MANG 3023 Project Management Assignment

Thomas J. Smith

MEng Electronic Engineering with Power Systems
University of Southampton

February 25, 2013

Project Management - "An endeavour in which human, material and financial resources are organised in a novel way, to undertake a unique scope of work of given specification, within constraints of cost and time, so as to achieve unitary, beneficial change, through the delivery of quantified and qualitative objectives." (Turner, 1992)

1 Introduction to Project Management

The overarching management of a project is integral to the successful completion of project goals. Various management tools are available to promote success throughout the four discrete project lifecycle phases; Plan, Implement, Monitor and Control (Stainton, 2012b). This enables the project goals to be completed within the constraints of time, cost and scope, usually referred to as the Iron Triangle (Chatfield and Johnson, 2007). This essay considers how success can be achieved during each of the project lifecycle stages.

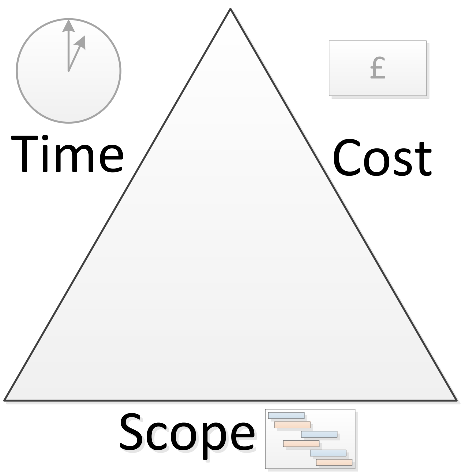

Figure 1: Iron Triangle of project constraints (Chatfield and Johnson, 2007)

2 Planning Phase

A project management plan brings together all of the plans for a project, and provides a baseline for the ensuing project phases (APM, 2006). During the planning stage, the project constraints must be balanced carefully.

2.1 Scope

To plan the scope of a project, the needs of the stakeholder must be identified and documented. This information can be used to construct a work breakdown structure, a deliverable-oriented hierarchical decomposition of the work to be executed (PMI, 2008), as shown in Figure 2. A work breakdown structure should contain 100% of the work required to complete the project (PMI, 2008). The concept has been well proven in many projects since its inception in 1959 (Haugan, 2002), and provides a concise overview of the scope of the project.

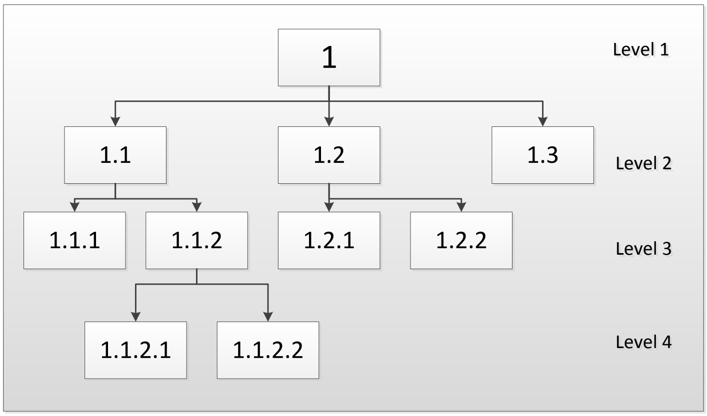

Figure 2: An example Hierachical Decomposition (APM, 2006)

2.2 Time and Scheduling

Once the scope is defined, a schedule can be developed by sequencing tasks, identifying dependencies and assigning realistic staffing targets (APM, 2006). There are many software tools available to automate this process, including Microsoft Project (Figure 3) and Primavera P6, which automate the process of producing Gantt charts, PERT charts and staffing allocations.

2.3 Cost and Reconciliation

Once the ideal scope of the project has been defined, there is a process of compromise to satisfy time and cost restraints. If the cost restraint is rigid, then it may be necessary to narrow the scope, or to extend the project schedule. Alternatively if the project is time critical, then higher capital will be required in order to complete the scope of work on time. These are described pictorially in Figure 4. It is this balance that must be found during the planning stage.

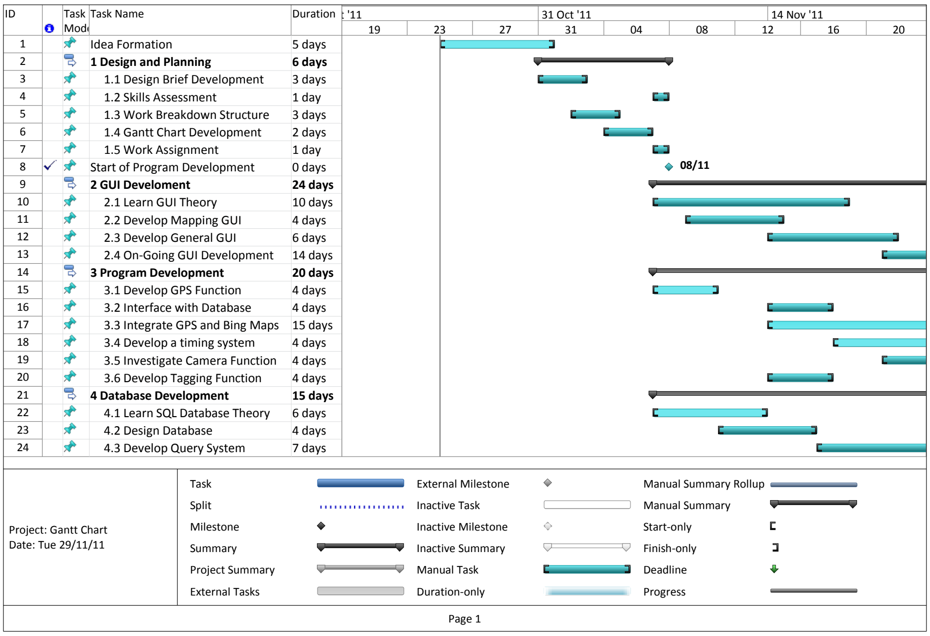

Figure 3: Extract of a Gantt Chart produced in Microsoft Project 2010 for a university software development project

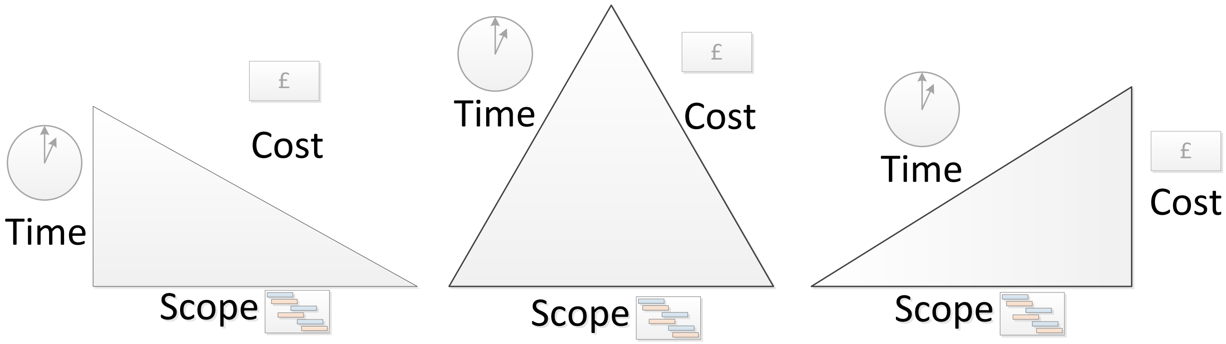

Figure 4: Weighted Iron Triangles

2.4 Practical Considerations

The importance of the planning phase is illustrated by the Mars Orbiter Project (Appendix A). The NASA philosophy of "Faster, Better, Cheaper" led to a great efficiency increase (Stainton, 2012a). However, many of the recommendations made by the Mishap Investigation Board (1999) could have been captured had the project management plan included a greater scope for specification definition and for testing. The Iron Triangle had been squeezed to breaking point, the time and cost constraints were not balanced in order to achieve an appropriate quality in the scope of work required. A full discussion is in Appendix A.

3 Project Execution (Implement, Monitor and Control)

3.1 Implement

Executing a project is far more than implementing the project management plan developed in the planning phase. A repeating cycle of implementation, monitor and control often takes place until project completion (PMI, 2008). The cycle is made up of an implementation phase, where the planned project activities are undertaken according to the project management plan. Consideration of the Iron Triangle should be minimal during this stage, since adequate consideration during planning leads to smooth implementation.

3.2 Monitor

However, projects do not always go to plan (Chapman and Ward, 2003). A perpetual appraisal of progress against the project objectives constitutes the monitor phase. Monitoring the project is important, as there may be unforeseen circumstances, such as delay in equipment availability, mechanical breakdowns, widening of project scope or a sudden budget change.

3.3 Control

When a deviation from the project management plan is identified, the control phase can be entered. Controlling the project enables the manager to maximise the opportunity or mitigate the risk (APM, 2006) posed by fluid circumstances in order to meet the constraints of cost, scope and time. The constraints can be altered in order to take account of the change in circumstance, and the project resumes, re-entering the implement phase, as illustrated in Figure 5.

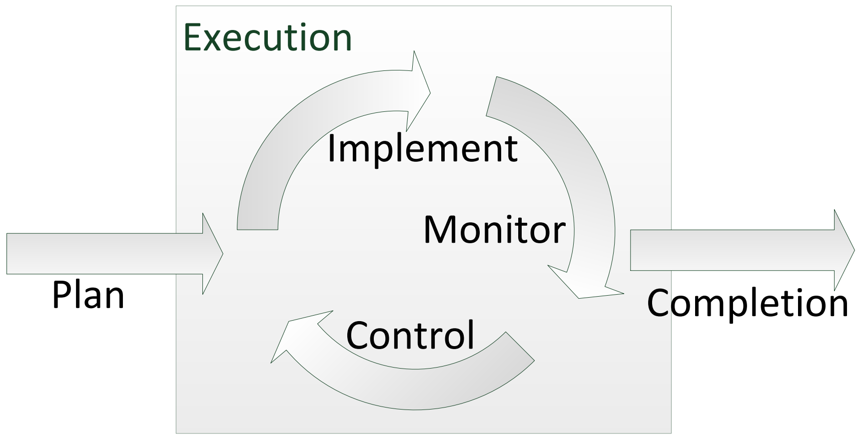

Figure 5: Project execution cycle (PMI, 2008)

3.4 Management Tools

Risk registers are extensively used for monitoring and controlling projects. A risk is defined by the PMI (2008) as an uncertain event or condition that, if it occurs, has a positive or negative effect on a project objective. Firstly, project risks must be identified. Chapman and Ward (2003) suggest the six Ws framework (who, why, what, whichway, wherewithal, when) as a starting point to identify project risks. Once a risk is identified, the threat or opportunity posed by the risk is calculated quantitatively using a probability impact matrix (Kendrick, 2009). A strategy to account for the risk is then proposed. The strategy may make steps to mitigate the threat caused by a negative risk, for example by hiring extra plant equipment to allow for breakdowns, or to maximise the opportunity posed by a positive risk, such as early planning permission being granted. The risk threat can then be reassessed. A current risk register enables effective monitoring and control of a project.

Thomas Smith
Third Year Project - Sensor Fusion in Lego Mindstorms Robots
Risk Register

				Pre Mitigation Assessment				Post Mitigation Assessment		
Date	Impact Type	Risk Title	Description	Probability	Impact	PI Rating	Mitigation Strategy	Probability2	Impact2	PI Rating2
25/06/12	Schedule and Quality	Limited Theoretical Knowledge	I currently have limited subject knowledge, I do not know enough about the subject to set a design brief. If the theory is very advanced, I may have to build up some more preliminary background knowledge about general control subjects. This will take up valuable time, and if I still can't grasp the concepts then my project will be technically poor	Very High	High	Very High Threat	•Start preliminary research immediately •Read previous dissertations for more insight in to the subject area •Ask supervisor about subject as they are a subject matter expert. Can he highlight some key subjects? •Read around the subject generally •Research the resource available in the library	Low	Medium	Low Threat

Figure 6: Excerpt from Third Year Project Risk Register

Thomas Smith
Third Year Project - Sensor Fusion in Lego Mindstorms Robots
Risk Probability Impact Matrix (PIM)

Threat Impact Levels	Threat Probability Ratings					Impact Type	
	Very Low (<10%)	Low (10% to 30%)	Medium (30% to 60%)	High (60% to 80%)	Very High (>80%)	Schedule	Quality
Very High Threat	16	24	40	56	72	>20 Week Delay	Functionality cannot be achieved
High Threat	12	18	30	42	54	13-20 Week Delay	Only basic functionality can be achieved
Medium Threat	6	9	15	21	27	8-12 Week Delay	Basic functionality can be achieved with few additional features
Low Threat	4	6	10	14	18	3-7 Week Delay	Some additional features are ommitted
Very Low Threat	2	3	5	7	9	< 3 Week Delay	Some additional features may not be fully finctional

PIM Ratings				
Very High Threat	High Threat	Medium Threat	Low Threat	Very Low Threat

25/06/12 The probability impact matrix has been recalibrated for third year project work

Figure 7: Probability Impact Matrix from Third Year Project.

3.5 Practical Considerations

A university project (Appendix B) I undertook succeeded due to the use of the management tools discussed in this essay. In this project the time constraint was fixed to two weeks, and the cost constraint fixed to £50. During the planning stage, the scope was to use a camera as an image processing tool, and act upon this input. However, as the project entered the execution cycle, it became clear that the scope may be too wide for such a time frame. To control this risk, a deadline was put in place, that if no significant progress was made with the camera within a week, alternative methods would be used. Fortunately, this implement, monitor and control process paid off, as the camera proved impossible to use, and my team had a head start in developing alternatives leading to winning the task.

4 Conclusions

Project managers have a difficult job. When challenged with reconciling the project constraints of time, cost and scope throughout the project lifecycle, it is inevitable that there will be some degree of deviation from the initial plan. However, using some of the tools described in this essay, and learning from the mistakes and successes of others, project managers can ensure that their projects are successful.

> *"Operations keeps the lights on, strategy provides a light at the end of the tunnel, but project management is the train engine that moves the organization forward."* - Joy Gumz

References

APM (2006). *APM Body of Knowledge Fifth Edition*. Association for Project Management.

BBC (1999). Confusion leads to mars failure. `http://news.bbc.co.uk/1/hi/sci/tech/462264.stm`.

Chapman, C. and Ward, S. (2003). *Project Risk management: Processes, Techniques and Insights*. John Wiley and Sons Ltd.

Chatfield, C. and Johnson, T. (2007). *A Short Course in Project Management*. Microsoft.

Gross, R. (2001). Faster, better, cheaper: Policy, strategic planning, and human resource alignment audit report.

Haugan, G. (2002). *Effective Work Breakdown Structures*. The Project Management Essential Ibrary Series. Management Concepts.

Kendrick, T. (2009). *Identifying and Managing Project Risk: Essential Tools for Failure-Proofing Your Project*. AMACOM.

Mishap Investigation Board (1999). *Mars Climate Orbiter: Phase I Report*. NASA.

PMI (2008). *A Guide to the Project Management Body of Knowledge (PMBOK Guide) Fourth Edition*. Project Management Institute.

Stainton, A. (2012a). Failure of the mars climate orbiter project (extracts from a report by nasa, 1999). University of Southampton Lecture Notes MANG3023 Management II.

Stainton, A. (2012b). Management 2 for engineers. University of Southampton Lecture Notes MANG3023 Management II.

Turner, J. R. (1992). *The Handbook of Project Based Management: Leading Strategic Change in Organizations*. McGraw-Hill Professional.

Appendices

A Mars Climate Orbiter Project

A.1 Project Overview

The Mars Surveyor Program started in 1993 as a series of missions to explore Mars. The Mars Climate Orbiter project was the second mission, commissioned in 1995 for launch in 1998. The launch took place on 11th December 1998 from Cape Canaveral, Florida (Stainton, 2012a). Space craft systems had been performing normally up until 23rd September 1999, when discrepancies between navigation systems were noticed. These discrepancies were never resolved. The mission continued, and signal was lost from the spacecraft after it entered the Martian atmosphere at a miscalculated trajectory (Mishap Investigation Board, 1999). It was shown by the Mishap Investigation Board (1999) that the root cause of incident was the use of imperial units in trajectory models instead of the expected metric units, causing calculations to be out by a factor of 4.45 (Mishap Investigation Board, 1999).

A.2 Project Management Reflections

Dr Edward Weiler, NASAs Associate Administrator for Space Science at the time commented that “the problem here was not the error, it was the failure of NASAs systems engineering, and the checks and balances in our processes to detect the error. Thats why we lost the spacecraft.” (BBC, 1999). In 1992, NASA attempted to change the way project managers think and do business by building a Faster, Better, Cheaper culture (Gross, 2001). While this is widely attributed to cost savings (Stainton, 2012a), NASA commissioned a report in 1999 after the failure of four missions using this philosophy (Gross, 2001).

Clearly there were some major organisational and cultural issues that were the root cause of the failure. During the planning phase, a culture of faster, better, cheaper leads to underestimation of timing estimates, the procurement of cheaper parts or contractors, and minimisation of the scope of work related to testing and evaluation. Systems were not setup in order to ensure quality standards were met between different contractors (Mishap Investigation Board, 1999) and hence the error was never found until after the incident happened.

The execution of the project was also flawed, as effective monitoring processes were not put in place. Had the project managers performed a thorough risk analysis, it is entirely possible to recognise there may have been issues integrating the different modules, especially considering the contractors were from different nationalities using different units as standard. A clear specification stage was required before the contractor started work, and a clear testing process was required once the work was completed. However, no such controlling processes were implemented. An effective execution cycle should identify issues such as this in order to ensure the project succeeds.

A.3 Conclusions

The project management tools and ideas discussed in this essay could have enabled NASA to avoid some of the mission failures that have been attributed to the faster, better, cheaper culture. While project management tools such as risk management and work breakdown structure sometimes seem an unnecessary burden to an organisation striving for efficiency, the likelihood of pushing the iron triangle of constraints too far becomes much greater with a mismanaged project.

B D4 University Project

B.1 Project Overview

The D4 project is undertaken during the second year of the electronic engineering course at the University of Southampton. It is widely regarded as the toughest challenge throughout the whole degree course. This year the challenge was to build autonomous football playing robots from scratch. The time and cost constraints of the project are fixed, two weeks with six people in each team and a budget of 50. The scope was narrowed to several key specification areas, although it was left to each individual team to decide how best to achieve and exceed the specification parameters in order to win the task.

B.2 Planning

The plan phase for this task was difficult, since the team had very little knowledge. The team had never worked together before, so a skills audit was performed to ascertain who would be best at each potential task. A work breakdown structure was drafted. It was difficult to ensure the work breakdown structure covered 100% of the work to do, since we had little technical experience. A rudimentary schedule was built from this, however it was mostly best guesses as to how long each activity would take. It did enable the identification of key tasks to complete, and when they would need to be completed by to finish the project on time. A risk register was started to identify, monitor and control project risks. Since there was a large uncertainty in the plan, it was wise to set this up early to react best to unexpected circumstances.

B.3 Execution

The execution of the project began, and the implement, monitor and control cycle was repeated extensively throughout the project. As the team learnt more about the technical aspects of the project the direction of the project took shape, and implementation began in earnest. It was critical to balance the amount of work spent on each aspect of the project, due to the limited time, in order to maximise the scope of work achieved.

As progress was made, it became clear that a critical component of the system, the camera module, was not as easy to work with as first thought. Poor quality schematics and example code, along with hardware defects made progress very slow. This was picked up in the monitoring phase of the risk register. To control this risk, a deadline was proposed approximately half way through the task that if no significant progress were made, then development of alternative methods should begin.

As this deadline passed, the critical decision to start alternative development started. The team started looking at technology such as infrared range finders, and light sensors. As the project drew towards completion, it became clear that this was the right decision. Other competing teams had continued to attempt to get the camera to work but to no avail. Hence, my team has several days head start in development of alternative methods. This led to our robot being one of the most functional, and although it could not play football properly, it still achieved much of the specification. This led to our team being the overall winners of the challenge.

B.4 Conclusions

Technically, this project was hugely demanding. The scope of work completed within the fixed time and cost constraints were commendable. However, it is down to the implement, monitor and control cycle that took place throughout the execution phase that led to the ultimate success. The importance of a risk monitoring process was illustrated. Project management techniques discussed in this essay are applicable in major infrastructure projects such as the Bosphorus Straits tunnel project, large investment technical projects such as the Mars Orbiter Project, and small university projects such as this.