projects.
- Secondly, identify, classify and analyze complex situations that arise from these elements.
- Thirdly, identify the type of competences needed to manage these complex situations in each step of the project life cycle, and what is the role of the project manager in this process.

Methodology

The methodology we will follow to write this master thesis is going to be based on the theoretical background which was developed in our previous work. We built up our framework on how to deal with complex situations based on the literature from 2002-2012. For this report the first step is a literature review about engineering R&D projects, in order to acquire more knowledge about them. After this we will identify the elements of these type of projects and their life cycle. The second part of the project work will be an empirical study — by means of face to face interviews— of companies involved in these kind of projects. With the information gathered in the empirical research, the final analysis, and cross-referencing can be made, and so the report —with its conclusions— finalized.

Pre-study report:

- Analysis of our work task content and where our new knowledge has to be gained.
- A description of the work packages which we are performing now, and which we will perform in the future to be able to accomplish the task.
- A time schedule for the project (see the paragraph “Gantt Chart”)

Literature review:

Literature selection: Selection of articles from 1990 to 2012 about engineering R&D projects. We will use a couple of articles from previous work about project complexity, and the missing information we will cover with new ones.

Literature reading: We are going to read around 50-60 articles, to see what an engineering R&D project entails, and how they are to deal with complex situations.

Literature analysis: We will analyze the information we have gathered through the reading. Focusing on the new knowledge gained and what is particular about engineering R&D projects. Also, we will try to see where the most complex situations in these projects lie.

Mid-term report: Progress report, we are going to present our work and explain deviations if they will arise in our work.

Case study: To compare the literature with real life cases, we are going to interview engineering R&D project companies.

Making questionnaire: We will prepare specific questions for our interviewee, and make sure the interview can extract all the relevant information we need.

Research of the case companies: Before meeting our case companies we are going to gather information about them, to get a better idea about their companies and what kind of product they are delivering.

Interview of engineering R&D companies: We will interview project managers and people who have a large influence in the project result. We will always be aiming at extracting the information of why the situations are so complex and what it depends on.

Analyzing information: We will see how valuable the information is for us, and what connection it has to the literature, and our previous work.

Master Thesis writing:

Literature review writing: Gathered literature information writing and grouping, in the way it will be in the final work.

Case study writing: After analyzing data from the interviews we will present it in our work, in the way it will be in the final work.

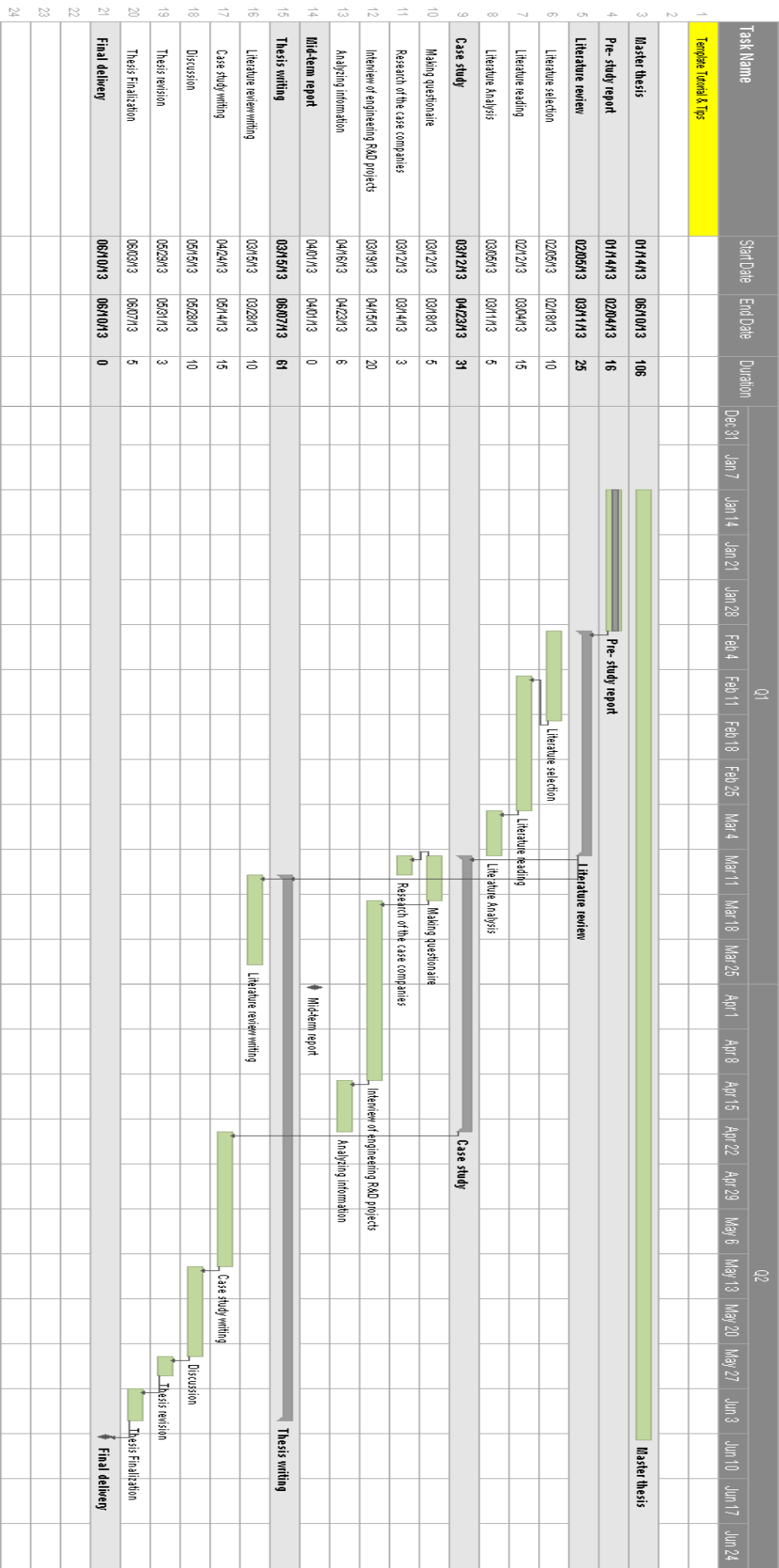
Discussion: Comparing literature and case study together, writing summaries about results and reaching conclusions of the work.

Thesis revision: Analyzing the written work. Reviewing possible mistakes and detailing what can be improved, and what can be maintained. Discussing final changes with our supervisor.

Thesis finalization: Making all the final corrections based on Thesis revision. Making sure all the data and information (annexes, etc.) are in the report before delivery.

Final deliver: delivering hard copy for evaluation.

Gantt Chart



Key references

1. Baccarini, D. (1996) 'The concept of project complexity — a review', *International Journal of Project Management*, Vol.14, No. 4, pp. 201-204.
2. Bosch-Rekveltdt, M., Jongkind, Y., Mooi, H., Bakker, H., Verbraeck, A. (2010) 'Grasping project complexity in large engineering projects: The TOE (Technical, Organizational and Environmental) framework', *International Journal of Project Management*, Vol. 29, pp. 728-739.
3. Chronéer, D. and Bergquist, B. (2012) 'Managerial Complexity in Process Industrial R&D projects: A Swedish Study', *Project Management Journal*, Vol. 43, No 2, pp. 21-36.
4. Duimering, R., Ran, B., Derbentseva, N. and Poile, C. (2006) 'The effects of ambiguity on project task structure in new product development', *Knowledge and Process Management*, Vol. 13, No 4, pp. 239-251.
5. Geraldi, J. & Adlbrecht, G. (2007) 'On faith, fact and interaction in projects', *Project Management Journal*, Vol.38, No1, pp. 32 -43.
6. Geraldi, J., Maylor, H. and Williams, T. (2011) 'Now, let's make it really complex (complicated) — A systematic review of the complexities of projects', *International Journal of Operations and Production Management*, Vol.31, No 9, pp. 966-990.
7. Gul, S. and Khan, S. (2011) 'Revisiting Project Complexity: Towards a Comprehensive Model of Project Complexity', *2nd. International Conference on Construction and project Management*, Singapore, IACSIT Press, pp. 148- 155.
8. Hussein, B. (2012) 'An empirical investigation of project complexity from the perspective of a project practitioner', *Proceedings of IWAMA- The second International workshop of advanced Manufacturing and Automation*, edited, pp. 335-342, Tapir AkademiskForlag.

9. Kim, J. and Wilemon, D. (2007) 'The learning organization as facilitator of complex NPD projects', *Creativity and Innovation Management*, Vol. 16, No 2, pp. 176-191.
10. Remington, K., Zolin, R. and Turner, R. (2009) 'A model of project complexity: distinguishing dimensions of complexity from severity', *In: Proceedings of the 9th International Research Network of Project Management Conference*, Berlin, IRNOP,
11. Söderlund, J. (2002) 'Managing complex development projects: arenas, knowledge processes and time', *R&D Management*, Vol. 32, No. 5, pp. 419-430.
12. Tatikonda, M. V. and Rosenthal, S. R. (2000) 'Technology Novelty, Project Complexity, and Product Development project Execution Success: A Deeper Look at Task Uncertainty in product Innovation', *IEEE Transactions on engineering management*, Vol. 47, No. 1, pp. 74-87.
13. Williams, T. M. (1999) 'The need for new paradigms for complex projects', *International Journal of Project Management*, Vol. 17, No. 5, pp. 269-273.
14. Xia, W. and Lee, G. (2004) 'Grasping the complexity of IS development projects', *Communications of the ACM*, Vol. 47, No. 5, pp. 69-74.