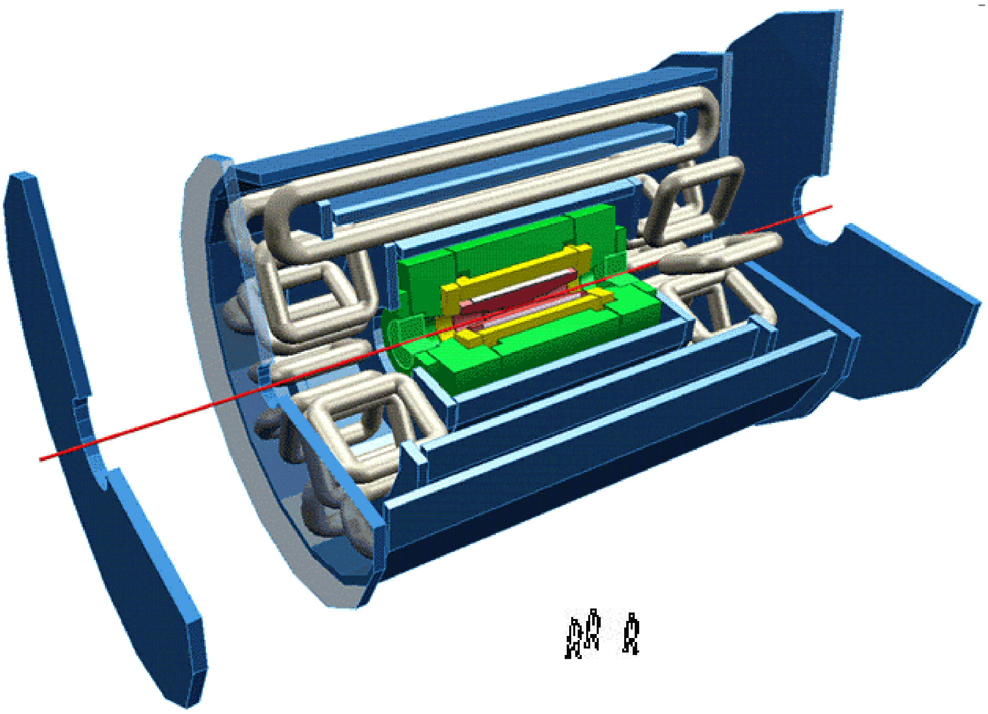
Schedule Management In Globally Distributed Project Environment



Diploma Thesis

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Preface

This report is the final documentation of my diploma thesis work. After four years of studies and exams, a major project work is demanded to complete the degree of "Sivilingeniør" (which is similar to the Master of Science degree) at The Norwegian University of Science and Technology, (NTNU).

The work has been carried out at CERN, The European Laboratory of Particle Physics, from March to September 1998.

My department, Department of Production and Quality Engineering is a part of the Faculty of Mechanical Engineering. My work is related to the research program "Prosjektstyring år 2000" (Project Management year 2000).

I would like to thank my supervisors Ari-Pekka Hameri and Gerard Bachy at CERN and Asbjørn Rolstadås at NTNU for help during the whole thesis work. I would also like to mention Halvard Kilde, which was the main link between my department at NTNU and CERN in the beginning. In addition I would like to thank these persons for help, encouragement and co-operation during all ups and downs in this period:

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The community on the balcony between tower C and D in building 40 ☺

Finally I would like to thank CERN for financial support during this thesis.

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English Summary

At CERN, European Laboratory for Particle Physics a large project is underway, this includes a new particle collider called Large Hadron Collider (LHC) associated with 4 new particle detectors. One of them is the ATLAS detector. This detector is going to be eight storeys high. The building of such a detector requires new or improved technologies and collaboration between 1700 scientists and engineers at 150 institutes in 33 countries. This is a huge project both scientific and engineering

Such a large scale, distributed project creates many challenges for the project management. One of them is the schedule management and another is the project follow-up.

This report focuses on schedule management and follow-up systems for the ATLAS project. It gives an overview of the complicated environment of the ATLAS project. Common procedures are suggested for creating schedules and a template for MS-Project is being presented. The template has been implemented in all ten systems (sub-projects) of the ATLAS project. The report also focuses on the need for links between the schedules from each system and the master schedule. Without this link the management of the schedules would be cumbersome and unreliable.

A follow-up system based on milestones has been developed and implemented. The follow-up system is using MS-Project, Excel and e-mail as main tools. In addition a system for work package management is described. The work package management system will, when implemented properly give ATLAS a planning and follow-up tool for the work packages. Data from the system can be used to create up-to-date schedules in addition to progress and status reports.

Key points for both schedule management and follow up of large scale, distributed projects are the need for strong co-ordination together with delegation of responsibilities of control to the systems (sub-projects).

Norwegian Summary

Ved CERN, European Laboratory for Particle Physics, skal det bygges en ny partikkel-akselerator. Den skal være ferdig i juli år 2005. Dette er et stort prosjekt, både når det gjelder teknologi og vitenskap. For å kjøre eksperiment og analysere data behøves det to nye detektorer. En av dem er ATLAS detektoren. Denne detektoren vil, når den er ferdig, være 9 etasjer høy og de innerste sensorene vil bestå av omkring 10,000,000,000 transistorer. Byggingen av detektoren krever ny eller forbedret teknologi og den krever også samarbeid 1700 mellom forskere og ingeniører ved 150 forsknings institutt I 33 land.

Et stort, distribuert prosjekt som ATLAS prosjektet gir store utfordringer til prosjektledelsen. En av dem er tidsstyring og en annen stor utfordring er oppfølging hvor tidsstyring bør være en del av oppfølgingen.

Denne rapporten fokuserer på tidsstyring og oppfølgings systemer for ATLAS prosjektet. Rapporten gir en oversikt over ATLAS prosjektets komplisert miljø. Felles prosedyrer blir foreslått for hvordan utarbeide tidsplaner og en template for MS-Project blir presentert. Templaten har blitt implementert i alle de ti systemene (del-prosjekter) I ATLAS. Rapporten fokuserer også på behovet for å koble tidsplanene for de ti systemene til hoved-tidsplanen (the master schedule). Uten denne koblingen blir styringen av tidsplanene vanskelig.

Et oppfølgingssystem basert på milepæler har blitt utviklet og implementert. Oppfølgingssystemet bruker MS-Project, Excel og e-mail som verktøy. I tillegg blir ett system for styring av arbeidspakker beskrevet. Dette systemet vil, når det er implementert, gi ATLAS et planleggings og oppfølgingsverktøy for arbeidspakker. Data fra dette systemet kan også brukes til å lage oppdaterte tidsplaner i tillegg til framdrifts- og statusrapporter.

Hovedpunkter for både tidsstyring og oppfølging av store, distribuerte prosjekter er behovet for koordinering i tillegg til delegering av ansvar for kontroll av prosjekter nedover i hierarkiet.

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INTRODUCTION

About CERN

CERN (Conseil Europeen pour la Recherche Nucleaire) was one of the first European organisations created after World War II and has served as a model for similar joint ventures. It was established in 1954. The aim of CERN is to study the nature and structure of matter. The CERN experiments are also designed to give a better understanding of the behaviour of matter, i.e. the interactions between the different components of matter. The branch of physics incorporating this type of fundamental research is called "particle physics".

In July 2005 a new particle collider at CERN is going to be finished. The new accelerator is the Large Hadron Collider (LHC). It will be built in the existing 27 km long circular tunnel that today hosts the present accelerator, called LEP (Large Electron Positron collider), see Figure 1. For the new accelerator four new detectors are planned; the ATLAS-detector (A Toroidal LHC ApparatuS), the CMS-detector (Compact Muon Solenoid), ALICE (A Large Ion Collider Experiment – Heavy Ion at LHC) and the LHC-b (Large Hadron Collider- B-meson). The ATLAS detector is going to be five storeys high (24 meters) yet able to measure particle tracks to a precision of 30 microns. The building of the detector requires new or improved technologies and collaboration between scientists and engineers all over the world. In total there are 1700 physicist in 150 institutes and universities in 33 countries collaborating to build the detector.

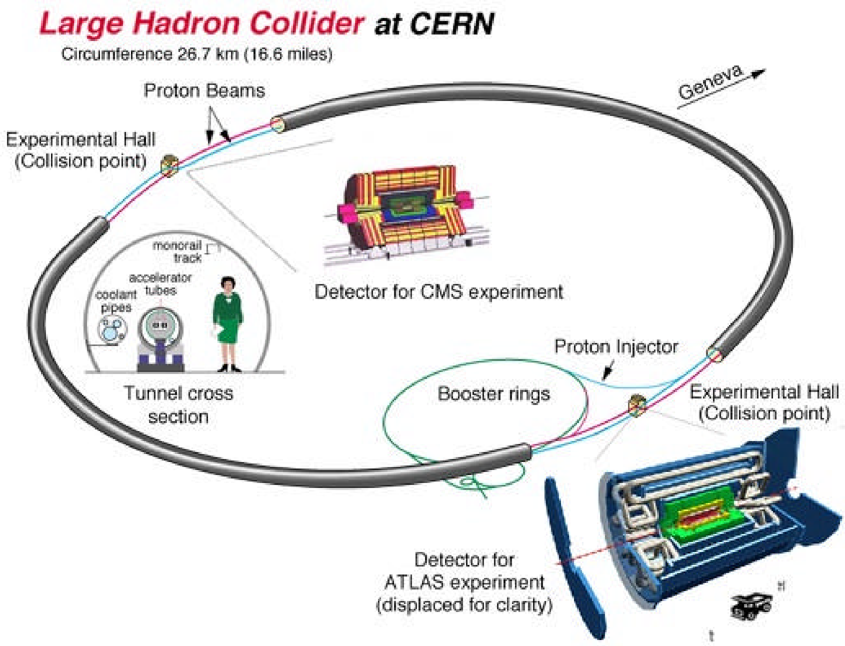

Figure 1 Overview of LHC with its detectors

Scope of the report

The ATLAS-project is globally distributed with its systems and sub-systems scattered all over the world from Japan to Sweden. This means there are several challenges for the project management to work with. One of them is scheduling. This report will focus on schedule management and the follow up of the project.

The report will not go into the technical details nor the tools related to the product itself. The report will not investigate the finance part of the project in detail, because of out of scope for the thesis.

Variance between predefined objectives and actual objectives in report

This report is the final documentation of a diploma thesis. The objectives of the thesis were meant to be the following:

- Develop standard procedures concerning scheduling to be used by the various systems
- Establish the necessary links between the System summary schedules and the Master Schedule. This should include all the filtering process to compress the information from the systems into a relevant and necessary information at the Master level.
- Further automate and develop this process and related tools from the user point of view.

The first task is solved. Task two is partly solved, but the linking of the schedules has yet to be done. Task three has not been accomplished due to the fact that part two was not fully accomplished. The reasons for why the tasks have not been accomplished, are presented below.

The linking of the schedules are only possible if the schedules on the system level are standardised. This work took more time than planned. Due to the prolonged time it took to standardise the system schedules, it was not enough time to link the schedules. At the same time as the schedules were standardised a follow-up procedure were made This was a slight change of scope of the predefined tasks. However, the change is so much linked to the original tasks, that a change of the official papers where not needed. A follow up system is very much linked to schedule management because of the update of schedules that has to be made during a projects lifecycle. The work with the follow-up system took time and also limited the time available to create the link between the system summary schedules and the master schedule.

This leads to a set of new objectives which are stated below:

- Develop standard procedures concerning scheduling to be used by the various systems
- Develop system for schedule follow-up

The layout of the report

Chapter 1 gives an introduction to CERN and the ATLAS project. It also defines the scope of the report. Finally it explains the gaps between the tasks defined in the task-definition given by the Department of Production and Quality Engineering.

Chapter 2 gives and overview of theory existing today about project management with a special focus on planning, scheduling and follow-up. The last chapter has been dedicated to a model for scheduling and follow-up in a large scale and distributed project.

Chapter 3 presents the project management in ATLAS. The first part gives an overview of the Quality Assurance Policy (QAP) of the ATLAS project, that is how the project in general should be run. Then the reality of the project is presented and discussed. Finally there is a discussion on how the ATLAS project is being run.

Chapter 4 presents and discusses a follow-up system based on milestones developed during the thesis.

Chapter 5 presents and discusses a Work Package Management System.

Chapter 6 is devoted to the final discussion and conclusions. In addition, recommendations for further work are stated here.

THEORY

Projects have been with us since before the days of the great pyramids. Today projects are used to solve tasks of varying size, importance and criticality. The tools and methods are basically the same for all projects, but to what extent and how elaborate the methods should be, is decided by the size and complexity of the project.

Project Management

According to Rolstadås (1997), a project has these characteristics:

- It is a unique task which is performed once
- It is performed to make a unique product (merchandise or service)
- A project can be divided into a collection of tasks where each has a responsible organisational unit
- The project require resources
- There are limitations concerning cost and time for the carrying out of the project

From these characteristics Rolstadås (1997) has deducted a definition of what a project is:

> *"A project is an effort which is characterised as a one-time job with a given goal and restricted extent and which is accomplished within a time- and cost-framework"*

There exist several definitions, but J.M. Juran (1989) probably has the shortest:

> *"A project is a problem scheduled for solution".*

This definition emphasises the problem-solving nature of project business in general: once the problem objective is defined then the most prominent solution or work plan is allocated according to predefined time constraints. By adding to this definition the prefixed budget, a temporarily mantled project organisation, a minimum of a decades duration, a technologically non-trivial nature, a global industrial and public collaboration you get the main features of a large scale project (Hameri, 1997).

All definitions of projects emphasise the uniqueness of the tasks performed in the project and that there is a temporary organisation and there exists time limits and cost limits. To sum up one can define a project as a one-time activity with well-defined set of desired end results (Meredith and Mantel, 1989).

Further in this chapter different theories about project management in general will be presented. Further in the chapter the focus will be on the scheduling and control-processes.

Finally a model for how distributed projects should be organised concerning planning, scheduling and control will be presented.

Project attributes

In addition to the projects characteristics, projects are also said to have certain attributes (see Figure 2).

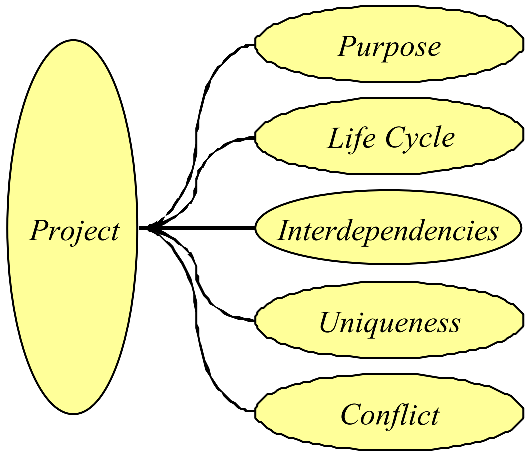

Figure 2 Project attributes (based on Meredith and Mantel, 1989)

A project has to have a purpose. The project has usually a well-defined set of goals that has to be met before closing down. Like organic entities, projects have life cycles. In the beginning the activity is low and slow. During the life of the project the activity increases and reaches a peak before it declines and dies out at the end of the project. Projects often interact with other projects being carried out by their parent organisations. The projects share resources and are interdependent of each other. Still, all projects are unique in some way or the other. Especially R&D (Research & Development) projects have a unique character. Each project needs customisation and a project manager must master management of exception. The last attribute of a project is conflicts. There are several levels of conflicts in a project. A project manager has to compete with the functional departments to get the right people to work for his/hers project. The project resources are almost always scarce and the project manager has to decide which part of the project should be prioritised at what time. Moreover, the project members have to relate to two managers. The project leader, which demands as much work as you can do in no time and the manager in the functional department, which demands that you have to do the daily work as usual.

Project processes and project phases

PMI (1996) claims that projects are composed of different processes. There are two major categories; project management processes and product oriented processes. The first are concerned with organising and describing the work of the project and the other are concerned with specifying and creating the project product. The process groups are linked by the result they produce – the result or outcome of one becomes an input to another (PMI, 1996). The project management processes can be organised into five groups of one or more processes each as shown in Figure 3. Although the figure is drawn with discrete processes, in an actual project there will be many overlaps.

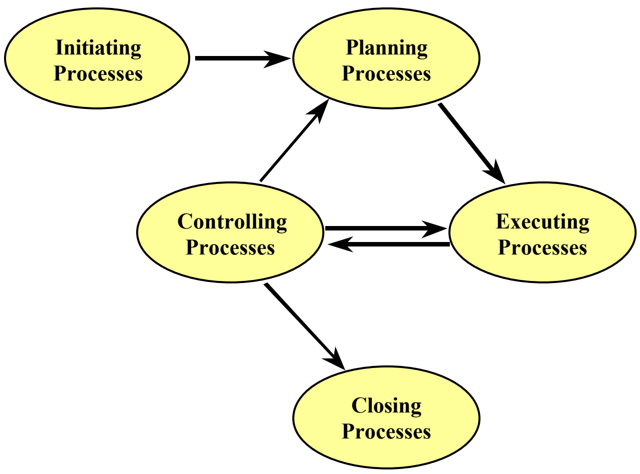

Figure 3 Process groups within a phase of a project (PMI, 1996)

These five processes can also represent different phases in a project. The initiating phase consists of the pre-studies and the first go/no-go decisions. Then you have the planning phase where planning and scheduling are made. You execute the project and control it until the goal of the project is reached and the delivery is made. The planning, execution and controlling forms an iterative process with a continuous development and correction of the plans and the schedules.

Meredith and Mantel (1989) divides projects up in three main phases: initiation, implementation and termination. Evaluation, selection and planning are part of initiation. Budgeting, scheduling, resource allocation, monitoring and project control is part of the implementation. Finally, evaluation and auditing are included in the last phase of the project, termination.

Rolstadås (1997) defines an overall model for the project where you have project tasks and operational tasks (see Figure 4). This model applies if you consider the whole lifecycle of the project, from the idea or the need arises to the result of the project is "retired" or destructed. Project management only concerns itself with the project tasks. Within the project tasks you have three phases: identification, definition and execution.

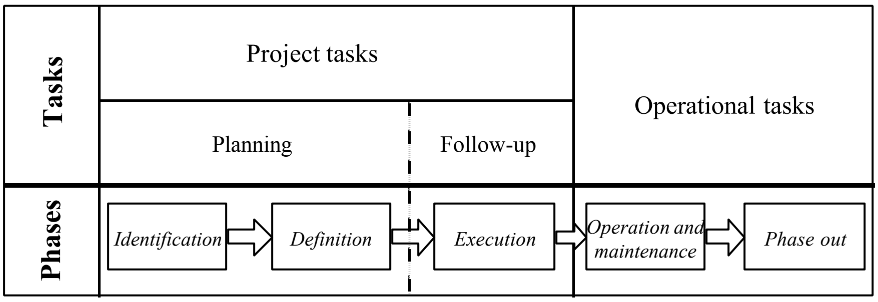

Figure 4 A project lifecycle (Rolstadås, 1997)

These three models all have in common the interaction between the phases. Between these phases there should be go/no-go decisions. The go/no-go decisions shall be defined in the planning phase. For each phase transition, certain criteria should be met and fulfilled for the project to go to the next phase. These criteria could be based on the control-parameters time, cost and quality.

The three control parameters, which traditionally have been considered as the most important ones are illustrated in Figure 5. The triangle illustrates that the three are depended on each other and equally important.

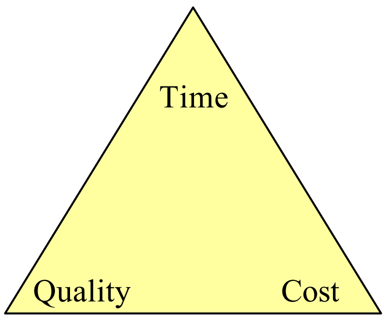

Figure 5 Three control parameters

Success factors

What are the most important criterions to decide if the project is a success or not? According to Rolstadås (1997) there exists no such list that can be applied to any project at any given time. However, many authors have discussed this problem and Pinto and Slevin (1987) have listed 10 factors that can have a major influence on a projects success:

1. *Project goal*, well defined goals are the basis for the planning of a project
2. *Involvement by top-management*, the fight for resources combined with insecurity can lead to conflicts and crisis. Involvement by the top management can be vital for motivation and the solution of conflicts
3. *Project planning*, the projects goal shall be transformed to plans and schedules. The planning will continue during the whole lifecycle of the project to handle change
4. *Communication with customer*, close dialog with the customer prevents later disagreements about what is actually to be done in the project
5. *Personnel circumstances*, Even though the customer is satisfied and the technical goals are achieved, the project doesn't have to be defined as a complete success. If the human relations between project members are bad, the moral is low and the project's success can be described as dubious.
6. *Technical circumstances*, a thorough understanding of the technical circumstances and to ensure the project team has the right qualifications, are solely the project leader's responsibility. Bad technological solutions can affect all aspects of the project, including quality, time and costs.
7. *Approval by customer*, continuos' consulting with the customer increases the possibility for the final approval by the customer
8. *Project follow-up*, continuos follow-up of the project make the project leader capable of handling unforeseen matters and thus can handle uncertainty
9. *Communication*, good co-ordination needs effective communication in between the project team and with the permanent project organisation together with the customer. <u>Clear responsibilities ease the communication</u>!
10. *Problem handling*, there will always arise problems which will be uncovered by the follow-up. Reserves and back-up plans are important actions when these problems happen.

This list is not a "ready-made" solution for any project. It is a sort of "shopping-list", a memo with points to remember during the whole project lifecycle. If one keeps all these points in mind the first steps towards a successful project are made. Point 3, 8 and 9 are especially important for the schedule-management of projects and even more for large scale, distributed projects. Communication is one of the crucial factors in such projects.

Further in chapter 2 the focus will be on the planning, scheduling and control of the project.

Planning, Scheduling and control

When the project leader is going to structure the Project, he must start with the definition of the work, also called "scoping" (Rolstadås, 1997). PMI (1996) defines this task as:

"Project Scope Management includes the processes required to ensure that the project includes all the work required, to complete the project successfully. It is primarily concerned with defining and controlling what is or is not included in the project"

Planning

Planning consist of basically three tasks: defining what to be done by whom and when. In the planning of a project it is important also to assume that if not everything, a lot can go wrong. The project management should investigate potential problems and make back-up plans (what-if). These plans may never be needed, but usually they are needed. Maybe not for the problems that where thought of when the project was planned, but for other problems, it is important that the project management is good in management by exception, but everything that have been foreseen, is helpful.

The purpose of the planning can be summed up in five points (Andersen, Grude and Haug, 1993):

- Get insight in the task that has to be solved
- Get insight in the work that has to be done
- Get a basic understanding of the scope of the project to be able to attach resources
- Be able to assign resources and organise the project-work
- Obtain a basis for follow-up

When planning the project it is important to differ between the strategic planning and the detailed planning. According to Andersen et al. (1993) the strategic planning can also be called milestone planning and the detailed planning can be called activity planning. For small projects it is sufficient to have these two plans. However, for big and complex projects, as for example for building an oilrig, more sophisticated systems are needed. For large scale distributed projects the project is also often split up in sub-projects. Referring to Figure 4, the planning takes place in the two first phases of the project, identification and definition. In the definition-phase, the breakdown of the project is done.

Bachy and Hameri (1997) has defined 4 break-down structures needed in especially large-scale projects:

- Product Breakdown Structure, **PBS**
- Work Breakdown Structure, **WBS**
- Assembly Breakdown Structure, **ABS**
- Organisational Breakdown Structure, **OBS**

Their main focus is on the product, not on the project processes. Thus, the PBS, as the complete part list, is the absolute prerequisite for the design of a successful work breakdown structure. The WBS is in turn needed to establish a proper organisational breakdown structure. To finalise the planning, an assembly breakdown structure is needed. This planning process is illustrated in Figure 6.

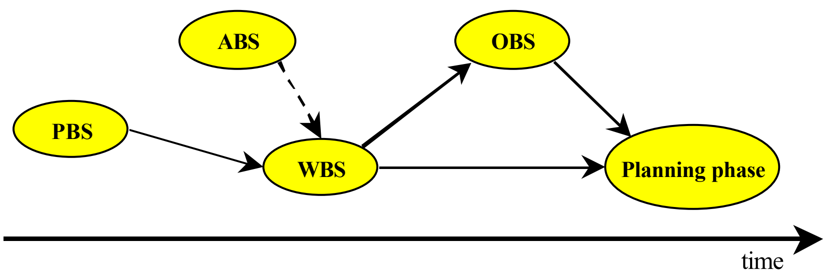

Figure 6 Main procedures to establish the project management plan (Bachy and Hameri, 1997)

Rolstadås (1997) also mentions a PBS, but with another meaning, Physical Breakdown Structure. In this report, Bachy and Hameri's (1997) definition will be used from this point forward. A fifth break down structure is also interesting, the Cost Breakdown Structure. This is, according to Rolstadås (1997), always needed together with the WBS when planning a project.

In the chapters below, the different breakdown structures will be described.

Product Breakdown Structure (WHAT)

A product is usually made out of several components, which again are composed of parts. These parts can be divided into subparts and sub-subparts until the elementary parts are reached. Going through this sub-division, the assembly information is also obtained. The elementary part possesses several attributes concerning its size, thread, head and so on. Also the information on how to manufacture the part is included in the attributes of the part.

The PBS (Product Breakdown Structure) comprises the entire product configuration in a tree structure, where the leaves are the elementary parts (see Figure 7).

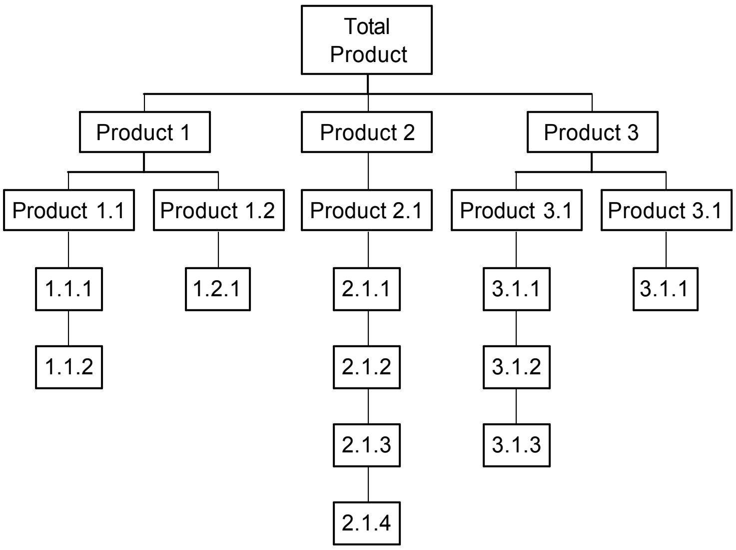

Figure 7 PBS-structure

To summarise, the PBS shall include this information about the parts (Bachy and Hameri, 1997):

- Product tree structure describing the complete configuration of the product
- Instructions on manufacturing, machining, quality control, etc. for each level and branch of the product structure
- Technical description of the elementary parts, i.e. the leaves, of the product structure

Work Breakdown Structure (HOW)

A Work Breakdown Structure (WBS) is usually build as a tree-structure, where the top level of the WBS refers to either the project or to the one-of-a-kind product to be accomplished (Bachy and Hameri, 1997). The work to be done is then broken down to the appropriate detailed level.

PMI (1996) defines a WBS as:

"…a deliverable-oriented grouping of project elements that organizes and defines the total scope of the project; work not in the WBS is outside the scope of the project. As with the scope statement, the WBS is often used to develop or confirm a common understanding of the project scope. Each descending level represents an increasingly detailed description of the project elements"

Bachy and Hameri (1997) argues that to construct a proper WBS, two other breakdown structures are needed; the PBS based on main components and a structure based on functions (design, manufacturing, purchase and so on). These two structures form a matrix, where each cell forms a work-package, see Figure 8.

		Products				
		Magnets	Cryogenics	Vacuum	Muon	Structures
Standard Tasks	Design		WP			
	Manufacturing			WP		
	Purchase		WP			
	Financing					

WP =Work Package

Figure 8 WBS-matrix, simplified

Assembly Breakdown Structure (WHERE)

When a project is to be finalised and the final product of the project is a physical product, the product has to be assembled. The assembly phase and assembly location constrains the final assembly sequence. The Assembly Breakdown Structure (ABS) complements the PBS to provide the WBS and planning phase with the relevant constraints.

According to Bachy & Hameri (1997) the ABS contains the following information:

- A description of the time-related sequence of activities needed to be taken to complete the final assembly of the whole project
- Part and activity related information that alters the original assembly sequence given by the PBS
- Other information related to the activities and the site, which influence the WBS development

To summarise, while the PBS usually comprise the manufacturing and assembly information of individual components, the ABS usually displays the assembly sequence and the related installation information of the project components.

Organisational Breakdown Structure (WHO)

While the WBS breaks down the project into work-packages or tasks, the organisational breakdown structure (OBS) breaks down the organisation to working groups to execute different tasks in the project. The WBS and the OBS thus share the tasks, and it is possible to combine these two structures, with the WBS as vertical and the OBS as the horizontal structure. Rolstadås (1997) names the common elements as "cost account". Bachy and Hameri (1997) also argues that the skills of the available people should partially determine what kind of breakdown is made at the top levels of the WBS.

The OBS shall provide a detailed framework for people and their organisational relationships. In addition, it also includes authority and reporting obligations (Bachy and Hameri, 1997).

Scheduling

According to Meredith and Mantel (1989) the definition of a schedule is:

> *"A schedule is the conversion of a project action plan into an operating timetable"*

Schedules can be made in networks or in Gantt charts. Both have their pros and cons (Rolstadås). The Gantt-diagram is easy to understand and it is easy to get the overview of the plan. However, a simple Gantt-diagram does not show the dependencies between activities. If the bars are linked in the Gantt-diagram, the problem is solved. Another disadvantage with the Gantt-diagram is that when it is drawn, you have to decide:

- interdependencies between activities
- duration of activities
- manage resources

Rolstadås also argues that in the planning and scheduling, it can be easier to take these decisions in sequence and then a network representation may be easier. It also shows the dependencies between activities directly. In return the network is not as easy to understand or perspicuous as a Gantt-diagram. When planning and scheduling a project, it will be practical to use both Gantt charts and network diagrams both for presenting the schedule and for working it out (see Figure 9 and Figure 10 for examples).

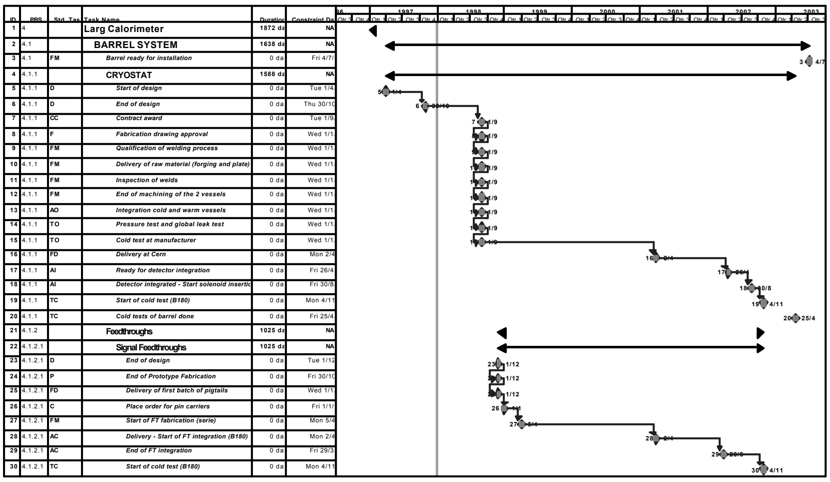

Figure 9 Example of Gantt chart

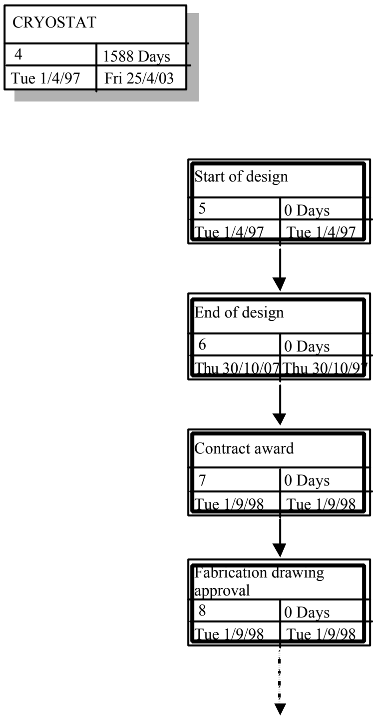

Figure 10 Example of PERT-diagram

The planning of a project can roughly be said to be done on two levels: the strategic level and the detailed level. For large scale distributed projects where the project has been split up into sub-projects, the detailed plans belong to the sub-projects and the strategic plans are the overall plan for the whole project. Using Bachy and Bonnal's (1996) terminology the strategic level is the master level and the detailed level is the detailed level (as before). Comparing this to the schedules, the master schedules exist on the strategic level and the detailed schedules exist on the detailed level. If the project is so large and complex that it has been split up in sub-projects, co-ordination schedules are also needed when sub-projects are acting in common.

There are two different techniques for scheduling in networks (Rolstadås, 1997):

- CPM (Critical Path Method)
- PERT (Program Evaluation and Review Technique)

When scheduling a project, one can either consider the duration of task as deterministic while that in real life, they are uncertain variables with a statistical distribution. The CPM considers the task as deterministic and PERT considers the task as a variable with statistical distribution. Both techniques operates with early and late start and finish. This is important when doing the scheduling, with creating more or less float between activities.

If a project management has been able to properly design a detailed schedule, the schedule can serve as a key input in establishing the follow-up system of the project. In the next chapter follow-up will be discussed in detail.

Follow-up

"Predicting the future is easy. It's trying to figure out what's going on now that's hard" *Fritz R.S. Dressler*

Rolstadås (1997) divides follow-up into two tasks:

- Registering progress
- Carry out corrective action

Some authors call the first task monitoring and the second task control. It is these latter terms that will be used further in this report. Lewis (1993) on the other hand calls the whole follow-up process for control of the project. In this report control will be used for only part of the follow-up system. He has also made a list for what characterises a good follow-up system:

- Planning performance
- Observing actual performance
- Comparing actual and planned performance
- Adjusting as required

The first point is part of the planning phase. The second is part of the monitoring (see chapter 2.2.3.2) and the two last points are part of the control phase.

To make sure one does not only monitor and control the easy accessible information, the project management has to identify key factors to be controlled (Meredith and Mantel, 1989). Usually these are represented by performance, cost and time. On these key-factors it is possible to define characteristics and to establish boundaries for what is acceptable variance. Labour hours used and the number or extent of engineering changes are two examples of characteristics that can be used.

Lewis (1993) list several factors that are important when a follow-up system is made for a project:

- Work is controlled – not people
- Control is based on completed work
- Control of complex work is based on motivation and self-control
- Methods of obtaining control data must be built into the work process
- Control data must go to the person who does the work
- A control system is designed for the routine
- Control of a complex process is achieved through levels of control

In addition to the follow up of the work of the project, Lewis (1993) defines the need for an overall, continuos evaluation of the project itself. This evaluation being an attempt to determine if the status of the project is acceptable, in terms of intended value to the client once the job is finished.

Evaluation

The purpose of the project evaluation was stated above. It should be conducted throughout the project lifecycle so that learning can take place as the job progresses (Lewis, 1993). Usually an evaluation is done only after the project has ended. Then it will be able to improve the next project but the present project will have no benefits from it. With the evaluation through out the project the performance may improve together with the management of the project. In addition the evaluation can ensure that the quality of project work does not take a back seat to schedule and cost concern. It can reveal developing problems early so that action can be taken. The evaluation can also help to reaffirm the organisation's commitment to the project for the benefit of the project team members.

Monitoring

A project has not only to be properly planned and scheduled, it also has to be monitored throughout the project and controlled. Without the monitoring it is difficult to control it and without the control, there is no way to make sure that a project stays on track. The monitoring is meant to be a link between planning and control.

Monitoring is built up of three parts (Meredith and Mantel, 1989):

- collecting
- recording
- reporting

There is no guarantee of a trouble free and successful project to have proper monitoring it is merely an improvement in minimising the risk of failure (Meredith and Mantel, 1989).

Based on the performance, time and cost goals defined in the project plan, it is possible to have the "baselines" to measure if the project is in line or not. These goals should relate to different levels of details, depending on who is interested in the reporting.

The reporting of the data should neither be too complicated or long. It is very important to ensure project members that the collecting and reporting of data is not only to fill up the shelves of the project management. It is not a control of the persons, it is a control of the activities and focuses on the outcome, not on the amount of work done (Lewis, 1993). It is also important that not everything is collected and controlled. To heavy procedures can kill the spirit of the project members and taking too much of their time.

To achieve a proper reporting-system, the need for information on all levels of the project organisation has to be analysed. Different levels need different kind and more or less detailed information (Meredith and Mantel, 1989). Timing of the reports is also important. Generally the reporting should correspond to the milestones of the project (Meredith and Mantel, 1989). This means that having weekly or monthly reports is not a general rule. The reports should be scheduled, but if major milestones are used, there is no need for periodic reports! When it comes to deciding which milestones are considered as major milestones, this depends on whom you are reporting for. For the project management, there may be many milestones that are interesting to follow, but on a more detailed level, the milestones appear even more frequent.

There are three kinds of reporting according to Meredith and Mantel (1989):

- Routine
- Exception
- Special analyses

The routine reports are issued on a regular basis, but not necessarily periodically. The exception reports can be issued in two cases. First, these reports should be distributed to the project members who will have responsibility for decisions or who must know. Second, the exception report should be issued when a decision has been made on an exception basis. The special analysis reports could be reports on studies made of capabilities of new software, description of new governmental regulations or evaluation of alternative manufacturing processes.

There are three common difficulties in the design of project reports. First of all the problem of too much details in the reports. Second there is often a poor interface between the projects information system and the parent's information system. The last but not the least problem concerns a poor correspondence between the planning and the monitoring system. For example if the monitoring system tracks information that is not directly related to the plan, the control will be meaningless. If one track milestones that are not in the project schedule, how can the effect the delay of these milestones have on the rest of the project be analysed?

Monitoring is often done by different kinds of information systems, so called Project Management Information Systems (PMIS). It is important to be aware of that there are several types of pitfalls when it comes to monitoring done by Information Systems (Meredith and Mantel, 1989):

> *Computer paralysis*, excessive use of computers instead of focusing on the project management-tasks can lead to loss of touch with the project and its realities
>
> *PMIS verification*, reports from the computer-program are massaged to look good or to simply verify that real problems exists
>
> *Information overload*, too many and too detailed reports to too many people
>
> *Project Isolation*, the computerised reports replace useful and frequent communication between the project management and top management or between the project management and the project team
>
> *Computer Dependence*, project management stop being proactive and act on its own analysis and start to wait for the computer results/reports
>
> *PMIS misdirection*, the PMIS may not be properly designed and fitted to the projects needs and as a result project sub-areas are over managed and other areas receive inadequate attention. For example, symptoms are monitored and reacted upon instead of the problems themselves

Control

Control is basically to compare the status that where obtained in the monitoring phase with what was planned to be accomplished to date and then to take corrective action to get back on target if a deviation is discovered (Lewis, 1993). A good plan is here crucial to compare the progress. As Meredith and Mantel (1989) puts it: *"In essence, control is the act of reducing the difference between plan and reality"*.

As mentioned earlier in this report, control is usually based on three elements – performance, cost and time. The project management should constantly keep an eye on these factors of the project to make sure that the project deliver what it promised to deliver, that it is making delivery on time or before time and that delivery is at or below the promised cost. Large projects have a tendency to develop their own momentum and tend to get out of hand. This calls for intervention and control by the project manager. Most project managers however find it difficult to perform control (Meredith and Mantel, 1989). One explanation can be that even in a large project, the team is an in-group. It is "we" and "the others"(Meredith and Mantel, 1989). It can be difficult to criticise your friends. In addition, control is seen as an ad-hoc process, and not as something which should be done continuously.

If one look at the control-process of a project with the engineering-glasses, you can divide the control-process in three types(Meredith and Mantel, 1989):

- Cybernetic control
- Go/No-Go controls
- Post-control

Cybernetic control

There are three types of cybernetic controls. 1st order is the simplest form with a control unit with a set of standard values where the system can have its variations. For example a thermostat to regulate the temperature in a room. The controller can not change the standard values. The 2nd order system has a controller, which can change the standard values of the system according to a set of predefined rules or program. An example of a system that use a second order controller are industrial robots. The most interesting one for project management is the 3rd order controller. This control-system is able to learn and reflect on system performance and from this information decide to act in ways that are not contained in its instructions. So far no computers are sophisticated enough to handle this kind of operations, so the 3rd order control-system has to contain humans. The second order system can also learn and recognise patterns and react in specific ways but only inside a pre-set programmed framework.

To establish total control the controller must be able to take a counteraction for every action the system takes. This is not possible for complex systems, as a large project is. It is important to make sure that the cost/benefit ratio is smaller than one! Very few elements of a project can be controlled automatically. However, if the elements have a mechanical characteristic and represent a continuos type of system that operate over a sufficient time period, the cybernetic controller can be useful. For this 3rd order controller, the controller does not act on the system if the system is out of bounds, but the controller acts on the project management who will decide what to do.

Go/No-go controls

This type of control can be used on almost all aspects of a project. The go/no-go controls are a set of predefined conditions that have to be met when tested. If these conditions are not fulfilled, the project management has to act accordingly. The conditions can take form of exact values or defined, wide limits. These go/no-go controls can be linked to penalties. If a producer does not meet the time-constraint, penalties in form of less payment can be exercised. The project management has a pre-designed control system with the plan, budget and the schedules. The schedule includes milestones that are perfect checkpoints. It is important that the go/no-go controls are part of an early warning system so that the project management will have the time to avoid a catastrophe. Controls are of no use if they only tell the project management that the project is already in trouble. The project management must be able to be proactive and not only act as firefighters.

Compared to the cybernetic controls that check the system continuously or as often as it is designed to check, the go/no-go controls are operated only when the project management decides to do so. It can for example be used as a decision making tool for the project management to decide if a project is to go from one phase to another!

Post control

While the cybernetic controls and the go/no-go controls are meant to help the project to achieve its goals, the post control shall aid the next projects to work better than the previous ones. Meredith and Mantel (1989) describes the post control as an analysis that is applied through a formal document built up of four distinct areas:

- The project objectives
- Milestones, checkpoints and budgets
- The final report on project results
- Recommendations for performance and process improvement

Meredith and Mantel (1989) mentions several characteristics that a good control system should have, regardless of which type of control system. The control system should be cost effective. The cost of the control should never exceed the benefit of the control. Moreover the system should be flexible and useful. The project management must be careful in the design of the control system so that it controls not only easy accessible information. As mentioned earlier, the control system must be able to report problems early enough so that the project management can act to avoid catastrophic conditions. To sum up, the common element of all three control-systems, is the use of feedback as a control system.

To sum up, Andersen, Grude & Haug (1993) points out two attitudes, which are very negative for all follow up and for the accomplishment of a project:

- “I am sure it will work out”
- “Let us just wait and see”

It is thus important to not behave like an ostrich that refuses to acknowledge the problems and to initiate action. Often the main problem is not that you do not know that the project is delayed, but that you do know but you are paralysed.

Another mistake, which is often made, is that work is not planned and controlled properly. It is often very easy to focus on doing, especially because it appears to be more effective to "stop all the talk and get on with the work" (Meredith and Mantel, 1989).

Model for scheduling and follow-up of distributed projects.

To sum up the most important factors for scheduling and follow-up in a large scale distributed project, a model has been made. This model is based on the theory presented in chapter 2, see Figure 11.

As mentioned earlier, the project has a life cycle that consists of different phases. The model is concentrated on two overall phases and three more detailed phases. These phases are presented as discrete cases, but in "real life" the phases have a more continuous nature. The project management has been split into two parts, Quality and IT. These two parts could also have been called techniques and tools, respectively. Quality represents the procedures and techniques while IT is the tools necessary to ensure the quality premises. For each phase the relevant tools and procedures are listed. The last column of the model is the schedule column. This defines when the different schedules of a large-scale project should exist.

<table>
<tr><th rowspan="2">Project Life cycle</th><th rowspan="2">Detailed Phases</th><th colspan="2">Project Management</th><th colspan="3" rowspan="2">Scheduling</th></tr>
<tr><th>Quality</th><th>IT</th></tr>
<tr><td>Definition</td><td>Definition</td><td>-Objective
-Planning
-BS
-Defining QAP
-Risk analyses
-Planning Follow-up system</td><td>-e-mail
-www
-EDMS
-Planning tools
-Statistical progr.
-Simulation
-Office system
-Accounting</td><td rowspan="3">Master Schedule</td><td></td><td rowspan="2"></td></tr>
<tr><td rowspan="2">Execution</td><td>Design/ Engineering</td><td>-Implementing QAP
-Design process and control
-Linking detailed schedules to master schedule
-Implementing Follow-up system
-Reporting</td><td>-e-mail
-www
-Scheduling tools
-EDMS
-Accounting
-Office system</td><td rowspan="2">Detailed schedule</td></tr>
<tr><td>Manufacturing/ Testing/ Installation</td><td>-Reporting
-Manufacturing and logistics
-QC</td><td>-Control system
-Manufacturing
-EDMS</td><td>Co-ordination schedules</td></tr>
</table>

IT: Information Technology QAP: Quality Assurance Policy
EDMS: Engineering Data Management System

Figure 11 Model for scheduling and follow-up for large scale distributed projects

Definition phase

The first phase is one of the most important phases of the project. This is were the objective of the project is stated and where the planning systems and the quality assurance policy has to be defined. In this phase, not only the planning systems are being defined, but they are also used to plan the project on the strategic level. This includes doing the overall breakdown of the project, according to the system proposed by Bachy and Hameri (1997). After the breakdown of the project, it is time to do the scheduling, that is the overall scheduling of the tasks on the master schedule level. The last procedures that has to be planned in this phase is the follow-up procedures with definitions of which parameters should be followed up when and by whom. This includes also the design and development/adaptation of a proper follow-up system. This phase demands the use of several IT-tools like EDMS, www, e-mail, statistical programs and simulation programs in addition to the obligatory office-programs like word-processors, presentation tools etc.

Design and Engineering phase

In this phase the detailed product breakdown of the project must be done to be able to create the work packages on all levels. This will make a basis, together with the master schedule for the detailed schedules. The detailed schedules should be created early in this phase. The summary schedules are then made (based on the detailed schedules) and should be linked to the master schedule for a proper follow up of the schedules of the project. Through the whole phase, as through the whole project, it is important to do the follow-up of the schedules and to update, if necessary, the master schedule according to the changes in the detailed schedules. The EDMS (Engineering Data Management System) is also important here for a quick distribution of the schedules, easy access of the schedules for all involved personnel and last but not least for the approval process of the schedules. The most important IT tools are still the ones mentioned in the first phase. The EDMS becomes more and more important due to the design process, approval of drawings, reviews and so on. Also the follow up of the project is becoming important here. In addition the risk analyses for the overall system also has to be done.

Manufacturing/Testing/Installation phase

In this phase it is important to have a logistics system adapted to the projects special needs together with manufacturing systems. In this phase the project needs more and more co-ordination as it moves from usually distinct sub-projects which have concentrated their work on parts of the total product to the assembly. This creates a need for schedules called co-ordination schedules that are meant to be schedules that, in much the same way as the master schedule, connects the different sub-projects together. Large scale, distributed projects especially needs these co-ordination schedules. The different sub-projects are often autonomous entities until the project reaches the assembly and testing period. There is co-ordination before this phase also, but no strong co-ordination is needed.

The model presented is more like a list of when to do what concerning scheduling and follow-up in a large scale, distributed project. It states when the different schedules should be made and when they should exist. It also states when the different schedules are more important than the others. The master schedule is important through the whole project together with the detailed schedules for the sub-projects. The co-ordination schedules are usually not important before the project reaches the time where the products of the different sub-projects are going to be integrated in one system. This however depends on what kind of co-ordination is needed in the project. If for example the project needs co-ordination of IT-tool implementation, this is needed usually early in the project to get the most out of the tool during the project lifecycle.

In the next chapter, the project management of CERN will be presented and discussed according to the model presented in this chapter.

PROJECT MANAGEMENT IN ATLAS

The ATLAS project is divided in five areas:

- ATLAS Assembly & Test Areas, ATA
- ATLAS Technical Co-ordination, ATC
- ATLAS General Facilities, ATF
- ATLAS Detector, ATL
- ATLAS Off-line Computing, ATO

This is presented graphically in Figure 12

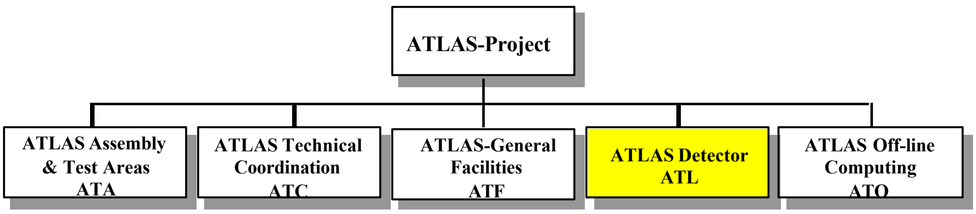

Figure 12 Organisational overview of the ATLAS project

In this report the focus will be on the ATL area, ATL being the ATLAS detector itself. The ATLAS Detector is divided into ten systems:

1. Vacuum Beam, V
2. Inner Detector, I
3. Solenoid Magnet, S
4. LAr Calorimeter, A
5. Tile Calorimeter, L
6. Toroid Magnets, T
7. Muon Chambers, M
8. Shielding, J
9. Support Structures, H
10. DAQ Trigger Control, D

This is presented graphically in Figure 13.

For seven of these systems, the project leader is situated at CERN. The rest are situated in Japan, UK and France. This applies to systems 2, 3 and 4. All the systems are again divided into sub-systems. These sub-systems are also distributed all over the world. In total there are 1700 physicists at 150 institutes, labs and universities in 35 countries and collaborating in constructing and designing the ATLAS-detector.

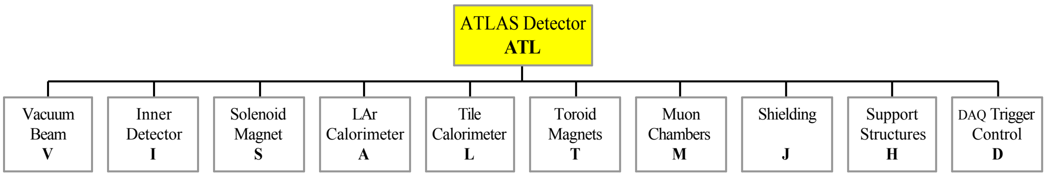

Figure 13 Ten systems of ATLAS detector

The ten systems of ATLAS are considered as separate projects until they reach the assembly and test period.

The ATLAS project can be said to have these attributes:

- Large scale
- Distributed
- Cutting edge technology
- Collaboration between physicists all over the world
- Lot of funding sources
- Based in an international organisation

The ATLAS project is conducted in an international environment. The ten systems of ATLAS are all distributed over the world. The technical co-ordination and the Project Management is seated at CERN which in it self is an international environment with its 19 member states and 7 observers. The size and the complexity of the product, the detector, can symbolise the actual size and complexity of the project. The goal of the ATLAS project is stated in the QAP (Bachy, 1996) and is as follows:

"The goal of the ATLAS project is to build a world class detector"

All the 1700 physicist who are collaborating in the project have the same goal. They want this detector to be able to conduct their experiments and provide them with world class results; experiments they have planned and experiments they have not yet thought of. As a basis, this should be enough to ensure the quality of the detector. However, because of the distributed and international nature of the project, strong co-ordination is needed to make sure all these physicist move towards the same goal, the building of the detector.

The distribution of the project is as much practical as political. CERN is a laboratory for particle physicist all over the world. The organisation is funded by the member states and more than 6500 scientists from all around the world visit CERN and perform experiments for shorter or longer stays. These scientists add to the already 3000 CERN staff members. Building a new accelerator and its associated experiments is a huge challenge for CERN and all the institutes involved. It is a prestigious project to be involved in. And the amount of resources needed to build a detector is far too much for one university or research institute to take on. The funding is as distributed as the project itself in the various participating countries.

All these factors together call for a strong co-ordination of the project. However, before the assembly phase starts, the systems are being treated as separate projects delivering parts to the total product. The special nature of the project also makes it often difficult to schedule and follow up the work.

Because the ten projects in ATLAS are distributed all over the world, it is difficult to make all the systems use the same procedures for project management and the same document formats. However, there have been approved common procedures for how to plan, break down and schedule the projects within ATLAS. All these procedures are written in the QAP-reports (Quality Assurance Policy reports). The structure of the QAP will be presented below.

Quality Assurance Policy

As for the rest of the LHC project, the ATLAS Detector has written a QAP concerning all aspects of the Project management. The QAP is built up of four manuals (Bachy, 1996):

- A – Introductory information
  - 0100 Quality Policy
  - 0200 Codification & General Procedures
- B – Quality Assurance Management
  - 0300 Quality Management
  - 0400 Quality System
- C – Quality Processes Management Manual
  - 0500 Processes (During product life cycle)
- D – Quality Results Management Manual
  - 0600 Quality results

The A-manual covers all the basic procedures in matter of naming, document identification and various coding to ease the communication throughout the project. This includes glossary, document-writing standards, document identification system, product naming and identification and quality classification categories. The B-manual covers organisational matters necessary for the co-ordination of the ATLAS Project such as a management plan, breakdown structures, scheduling process and standards, configuration management and change control and the associated assessment and responsibilities. The C-manual contains procedures, which defines the quality assurance implementation strategy of the processes in use during the product life cycle from the design phase to the delivery phase. The last manual, D-manual, provides guidelines for establishing the specific Quality Control procedures to be defined and implemented by the various ATLAS systems. These procedures fall in two main categories: the Work documents and the Quality records

The QAP states that that the very high tech nature of the detector, its size and the unprecedented number of partners involved all over the world calls for a Total Quality Management system based on defect prevention and continuous improvement.

In the following sub-chapters the theoretical part of the project management in ATLAS is being presented together with a short presentation of the use of the Engineering Data Management System in ATLAS. At the end of the chapter, the reality of the project management is presented and discussed according to the model described in Chapter 2.3.

Breakdown Structures

The purposes of the break down structures are to help organise the whole ATLAS project. For the project there shall exist four breakdown structures:

- PBS (Product Breakdown Structure)
- WBS (Work Breakdown Structure)
- ABS (Assembly Breakdown Structure)
- OBS Organisational Breakdown Structure)

The PBS is an organised part lists. It is the basis for the overall project organisation and it shall reflect the structure of the ATLAS detector from the engineering point of view. The PBS constitutes the basis for all other needed breakdown structures. The ABS is needed to describe the assembly sequence of the whole detector and finally the WBS defines the work packages to be performed to achieve the ATLAS Project. In subchapters 3.1.1.2 to 3.1.1.3 the PBS and the WBS will be described in detail. Concerning the ABS and the OBS, the QAPs does not yet exist. However, in appendix 4, an overview of the people in the technical co-ordination of ATLAS is presented. Chapter 3.1.1.1 presents the standard tasks.

Standard Tasks

The technical co-ordination of ATLAS has defined a set of standard tasks, which defines the various actions that occurs in the life cycle of a typical project, see appendix 5. The standard tasks are defined as a letter code. The two first levels are frozen to facilitate the schedule consolidation and the understanding of WP numbering. It is up to each Project Leader to define his detailed Standard Task list to be part of his detailed WBS. Three levels (in some cases four) are a maximum. The establishment of these standard tasks together with the PBS, will help the project leaders to plan the WBS.

Product Breakdown Structures

As explained earlier, the PBS is a tree structure, which displays the component structure of ATLAS in a structured way. The division is based on the natural technological breakdown of the product as it is constructed (a list of sub-systems, assemblies, sub-assemblies, components). This is not necessarily organised according to function, but on a geometrical split. A set of rules has been developed for how to build up the PBS. These are

- Only elements to be installed in the ATLAS detector have to appear in the PBS. All other devices such as manufacturing or assembly tools, installation devices, test facilities should not be included in the PBS but in an "attached" PBS
- Number of PBS levels is not limited; however, the last level shall correspond to the last component/item for which a specification is to be prepared.
- The maximum number of elements on each PBS level should not exceed 20. This to prevent too complicated PBS-structures.

Work Breakdown Structure

The WBS shall be constructed by using the PBS and the standard task list. The WBS is a 2D-matrix where the PBS is vertical and the Standard Tasks are horizontal, see Figure 14. By scanning all the intersections of the matrix, all the work that has to be performed can be identified. Each intersection between a row (a given component) and a column (a given task) is called a WBS cell. If the cell is filled, it is called a Work Package (WP). Since the PBS and the Standard Task list shall be exhaustive, the complete collection of WPs (filled WBS Cells) constitutes the scope of the work of the ATLAS project. The WPs can be compared with the leaves of the three-like WBS (see Figure 15). The branches of the tree correspond to the PBS hierarchy and the Standard Task list.

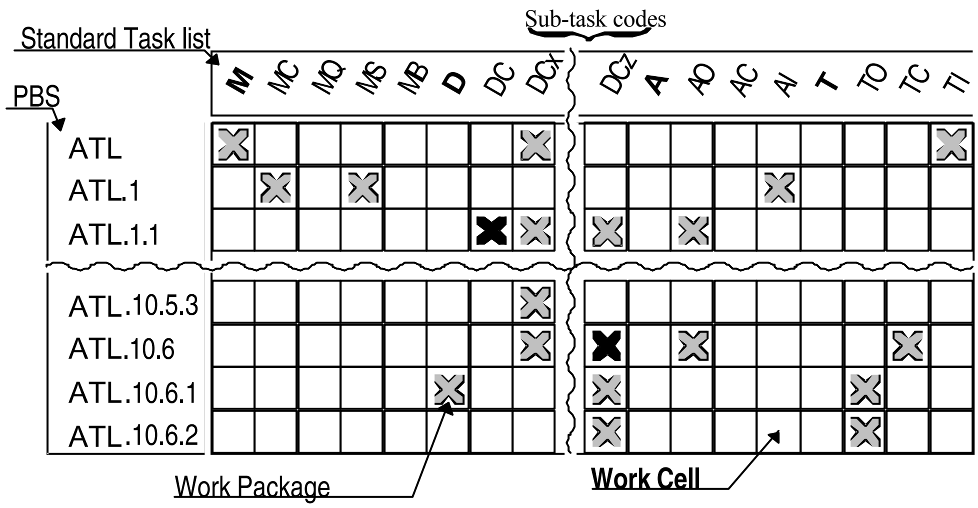

Figure 14 Work Breakdown Structure matrix

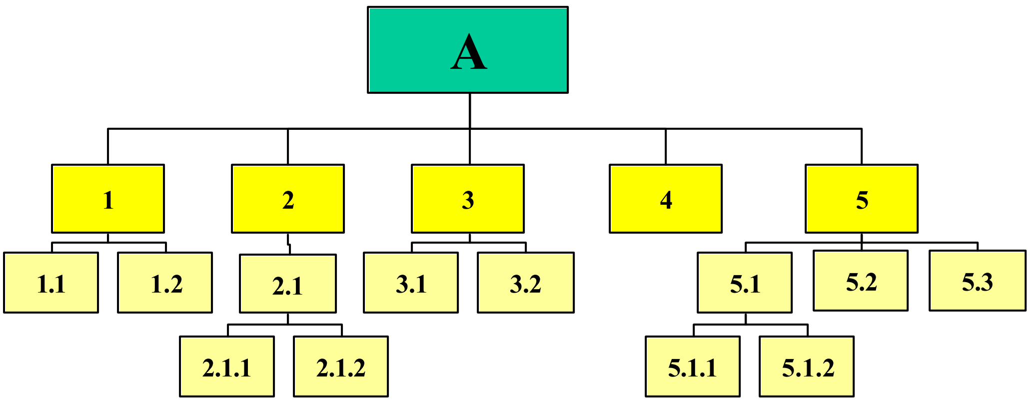

Figure 15 "Traditional" WBS

Scheduling

The ten systems of ATLAS should be using MS-Project to schedule their projects. The scheduling process of the ATLAS-detector is composed of three levels:

- The Master Schedule
- The System Summary Schedule (systems)
- The system detailed schedules (systems)

The Master Schedule shall define all major activities needed to construct the detector. It shall define time constraints and interdependencies between the major tasks. This includes the Project Breakdown Structure (PBS) items down to the third level (some times 4th) and the associated standard tasks at the top level. In addition it shall include all the milestones relevant for the ATLAS-project.

The system detailed schedule shall be made by the systems respectively. The major dates are defined by the master schedule. They should use the PBS Coding to the lowest level as well as the standard tasks down to the detailed level. This is done as needed by the various systems to manage their projects.

The System Summary Schedule shall be established by each of the ten systems compiling the entire system detailed schedule. This summary schedule is again going to be used as an input to the master schedule (see Figure 16).

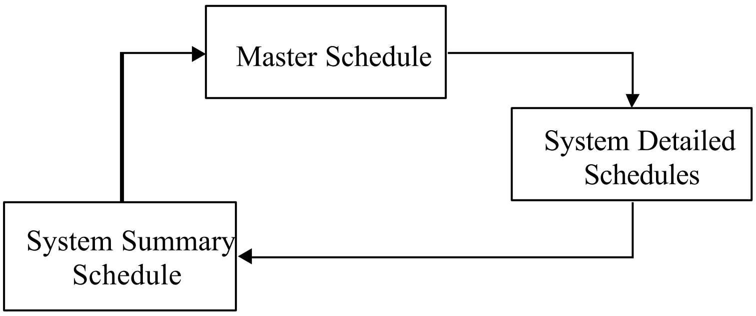

Figure 16 Schedules of ATLAS

In addition, there shall exist co-ordination schedules such as the Installation schedule and the Assembly and Test area schedule.

Engineering Data Management System

The ATLAS project at CERN requires both the handling of a huge amount of engineering information and the control of the coherence of this information as the design work evolves on the detector. A commercial Engineering Data Management System, (EDMS), is being implemented to manage data for the design, construction, installation and maintenance of both the accelerator and the experiments. This CERN-wide project is called CEDAR. The World Wide Web, which was developed at CERN, is used to make the information accessible at CERN and in the external collaborating laboratories around the world.

ATLAS has since 1993-4 used a simple Web based system for engineering data exchange and management as proposed by the CADD initiative. (http://cadd.cern.ch/) After a request from the ATLAS technical co-ordination for a more industrial approach and to benefit from experience from engineering data management in industry, a task force was created to select a CERN-wide engineering data management system for the LHC (CEDAR, http://cedar.cern.ch/cedar). After a long information gathering and selection procedure, the EDM system CADIM/EDB was selected.

In parallel the IT support group in the CERN Accelerator Sector developed their Oracle Drawing Directory drawing archive into a more generalised drawing management application, CDD. CDD is since 1996 in production use in the Accelerator Sector, but is an application designed for handling CAD-drawings produced at CERN and does not address the need for exchange of data between multiple institutes as required by the LHC experiments.

At the same time a team from Helsinki Institute of Physics in co-operation with CERN developed an automated version of the simple Web-based system used by ATLAS - TuoviWDM. This system has first come into use by the ATLAS technical co-ordination then by the ATLAS systems. The TuoviWDM is a universal data management tool that allows designers and engineers to access their data through a simple interface regardless of what EDM or PDM system hosts it in the background. The system is also capable of using the local file system of the WWW server as a data vault before EDMS-implementation. The TuoviWDM interface is presented in Figure 17.

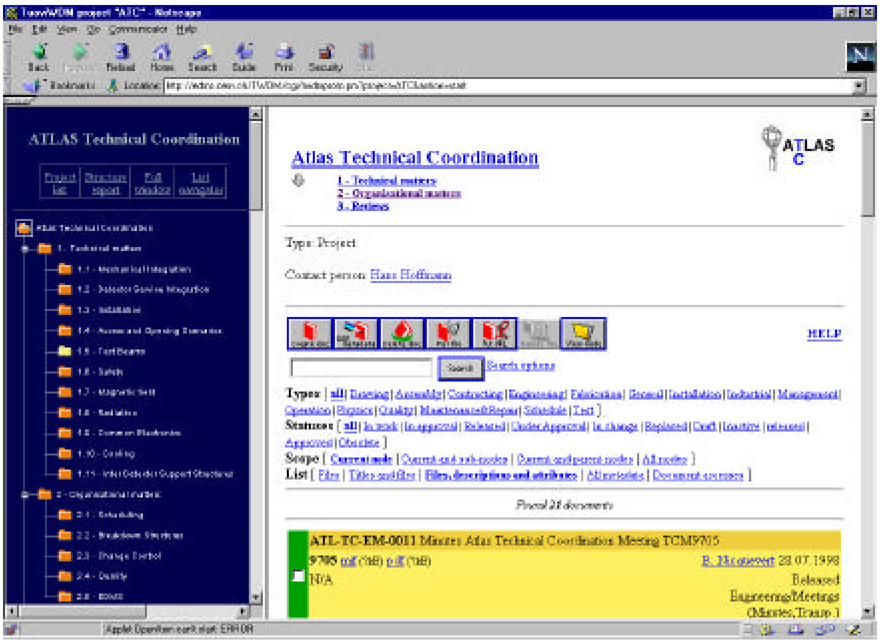

Figure 17 Example of the TuoviWDM interface

The window is initially split into two frames. The left frame hosts a tree presentation for organising data. You can select a node (make it active) by clicking on its name or folder icon in the tree. The right frame lists information related to the active node.

Currently the CEDAR project implements CADIM/EDB with TuoviWDM as a simple Web user interface for document management. CADIM EDMS/Tuovi is coming into use in the LHC projects for data of an official character, but as the projects are already in the middle of the project execution, many people tend to stick to the existing methods, which means communication by means of email and Web pages.

Project management in practise in ATLAS

In this chapter the project management in ATLAS will be presented again, but this time with a focus on what is happening in "real life. The discussion is structured in the same way as chapter 2.3 with focus on the different phases of the project. For each phase, the status of the ATLAS project will be presented and then discussed according to the model in Figure 11. At the end of this chapter, the project management in general will be discussed.

In Figure 18 the ATLAS project's status is compared to the model in chapter 2.3. The points of the model which ATLAS fulfil, are written in bold. The phase which the project is in now is shaded.

<table>
<tr><th rowspan="2">Project Life cycle</th><th rowspan="2">Detailed Phases</th><th colspan="2">Project Management</th><th rowspan="2" colspan="3">Scheduling</th></tr>
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-Statistical progr.
-Simulation
-Office system
-Accounting</td><td rowspan="3">Master Schedule</td><td></td><td rowspan="2"></td></tr>
<tr><td rowspan="2">Execution</td><td>Design/ Engineering</td><td>-Implementing QAP, only partly
-Design process and control
-Linking detailed schedules to master schedule
-Implementing Follow-up system
-Reporting</td><td>-e-mail
-www
-Scheduling tools
-EDMS
-Accounting
-Office system</td><td rowspan="2">System Detailed schedule/ System Summary Schedule</td></tr>
<tr><td>Manufacturing/ Testing/ Installation</td><td>-Reporting
-Manufacturing and logistics
-QS</td><td>-Control system
-Manufacturing
-EDMS</td><td>Co-ordination schedules</td></tr>
</table>

IT: Information Technology
EDMS: Engineering Data Management System
QAP: Quality Assurance Policy

Figure 18 ATLAS project compared to model

Definition phase

The technical co-ordination of ATLAS has issued a set of Quality Assurance Policy (QAP) reports that are the formal part of the quality management system of the project. This work was started after the project started and is still going on. Some parts of the QAP do still no exist. This is due to lack of manpower.

The QAP defines how to break down the project. The PBS has been done by all systems. The ATLAS Master PBS was finished at the end of the definition phase but the PBS on the system level was only completed during the design and engineering phase. This is according to Bachy and Hameri (1997). In the model it is argued that the break down structures should be made in the definition phase. This is true, when it comes to the overall break down structures. The detailed structures can only be made during the design and engineering phase. The work breakdown structures for the project did not exist in this phase. It was argued in the article of Bachy and Hameri (1997) that without the proper breakdown structures, a proper schedule could not be created. This is true, and the master schedule of the ATLAS project did not exist until mid 1996, which means well after the recommended time to do this.

The ATLAS Project has been scheduled in a backward manner. The final date is fixed and the project has to finish within this date. This means that if there are critical delays the project managers have to either increase the effort on the work-packages or the quality has to be adjusted according to how much work there is time to do on the different work-packages. For this project however, it is less likely that the project members will agree to a reduced quality to meet a deadline planned ten years in beforehand. The quality of the final product is permanently competing with the meeting of the schedule deadline. The final date of the ATLAS project is the start of the beam in LHC: 1.July 2005. That is when the operational schedules take over. In addition to the final date, there are two important dates, which have been used for the scheduling. Cavern availability date and the start of detector installation. With focus on these three dates, the scheduling has been done with using experience from the previous built accelerators (SPS and LEP) and thumb-rules. The master-schedule, which the last version is from November 1997, thus has to be revised. The project has been running since 1995. Now the project leaders have the experience and the knowledge to do real estimates on when and for how long tasks should be executed. Therefore a thorough review of the systems detailed schedules has to be done to get an up-to-date master schedule. As a matter of fact, some of the systems do not yet have a proper approved schedule. This was confirmed when asking for milestone schedules from all systems (see chapter 4). But as the milestone follow-up system is being implemented the systems are forced to make not only the milestone schedules but also the system detailed and system summary schedules.

The model in Chapter 2.3 also addresses a need for a follow up system early in the project life cycle. Such a system was not planned in this phase and does only exist on the complete master schedule level at the moment (late August 1998), that is in the engineering phase. A good follow-up system is crucial to ensure that the project meets its objectives and satisfies its customers. For the ATLAS project however, the project members are also to a great extent the projects customers. So everybody participating in building the detector is very concerned about the quality and that the end result meets the products specifications. Still, a good follow-up system is also crucial for this project. Not so much to ensure customer satisfaction but to make sure the project meets its own specifications, as deadlines and budgets.

In this phase, the use of an engineering data management system is of great help to save, share/distribute and approve documents. When the ATLAS project started, a simple WEB based document and handling system where used. This was not considered as advanced enough and a process started to find an EDM system that could fulfil the needs of the whole LHC-project. In parallel, a system for CAD-drawings was developed at CERN, called CERN Drawing Directory, CDD. Both the CDD and the EDM system are currently at use in the ATLAS project.

Design and Engineering phase

In the design and engineering phase, the follow-up system is of outmost importance. As discussed in the previous chapter a follow-up system for ATLAS did not exist at the start of this phase of the project either. Without a defined follow-up system it is difficult to control the project. This concerns all aspects of the project. If follow-up variables have not been defined in the planning phase, often the control of the project is done on easy accessible, not very useful information. Another effect is too frequent reporting that overload the project team members with work and fills up the shelves of the project manager, it neither helps the project managers to keep the project on track and to fulfil the goal of the project within time and budget.

The breakdown structures of the project to a certain amount exist. The PBS is getting more and more detailed and is approved by the systems and the project management for the ATLAS project. The reporting and the communication of the project are being done through the Technical co-ordination meetings and the Executive Board meetings of ATLAS. In addition, the EDM system is being used to a certain degree for distributing documents. The finnish Tuovi team has developed an automated version of a simple Web-based system as an interface to the EDM system. The CERN Drawing Directory is being used for management of CAD-drawings in this phase. This system do has its limitations, because it does not address the need for exchange of data between multiple institutes as required not only by ATLAS but also by the LHC machine and the other three experiments.

The detailed schedules are important, and on the system level, the internal schedules of the systems exists but there is no coherency between the schedules. Moreover, there is no link between the schedules or with the master schedule. This link is important to maintain control over the project. Without this link, it is nearly impossible to analyse the effect of delays. As there exist no follow-up system on any level in the project, there is no proper follow up and control of the schedules.

A follow up system based on milestones is being implemented with a template for MS-Project. This template and the follow-up system are explained in detail in chapter 4.

Manufacturing/Testing/Installation phase

The project is at present date, going into this phase. Here the co-ordination of the project is very important. Co-ordination between the different systems is important through the whole project, but is especially important in this phase. Before this phase the systems can in some degree be seen as autonomous projects which are supposed to deliver parts to a common product, the ATLAS detector. And the systems are also seen as separate projects until this phase.

For this part of the project, the QAP states that co-ordination schedules shall exists for these areas:

- Installation
- External services
- Infrastructure
- Assembly and Test area

The first one do exist and the three others are now being prepared. For this phase the assembly breakdown structure (ABS) is also very important. All the breakdown schedules should, according to the model, be constructed in the first phase of the project to be able to plan and schedule the project. When this report is written, the ABS still does not exists, neither do the QAP report for the ABS. To ensure that the assembly is going to be successful, both the ABS and the co-ordination schedules has to be constructed and analysed and of course followed. This will require a lot of work from the technical co-ordination to gather all the necessary information from the systems.

Conclusions

Achieving the goal of building a "world class detector" will mostly be due to the fact that the project members are to a great extent the projects customers. The customers being the future users of the detectors facilities. However, there is a big question mark on if the project is going to reach its goal within the present deadline. One reason is the "difficult" project environment with 1700 physicists spread around the globe, almost all of them speaking different languages, using different computer systems/programs and operating in different cultures, both nationally and scientifically speaking. These 1700 physicist are organised in 10 systems but these ten systems have a tendency to consider themselves as autonomous projects and not as a part of a common project. This leads to co-ordination problems!
One other problem is the QAP which looks fine on paper, but without implementation it has very little value to the project. Some parts of the QAP is implemented but a lot is still missing. Examples are the breakdown structures of the project and the scheduling.
When it comes to the scheduling, the different systems have created their own schedules but they are not made according to the present standards. They are not coherent and most importantly, they are not linked to the master schedule. This is illustrated in Figure 19. All this deserve a supplementary man power effort.

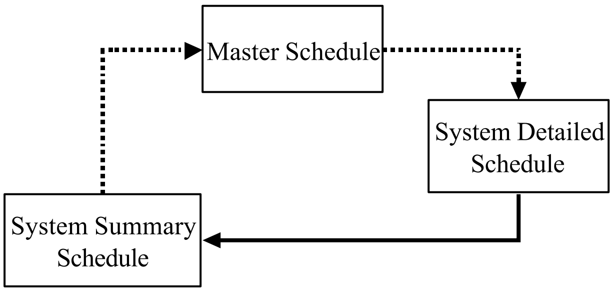


Figure 19 Missing links between the systems schedules and master schedule

A follow up system of the project is also missing. Now there exist a follow up system based on milestones on the system summary level (see chapter 4). This is however not sufficient for a large scale, complex and highly distributed project.

FOLLOW-UP SYSTEM FOR ATLAS

General description

The ATLAS project is a very complex project, not only because it is geographically distributed. Its collaborations and divers contracts and agreements also illustrate the highly complex nature of the project. For example, the costs calculated in man-hours are very difficult to track, because some work is done by institutes for a fixed amount of money and some work is done by departments at CERN where the costs are not directly charged the project. In addition there are a diverse set of funding-mechanisms for the project.

The complex nature of the project and its agreements make it difficult to use traditional follow-up procedures, like tracking planned man-hours. A solution to get some control with a complex project like the ATLAS project is to control milestones on the system level.

Each system has been asked to create or extract milestones from their system detailed schedules. The milestones should represent start and end dates of tasks and if possible/practical milestones for 10% readiness, 20% readiness, 50% readiness and 100% readiness.

The tools of the system are milestone-schedules from the ten systems, MS-Project template and Excel. The MS-Project template provides a common framework for the schedules so it will be possible to link the system schedules to the master schedule (see Figure 20).

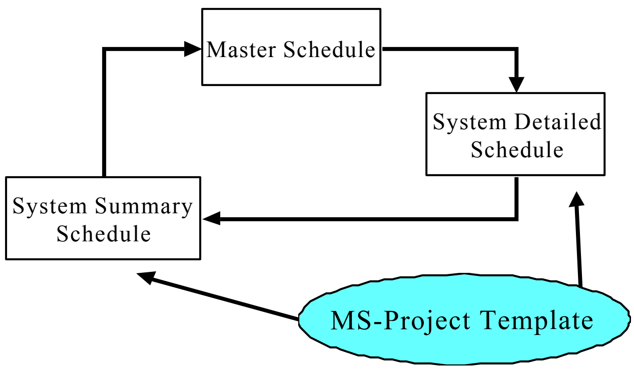


Figure 20 Linking of schedules with the help of template

A macro exports data from MS-Project and reports on milestones in Excel for a given period. This procedure will be described later in this chapter. Excel has also been customised to sort out the delayed milestones and report these in a separate sheet. A more detailed description of the macros and templates are given in chapter 4.2. Both MS-Project and Excel are programs that are being used in all ten systems. At CERN there is a common standard for all PC-users and the other systems are also using the same versions of MS-project and Excel.

The principle of the follow-up system is illustrated in the following figure:

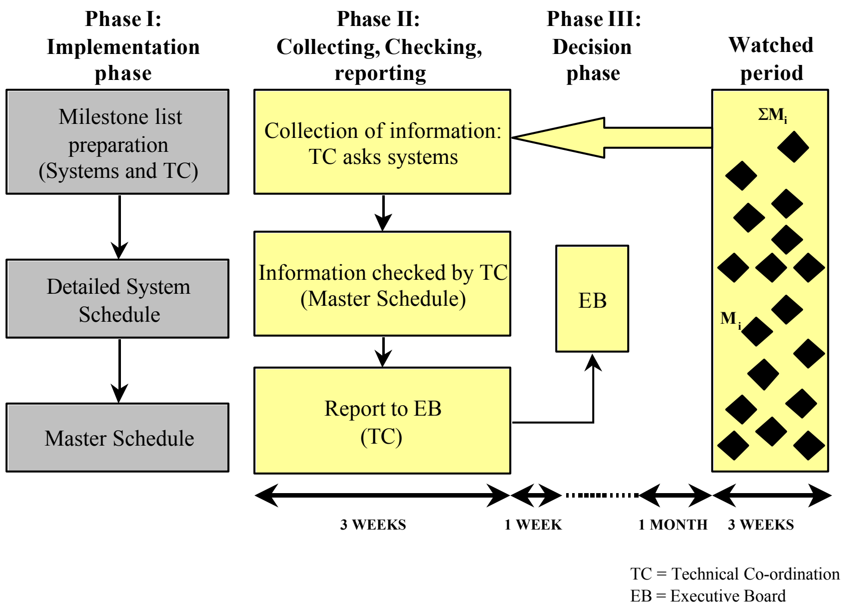


Figure 21 Principle of follow-up system

The follow-up system is divided into three phases:

- Phase I: Implementation phase
- Phase II: Monitoring and controlling phase
- Phase III: Decision phase

The follow-up is built up of three phases. The implementation is the first phase and consists of implementing the MS-Project template in the ten systems. In addition, the implementation phase consists of collecting the milestone-schedules from the systems. This is because the technical co-ordination shall have the latest version of the milestone-schedule to use for the follow-up procedure.

The second phase is the collecting, checking and reporting phase where milestones for a given period, three months, are extracted from the milestone schedules into an excel template (se chapter 4.2.2). The Excel-file is send to the relevant system and the system-responsible for an update of the current milestones. The filled out form with the correct dates and the possibly late or achieved milestones is send back to the technical co-ordination. The technical co-ordination collects all the files, extract the delayed milestones and investigates the effect of the delays. Then the technical co-ordination presents all the system milestones in a report to the Executive Board (EB) meeting.

The third phase is the decision-making made in the EB. When the effect of the delayed milestones is thoroughly investigated, the EB can take the final decisions for what to be done. The decisions on what to be done are made together with the project leaders of the ten systems. The feedback to the systems is done during and after the EB meeting.

The information flow in the follow-up system is presented in Figure 22.

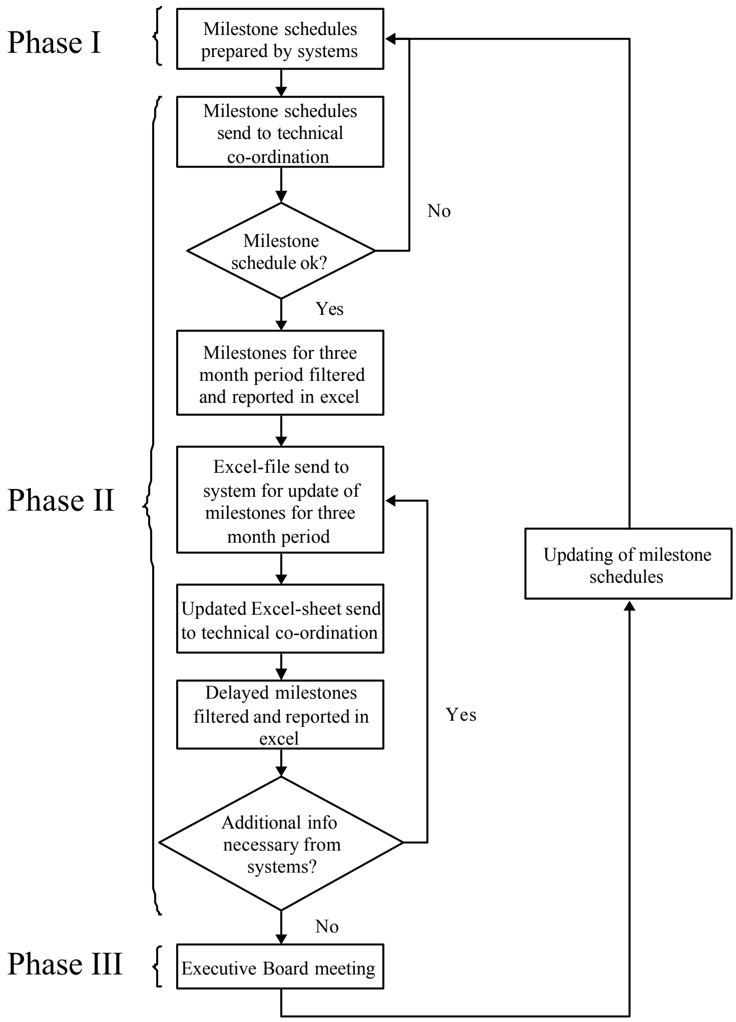


Figure 22 Information flow in follow-up system

The linking of the system schedules to the master schedules is crucial for the follow-up systems consistency and credibility. To follow up milestones for the different systems and to check these to the different systems is relatively simple. To compare and check what kind of impact the delayed milestones have on the master schedule, and the total progress of the project, is far more complicated.

Templates in MS-Project and Excel

MS-Project has been defined as the official Project management tool for ATLAS. It has been decided that a template is needed to ensure the same standard on the schedules and also to encourage the schedule responsible of each system to make the system summary schedule. The customisation of the program should make it easier for the project managers to create schedules for their systems schedules. It should also make a basis for the future linking of the schedules.

The main objective of the customisation is to make sure that all the schedules (on the system level) contain the same kind of information and that the layout is the same. The necessary information that the Project leaders should include is standard task codes, PBS-codes and PBS-names in addition to the task-name and start and end dates (see chapter 3).

To customise MS-Project, a template has been made, based on previous templates and discussions with the technical co-ordination of ATLAS. The template consists of several macros that formats the layout of the project text and bars in addition to functions for managing resources. The cost-functions of the program have not been explored because of the diversity of needs from the different systems and because of the multiple funding-possibilities of the project.

MS-Project provides a set of predefined "views" based on a calendar view, a Gantt chart view and PERT-view (Project Evaluation and Review Technique) see Figure 23, Figure 24 and Figure 25. The calendar and PERT-view have not been modified. The Gantt chart view has been used to create 4 special views for ATLAS.

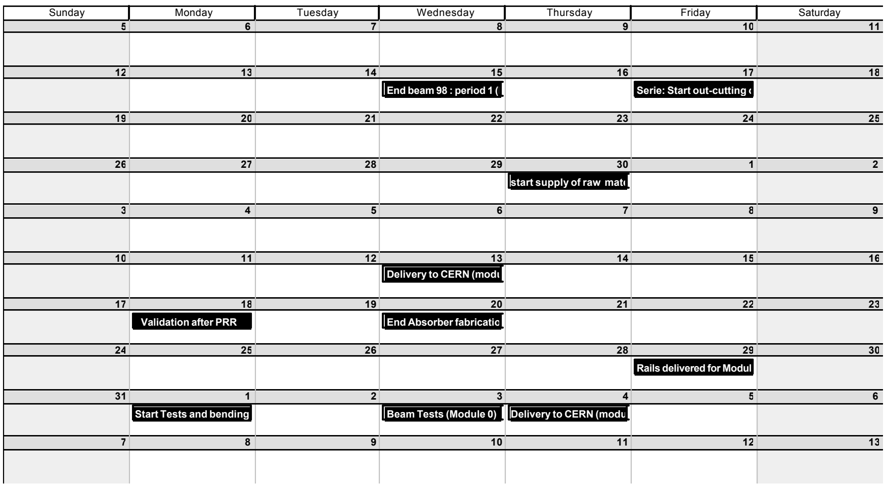


Figure 23 Calendar view provided by MS-Project

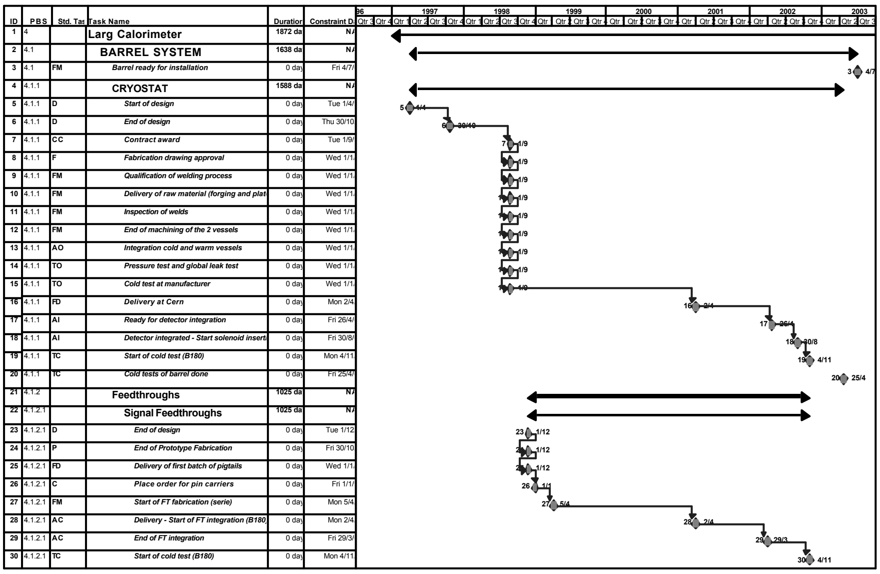


Figure 24 Gantt view customised in MS-Project

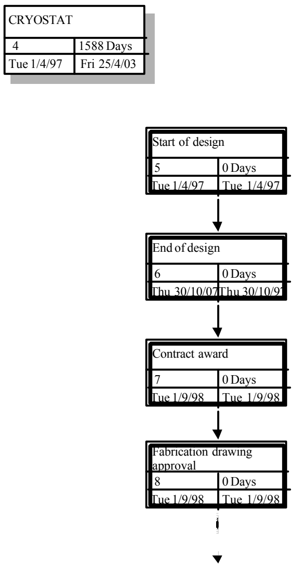


Figure 25 PERT view provided by MS-Project

The template has six basic views, where 4 are customised specially for ATLAS. The different views have been created to satisfy the needs of the project managers and the technical co-ordination. The view, Milestones_ATLAS, has been created to satisfy the needs of the follow-up procedures and it is the same for the view ReportMilestones@ATLAS. The Gantt-chart and the Print_ATLAS views have been modified to ease the creating and the presentation of the schedules, both on screen and on paper.

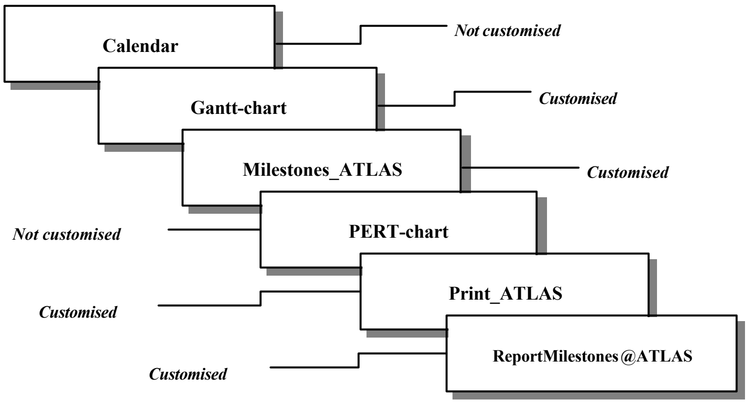


Figure 26 Six views provided by template in MS-Project

In addition, the tables, where the information of the tasks in the project is contained, has also been modified and some new tables has been created for the "new views". The modifying of the tables has the same motivation as the customising of the views.

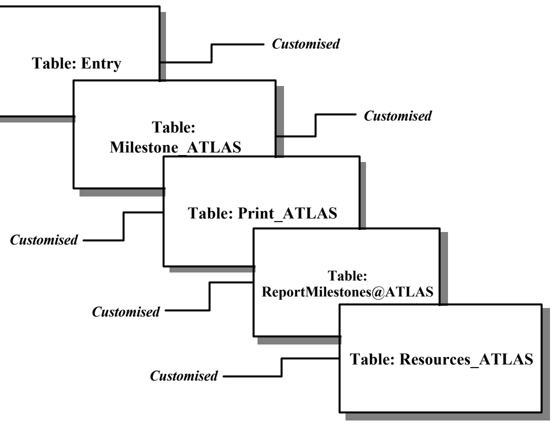


Figure 27 Tables in MS-Project customised for the ATLAS template

MS-Project macros

17 macros have been created. Most of the macros have been made to modify the layout of the schedule, either for the screen or the printer or both. Some of the macros are being used by other macros. To see the whole Visual Basic code of all the macros, see appendix 6. Also, see appendix 3: “Users guide for ATLAS-template” for a short description of the template and the macros.

The 17 macros are described underneath, some in more detail than others. The volume of the description reflects the complexity of the macros.

Time_Scale_YQ. Sets the time scale of the project. Years are major unit and Quarters are minor units. This macro exists is four versions, changing the time scale to four different scales: years and quarters, years and months, months and weeks and weeks and days.

Format1stCol_Atlas. Formats the task name column according to type of task. Differs between summary tasks, tasks or milestones. Differs also between tasks on different levels in the WBS. The macro scans through all the tasks of the schedule and checks what kind of type the task is.

Format1stColMile_Atlas. Formats task name column for milestone-view only. Works in the same way as Format1stCol_Atlas.

FormatGanttBars_Atlas. Formats the Gantt bars according to type and criticality. It defines styles for each possible type of task in MS-Project. This includes colour, pattern, shape and size of the bars. The macro also includes an "errorhandler" that creates a new bar-type when an error occurs. The macro has been tested and with this "errorhandler" the macro works.

FormatMilestones_Atlas. Formats milestone bars according to type and criticality. It works in the same way as FormatGanttBars_Atlas and has also an "errorhandler". This macro is used only for the Milestones_ATLAS-view. A separate macro is needed to format milestones when the milestones are filtered from the rest of the tasks. This is because of MS-Projects way of referring to tasks.

PrintFormatBars_Atlas. Formats Gantt bars according to Standard Task code attached to each task. This macro scans through all tasks in the schedule with focus on column "Text2" which contains the Standard Task code. According to which two-letter code is present in the column, the bar gets a colour. Milestones, empty tasks and summary tasks are not affected by this macro.

Resourceview_Atlas. Displays a split window with the Gantt-bar view as the upper part and the lower part a table where the user can assign resources to the selected tasks. This macro uses macro Time_Scale_YQ.

Resourcesheet_Atlas. Displays resource-sheet where user can enter all resources needed for the project. This sheet is not customised for ATLAS.

Milestones_Atlas. Displays all the milestones of the schedule. Uses a built-in filter that filter outs all milestones and displays them in Milestones_Atlas-view. This macro uses the macros FormatMilestones_Atlas and Time_Scale_YQ.

Milestones_Report. Displays milestones filtered with the customised filter Milestones@Atlas. The user types in for which period the milestones should be displayed. The milestones are then displayed in a customised report called Milestones@report.

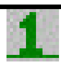
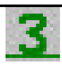
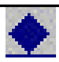
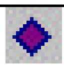
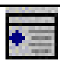
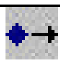
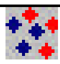
Entryview_Atlas. Formats the project in Gantt chart view with formatting the text with the correct style and formatting the bars of the project. This macro uses the following macros: Time_Scale_YQ, Format1stCol_Atlas and FormatGanttBars_Atlas.

Print_Atlas. Formats the project for printing with giving the bars a colour corresponding to the standard task codes. This view uses a simplified table, which do not display all the information as in the Entry-table. This macro also formats the column where the task is described. This macro uses the same macros as Entryview_Atlas, except for that FormatGanttBars_Atlas has been replaced with PrintFormatBars_Atlas. This macro scans through the project to check the two-letter standard task code of each task. According to the given two-letter code the bar is given a colour. This has been done to easily identify the different types of tasks to be done in the project.

Export_Milestones. This is a macro that is made especially for the follow-up procedures of ATLAS. The macro filters milestones for a given period. The filter gives the user the opportunity to type in the desired period for which the milestones shall be filtered. After the filtering, the milestones are copied, with some of the columns from the table. After the milestones have been copied, the macro starts excel. Excel has also been customised with macros. They will be described in the next chapter.

Some customised buttons have been made which gives an easy access to the macros. These are presented in Table 1.

Table 1 List and description of buttons in template for MS-Project

Button	Name	Function
	Enter Tasks	Use macro Entryview_Atlas
	Enter Resources	Use macro Resourcesheet_Atlas.
	Assign Resources	Use macro Resourceview_Atlas
	Print View	Use macro Print_Atlas
	Milestones	Use macro Milestones_Atlas
	Formats Task Name Column	Use macro Format1stColMile_Atlas
	Creates Milestones Report	Use macro Milestones_Report
	Filters and exports milestones	Use macro Export_Milestones
	Filters and Counts Milestones	Use macro Count_Milestones
	Changes the time scale	Use macros Time_Scale_XX where XX is YQ, YM, MW or WD.

Excel-macros

The follow-up system based on milestones, demands a reporting system where the project leaders easily can report on the achievement and delays of the milestones of their systems. To achieve this, Excel has been used. It is only the technical co-ordination that is going to use the excel-template, so no implementation has been necessary and therefor a users guide for this template has not been made.

As described before, one of the macros in MS-Project copies information to the clipboard and opens Excel. In Excel, the following macros has been created:

- OpenTemplate_Atlas
- InsertData_Atlas
- CountMile_Atlas
- CheckComments_Atlas

OpenTemplate_Atlas. It is a macro that opens the file Global.xlt. This file contains two sheets. Sheet 1 is for pasting the information from the clipboard and sheet 2 is for the delayed milestones (see Figure 28 and Figure 29).

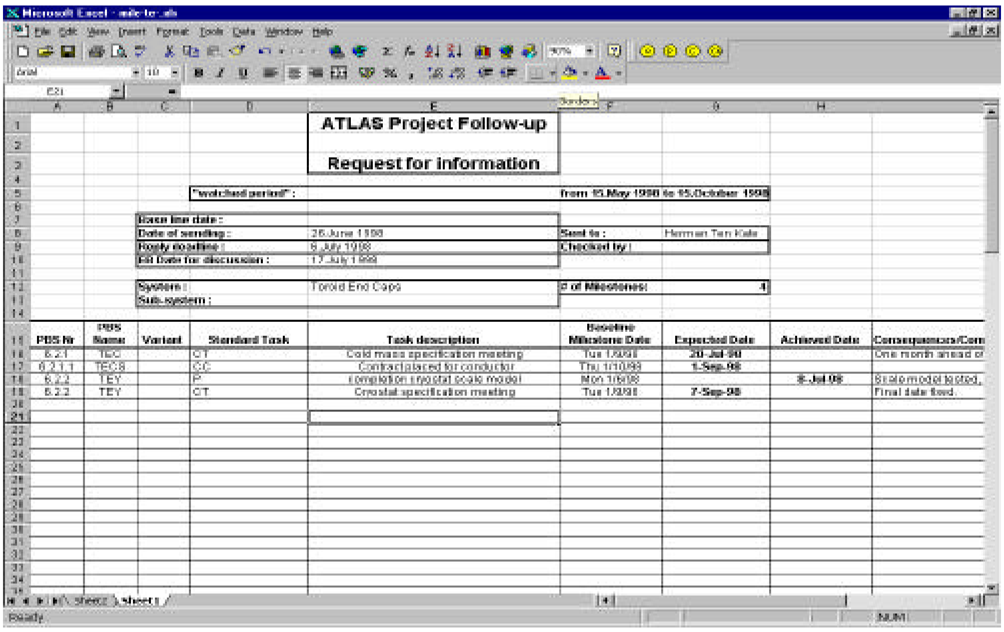


Figure 28 Request for information sheet

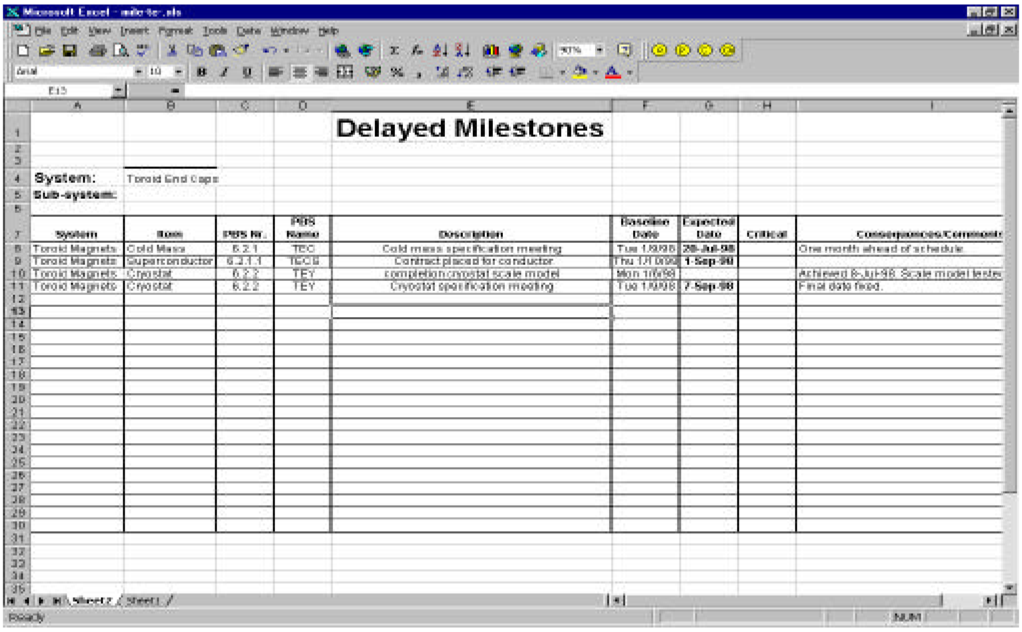


Figure 29 Delayed milestone sheet

InsertData_Atlas. Pastes the information from the clipboard to sheet 1. It is important that the columns of the milestone-table of MS-Project correspond to the columns in table in sheet 1. This macro has an error-handler. If there are no milestones to copy from MS-Project, the clipboard will be empty. This has created an error-message in case of no error-handler. The error-handler prints a message in the top row of the scheme in sheet 1 that says: "NO MILESTONES FOR THIS PERIOD". In addition, the macro formats the sheet with setting up boarders.

CountMile_Atlas. Scans through sheet 1 and count how many milestones there are. It displays the count-result in a cell in sheet 1.

CheckComments_Atlas. It is the most advanced macro made for Excel in this template. This macro scans through the column where the project-leaders are supposed to write the comments for the delayed milestones. It then copies the rows of the delayed milestones and pastes these rows in sheet 2. This macro also formats the sheet with setting up boarders.

For each macro, customised buttons have been created. These are listed in Table 2.

Table 2 List and description of buttons created for template in Excel

Button	Name	Macro
	Open ATLAS template	Use macro OpenTemplate_Atlas.
	Paste milestones	InsertData_Atlas
	Count milestones	CountMile_Atlas
	Copy and paste delayed milestones	CheckComments_Atlas

Discussion and conclusions

The monitoring and control system described in this chapter requires a template both for MS-Project and for Excel. The template for MS-Project has been created to ensure that all the systems of the ATLAS project have coherent schedules which contains the same information so it will be possible to link all the system summary schedules together. Before the template where send to all implied persons, it was tested by two of the project leaders in ATLAS. They made some useful remarks. Some corrections where made before the template was distributed to all project leaders in ATLAS. In addition the template together with the users-guide has been put in the EDMS-system at CERN. Everybody who has access to the EDMS system can download and utilise the template.

The monitoring and control-system described in this chapter is meant only for the system summary and master level. In the theory chapter (chapter 2) it was argued that large projects need more sophisticated planning and follow-up than a milestone plan and follow-up can provide. This is true, but when there are no other variables to monitor and control, you have to find the best possible solution, and at this stage of the project, milestone follow-up is one of the best ways. It is a possibility that the milestones are the easiest accessible data and therefor also easiest to control but not the most useful data to control. On the system summary level it is not possible, maybe not even desirable, today to plan and track man-hours worked on the project. For example, the people working in different departments at CERN are not registering the time they are working on the project. This is also the case for most of the external firms and institutes that contribute to the ATLAS project. This leads to a high uncertainty of the time estimates for each task. This simplifies the planning, scheduling and follow-up but it increases the uncertainty of the control of the project.

If the milestone follow-up system is going to work, the milestones have to be properly defined so that the variables controlled give useful information and gives the project management the control they need over the project. In addition, the project leaders must be willing to provide the information needed for each follow-up period. Last but not least, the system summary schedules must be linked to the master schedule. This should preferably be automated in a www-interface and not as it is today with a "manual" system using the e-mail as main communication tool.

The different macros made in MS-Project and Excel and their role in the projects lifecycle is presented in Figure 30. Macros for Excel are in italic.

<table>
<tr><th rowspan="2">Project Life cycle</th><th rowspan="2">Detailed Phases</th><th colspan="2">Project Management</th><th colspan="3" rowspan="2">Scheduling</th><th rowspan="2">Macros</th></tr>
<tr><th>Quality</th><th>IT</th></tr>
<tr><td>Definition</td><td>Definition</td><td>-Objective
-Planning system
-BS
-Defining QAP
-Risk analyses
-Planning Follow-up system</td><td>-e-mail
-www
-EDMS
-Planning tools
-Statistical progr.
-Simulation
-Office system
-Accounting</td><td rowspan="3">Master Schedule</td><td></td><td rowspan="2"></td><td>Time_Scale_YQ
Format1stCol_Atlas
Format1stColMile_Atlas
FormatGanttBars_Atlas
FormatMilestones_Atlas
PrintFormatBars_Atlas
Milestones_Atlas
Entryview_Atlas
Print_Atlas</td></tr>
<tr><td rowspan="2">Execution</td><td>Design/ Engineering</td><td>-Implementing QAP, only partly
-Design process and control
-Linking detailed schedules to master schedule
-Implementing Follow-up system
-Reporting</td><td>-e-mail
-www
-Scheduling tools
-EDMS
-Accounting
-Office system</td><td rowspan="2">System Detailed schedule/System Summary Schedule</td><td>Resourceview_Atlas
Resourcesheet_Atlas
Milestones_Report
Export_Milestones
Open template_Atlas
InsertData_Atlas
CountMile_Atlas
CheckComment_Atlas</td></tr>
<tr><td>Manufacturing</td><td>-Reporting
-Manufacturing and logistics</td><td>-Control system
-Manufacturing
-EDMS</td><td>Co-ordination schedules</td><td></td></tr>
</table>

IT: Information Technology
QAP: Quality Assurance Policy
EDMS: Engineering Data Management System

Figure 30 Macros developed and their role in the projects lifecycle

WORK PACKAGE MANAGEMENT SYSTEM

Goals and structure

The Work Package Management System (WPMS) is intended to be used to define work needed to accomplish the project and to monitor the progress of the project. The aim of the proposed follow-up system is to provide up to date management reports and to predict potential arising problems in matter of time, cost and risk. Basic functionalities of the system are the following:

- Work package creation
- Work package access and editing
- Progress reporting and follow-up

The goals of the system is stated in the specification document (Bachy et. al., 1998) and are as follows:

1. To assist project managers and sub project managers to define their workpackages
2. To make sure that all necessary work is defined (all PBS parts belong to a Work Package)
3. To make sure that unnecessary work is not defined (no extra inputs, outputs)
4. To co-ordinate work between different Work Packages
5. To assist progress reporting of the project (Content, Schedule, Costs and Risk)

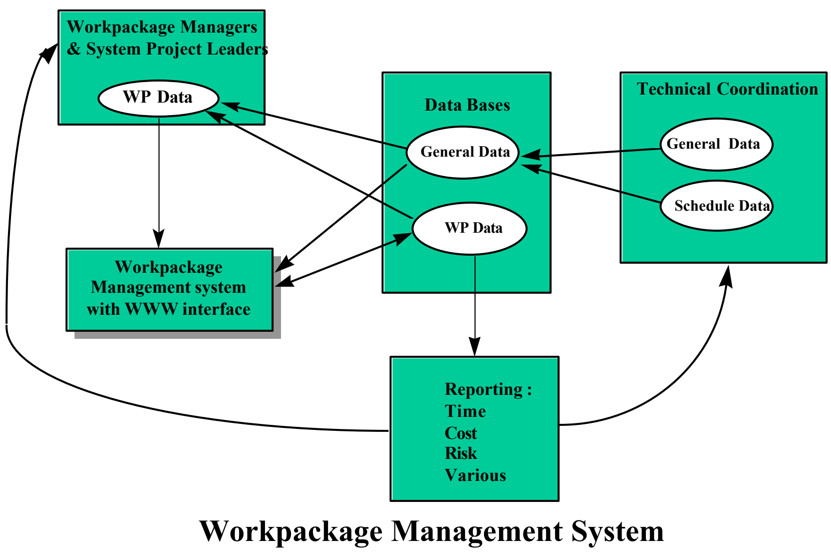


Figure 31 Work Package Management System, overview (Bachy et. al., 1998)

The expected users of the system are the project leaders, work package managers and other members of the project. The project leaders will use the system to work out management reports, status reports, “emergency-reports” and so on. The work package managers will also use the WPMS as a reporting tool and to also to access the linked Work Packages. Other members of the project can access the system to get information about scope and targets for the Work Packages and responsible systems/institutions/persons and so on.

Because the project is geographically distributed it is a need for efficient and easy-to-access communication. All the project managers and project teams must be able to access information easy and whenever they need. In addition, the project is large and complex. There is a need for visualising structures and dependencies between the structures. There is also a need for automatic report generation to get easy access to follow-up data. A large project like ATLAS has a lot of users with varying experience with IT-tools. This situation demands simple and easy-to-learn tools. In addition, the project has a long lifecycle and the tools developed need to be configurable and maintainable. The needs of the project to the system will change during the projects lifecycle. Last but not least, the lack of experience in modern project management techniques creates a need for clear instructions and support for the users. The implementation phase of a software is just as important as the development phase.

To be able to use the WPMS effectively, the break down of the project has to be done properly. The WBS is based on the Product Breakdown Structure (PBS) and the Standard Task list (see chapter 3). The work packages define the work needed to produce the parts of the Product Breakdown Structure. The elementary activity of the WBS is called a work-package. A work package is defined as a contract and should contain the following information:

WHAT: the deliverables to be produced (<u>Output</u>, specifications, drawings, parts...) and their quantity

HOW: the necessary means to complete the task (<u>Input</u> needed, cost, procedures, tooling....)

WHERE: Institute, Laboratory, University or Industry

WHO: the responsible person

WHEN: the time schedule for the task (start and end dates as well as intermediate milestones).

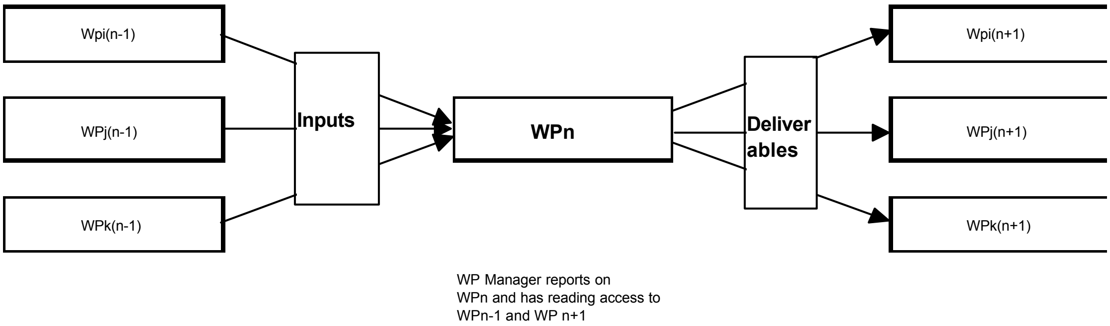


Figure 32 The Work Package "network" (Bachy et. al., 1998)

Figure 32 shows the basic principle that must be fulfilled if the WPMS is going to work. Each WP must be linked upstream to other WPs providing the necessary input to start the process and down stream in matter of deliverables for next WPs. All the linked WPs make up a network called Work Breakdown Structure. The successive Work Packages are suppliers and customers to each other.

User interface

The system will, when finished, have a user-friendly interface, accessible via www. The hart of the system is the WP Data Sheet, see Figure 33

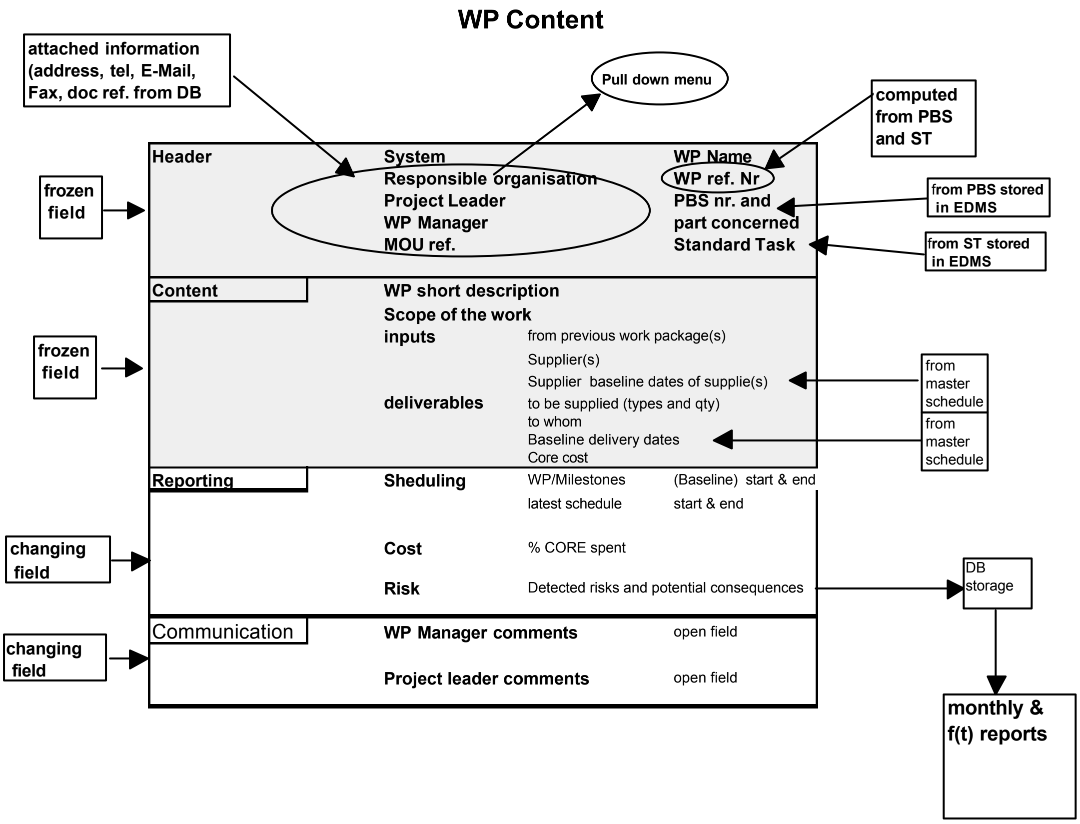


Figure 33 Proposal for Work Package Data Sheet (Bachy et. al., 1998)

Each work package sheet consists of four parts:

- Header information (frozen field)
- Contents (frozen field)
- Reporting part (changing field)
- Communication field (changing field)

The header information defines which system the work package belongs to, where in the WBS does the WP belong and who is responsible for the work package. This is a frozen field. When the work package is defined and approved, this field is not possible to change. The second frozen field is Content. Here the WP-responsible gives a description of the work package. In addition, the inputs and outputs with belonging dates and core costs are defined. The reporting field is changeable. Here the scheduling of the work package is being done, with defining baseline dates and if necessary, milestones of the work package. The % core cost spent shall be registered here. Aspects concerning risk is filled inn in this field. The last field, communication gives the project leaders and WP-managers the opportunity to give comments concerning the WP. The different fields interact with the EDM system. For example, the header field is almost automatically filled, because to be able to create a work package, the user has to log in with his user name and password. The username is linked to the users location, system and area of responsibility. To create a WP the user also has to define for which part the work should be done, and has therefor to select the PBS-node where the WP shall be created. The PBS nodes are the structure of the www-interface for each system.

Discussion and conclusions

The goals of the system are among others to give the project a follow-up tool. It should make it easier to monitor the project on several levels and with the focus on different variables. It should also ease the reporting of the project. The system of the "work-package network" where the successive work packages are customers and deliverers to each other allows the top project management to delegate responsibility to the work package managers. With this system it will be possible to shift the power and responsibility downward in the organisational hierarchy. The load of the control-work on the technical co-ordination can become less heavy.

The WPMS can be used actively for the scheduling of the project. All the work packages are given start and end dates and also milestones if required. This data can be transferred to a table in MS-Project and a schedule can be created based on up to date data. The status of this work is at the moment unclear. There are some problems with the compatibility of the data from the database of the WPMS and MS-Project. The problems have not yet been solved and it could be just another bug from Microsoft!

The WPMS is at present day not yet ready but under implementation. It remains to be seen if the system will be integrated in the project management work. Since this system is introduced in the middle of the project, it will take some time to change the work habits. Today the only system accessible via www is the Tuovi-interface for the EDMS and CDD. Moreover, the WPMS demand that the project managers define the work packages for their respective systems down to a certain level. This adds to their already heavy workload. It also may seem a bit late to implement such a system in the middle of the project life cycle. However, this project is going to run at least until year 2005 and from now and until then, the project needs a control system, which is more advanced than the milestone follow up. One more aspect of this system is the danger of project leaders that get over-eager and wants to put all their work packages into the system. This will overload the system, create far too many status reports and will only lead to too much administration.

To sum up, this system can be, if integrated in the project management work, a good planning, monitoring and control system for ATLAS.

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK

Scheduling

A project like ATLAS with its distributed nature require strong co-ordination on all levels of the project. For the schedules, there is now being developed a system for controlling and co-ordinating the schedules. Before this work started, the systems either did not have any schedules or if the schedules existed, they were in a local format not compatible with the master schedule. This is mainly due to the lack of implementation of the Quality Assurance Policy and the lack of awareness in the systems of the necessity of being integrated in the overall project.

Since the schedules are not coherent, there is no possibility of linking the schedules to the master schedule, neither automatically nor manually. As stated before in this report, the link between the system summary schedules and the master schedule are crucial to be able to obtain a follow-up system that are useful for monitoring, controlling and reporting in a project. This is especially true for large scale distributed complex projects like the ATLAS project. The Technical Co-ordination shall obtain this within short time.

A new simplified template for MS-Project has been implemented in the systems for creating schedules during this thesis. This template is currently in use to create milestone schedules for the milestone follow-up system.

Follow up

A complete procedure for ATLAS do not exist yet. Neither on the system detailed level nor on the master schedule level. This makes control of the project very difficult. As there is no overall follow-up there is no follow-up of the schedules and thus no control of the project. As stated before in this report, a proper follow-up system is crucial for the success of the project. Without monitoring and control of important variables it is difficult for the project management to be sure of that the project is "on track" and not out of control.
For this reason a provisional follow-up system based on milestones has been developed and implemented during this thesis. It is based on the use of MS-project and Excel. MS-project has been used to create milestone schedules. Excel has been used to create reports and e-mail has been used to communicate between the systems and the technical co-ordination.
A follow-up system based on milestones is not considered powerful enough for a large scale project like ATLAS. However, the very complex and distributed nature of the project makes it difficult to implement a more sophisticated system. More effort should however be put into the follow-up of the project, on all levels and concerning all aspects of the project.
A WPMS shall be the solution to a proper follow-up system. This however demands a strong involvement by the technical co-ordination managers to emphasise the importance of such a system for the whole project. If the WPMS is not properly implemented and used

there is no meaning in using time and money on developing such a system. It is also important to keep in mind that an IT-tool does not solve an organisations problems!

Recommendations for further work

- Further work with follow up of the use of MS-project template is needed to ensure all schedule responsibles in the ATLAS-systems are using it.
- Linking the system schedules to the master-schedule preferably using a www-interface.
- Continue to improve the milestone follow-up system until the WPM system is up and running
- Increase efforts in implementing the WPMS. Educate the future users of the system to shorten the time between implementation phase and the active use of the system.
- Update existing QAP reports and write missing QAP reports needed for the rest of this projects lifecycle

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Appendix

Prestudy Report

Schedule Management in Globally Distributed Project Environment

Diploma Thesis

Stud. Techn. Marianne Kulseth

Prosjektstyring år 2000

Norges Teknisk Naturvitenskapelige Universitet
Institutt for Produksjon og Kvalitetsteknikk
Geneve 2.April 1998

Contents

INTRODUCTION

CERN (Conseil Europeen pour la Recherche Nucleaire) was one of the first European organizations created after World War II and has served as a model for similar joint ventures. It was established in 1954. The aim of CERN is to study the nature and structure of matter. The CERN experiments are also designed to give a better understanding of the behavior of matter, i.e. the interactions between the different components of matter. The branch of physics incorporating this type of fundamental research is called “particle physics”.

In July 2005 a new particle accelerator at CERN is going to be finished. The new accelerator is the Large Hadron Collider (LHC). For the new accelerator a new detector is needed; the ATLAS-detector. This detector is going to be five stories high (20 meters) yet able to measure particle tracks to a precision of 0.01 millimeters. The innermost sensors in ATLAS will contain about 10,000,000,000 transistors, nearly as many as the number of stars in the Milky Way. The building of the detector require new or improved technologies and collaboration between scientists and engineers all over the world.

The creating of the ATLAS-detector is run as a project. The organization of the project is described in Figure 34 and Figure 35.

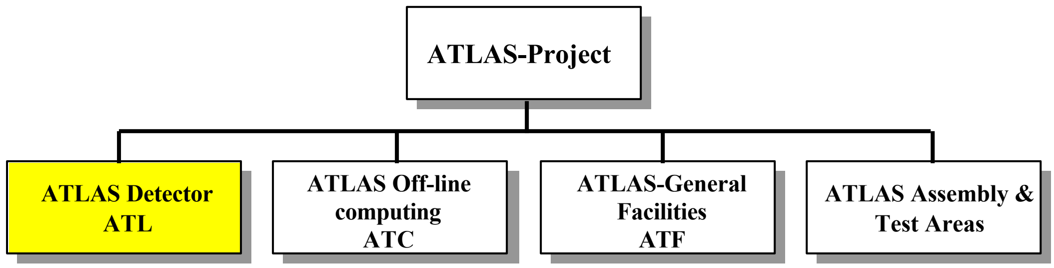


Figure 34 Structure of the ATLAS-project

The ATLAS-project, as can be seen from Figure 34, is divided into four major areas. First you have the ATLAS Detector. Then you have the ATLAS Off-line computing, ATLAS General Facilities and ATLAS Assembly & Test areas. This report will focus on the project management in the ATLAS Detector.

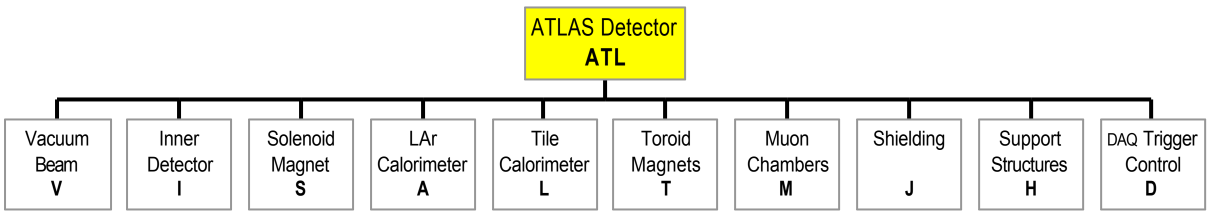


Figure 35 The ten subsystems of the ATLAS Detector

The ATLAS Detector is divided in ten subsystems:

1. Vacuum Beam, V
2. Inner Detector, I
3. Solenoid Magnet, S
4. LAr Calorimeter, A
5. Tile Calorimeter, L
6. Toroid Magnets, T
7. Muon Chambers, M
8. Shielding, J
9. Support Structures, H
10. DAQ Trigger Control, D

For seven of these sub-systems, their project leaders are situated at CERN. The rest are situated in Japan, UK and France. This applies to subsystems 2, 3 and 4.
All the sub-systems are again divided into smaller systems. These “sub-sub-systems” are also distributed all over the world. In total there are 1700 physicists at 150 universities collaborating in constructing and designing the ATLAS-detector.

ANALYSIS OF SCHEDULING IN ATLAS

The ten sub-projects in ATLAS are distributed all over the world, it is thus difficult to make all the systems use the same procedures and document formats. However, there has been approved common procedures for how to plan, break down and schedule the projects within ATLAS. All these procedures are written in the QAP-reports (Quality Assurance Policy reports) [4]. In addition all ten sub-systems of ATLAS is using MS-Project to schedule their projects. In what extent the procedures in the QAP-reports have been implemented is yet to be found out.

The scheduling process of the ATLAS-detector is composed of three levels:

- The Master Schedule
- The System Summary Schedule (systems)
- The system detailed schedules (sub-systems)

The Master Schedule defines all major activities needed to construct the detector. It defines time constraints and interdependencies between the major tasks. This includes the Project Breakdown Structure (PBS) items down to the third level (event 4^{th}) and the associated standard tasks at the top level. In addition it includes all the milestones relevant for the ATLAS-project.

The subsystem detailed schedule is made by the subsystems respectively. They should use the PBS Coding to the lowest level as well as the standard tasks down to the detailed level. This is done as needed by the various sub-systems to manage their projects.

The System Summary Schedule shall be established by each of the ten subsystems compiling the entire sub-system detailed schedule. This summary schedule is used as an input to the master schedule.

One of the main challenges is to link the system summary schedules from the ten subsystems to the master schedule. In order to do that, all the schedules from the sub-systems have to be in a common format. This can be done with a template in MS-Project which defines the layout and the structure of the schedules. Together with the QAP-reports this will ensure that the schedules are on the same format, simplifying the linking and the collation of the schedules. Another purpose of standardizing the schedules is also to make it possible to have an automatic follow-up system of the whole ATLAS-project. The follow-up system will be based on the use of MS-project and www/e-mail.

THEORY

According to PMI [2] a project consists of different processes. There are two major categories; project management processes and product-oriented processes. The first concerned with organising and describing the work of the project and the other concerned with specifying and creating the project product. The project management processes can be organised into five groups of one or more processes each as shown in Figure 36:

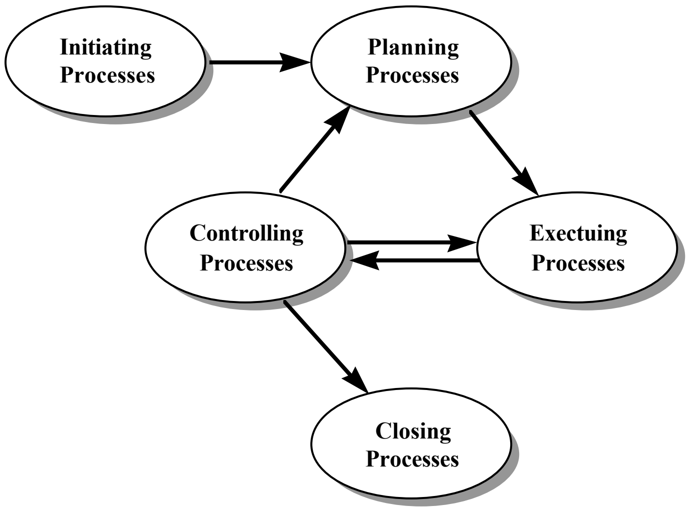


Figure 36 Process groups within a phase of a project [2]

These project-processes can also be different phases within a project. First you have the initiating phase with the pre-studies and the go-no go decisions. Then you enter the planning phase where the schedules and the resource-planning is made. You execute the project and control it until the end of the project is reach and you close the project. The planning, execution and controlling is an iterative process with a continuos development and correction of the schedules.

Planning

The purpose of planning can be summed up in five points [1]:

- Get insight in the task that has to be solved
- Get insight in the work that has to be done
- Get a basic understanding for the scope of the project to be able to commit resources
- Be able to assign resources and organise the project-work
- Obtain a basis for follow-up

It is important to differ between the strategic planning and the detailed planning. The strategic planning is also called milestone-planning and the detailed planning is also called activity-planning [1]. The reason for why one should have two levels when planning is that first you have to decide what to do, and then you can decide how to do it. A project will also consist of different phases. Often you have a pre-study project which investigates the need of the project and the need of the customers which have initiated the project. The second phase can consist of the carrying out of the project. The second phase can again be divided in different phases.

A milestone plan is showing the logic of the project. An example of a milestone plan is showed in Figure 37:

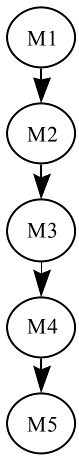


Figure 37 Milestone plan [1]

To achieve milestone 5 you have to first achieve milestone 4 and so on. However, the activities you have to do to achieve milestone 5 can start before milestone 4 is rolled-up. This is very important to understand.

The plan in Figure 37 is however not typical for a project. This plan is one-dimensional, where as most projects are multidimensional because the project has to satisfy several needs. You get result courses for milestones that contributes to a specific result in the project. This is shown in Figure 38.

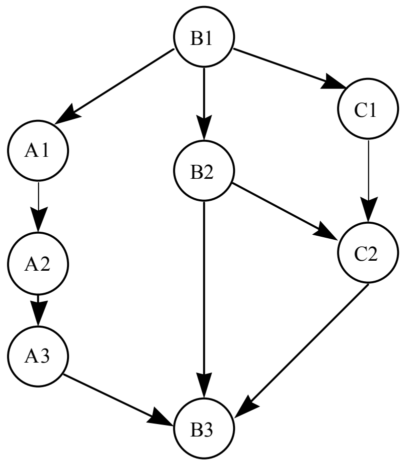


Figure 38 Multidimensional Milestone plan [1]

You have three result courses in Figure 38. The purpose of why one should use result courses in the milestone planning is to focus on what results the project should achieve. Before one decides the final result courses of the plan, one should try to see if there are certain areas that might be critical for the project, for example quality assurance. This could be one of the result courses. It is important to understand that the result-courses changes for each phase of the project. For the pre-study you will have one set of result courses and for the carrying out of the project you will have a different set of result courses. This is due to the fact that each phase creates different result/output.

Follow up

During the project you need procedures to follow up the project. To follow up a project is not the same as reporting the status of the work. To follow up is to do what is required based on the status-reports, whether it means to move milestones and maybe delay the whole project, assign more resources or lower the demands for the output. Rolstadås [3] divides follow up in two tasks:

- Registering progress
- Carry out corrective action

Andersen, Grude & Haug [1] points out two attitudes which is very negative for all follow up and for the accomplishment of a project:

- “I am sure it will work out”
- “Let us just wait and see”

It is thus important to not behave like an ostrich which refuses to acknowledge the problems and to initiate action. Often the main problem is not that you do not know that the project is delayed, but that you do know but you are paralysed.

How to obtain a good follow up

Reporting is important but it should not imply too much bureaucracy and elaborate procedures. It is also important that people feel that their reports are useful, and that they are not used to fill up the bookshelves of the project-manager. To avoid a lot of uninteresting reports with either "Everything OK" or pages of details and "chatting", Andersen, Grude & Haug [1] suggests to define standard procedures. The standard procedures can mean that the reporting is to be done on certain time intervals. How often one should report, depends on what level you report from. On the activity level it might be necessary to report more often than on the strategic level.
Reporting according to the milestones should include:

- Description of the milestones
- Actual finish and expected finish of the milestones

PURPOSE OF WORK

The ATLAS-project is globally distributed. This means there are several challenges to work with. One of them is the scheduling. This report is a pre-study for a project done as a final thesis to finish my studies. The operational tasks of the thesis will be the following:

- Develop standard procedures to be used by the various sub-systems
- Establish the necessary links between the System summary schedules and the Master Schedule. This should include all the filtering process to compress the information from the sub-systems into a relevant and necessary information at the Master level.
- Further automate and develop this process and related tools from the user point of view.

At the end of my thesis I will finish a report which shall include a description of the ATLAS project with emphasis on the scheduling process, a study of related theory, a discussion of the results achieved from the operational tasks and a rough plan for further work with schedule management.

WBS

An overview of the workpackages are given in the following figure:

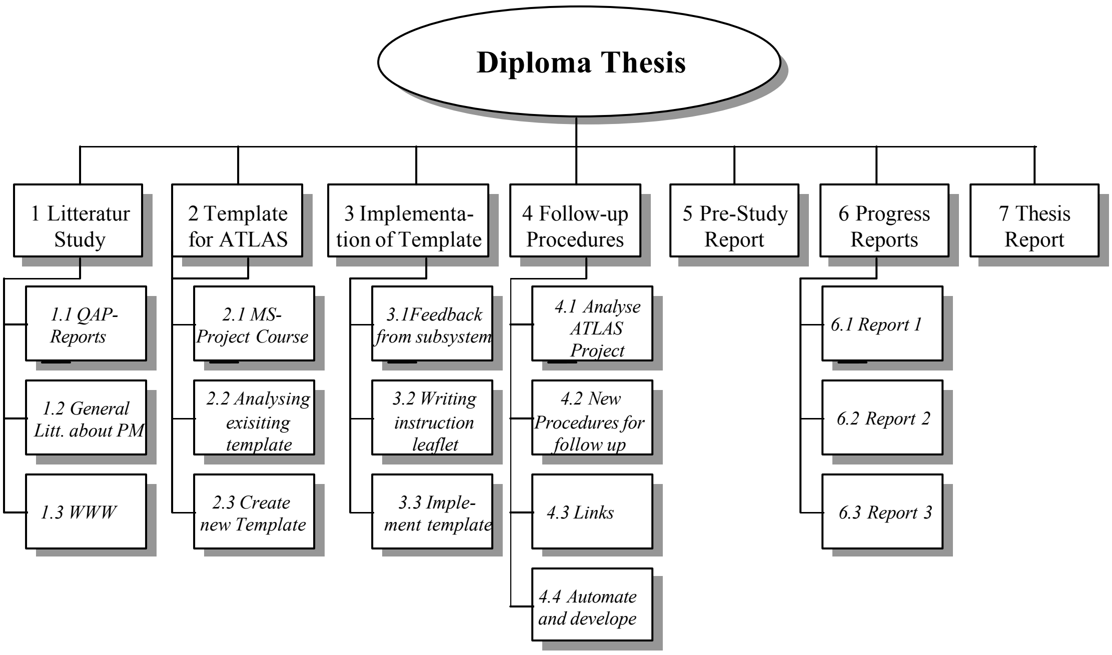
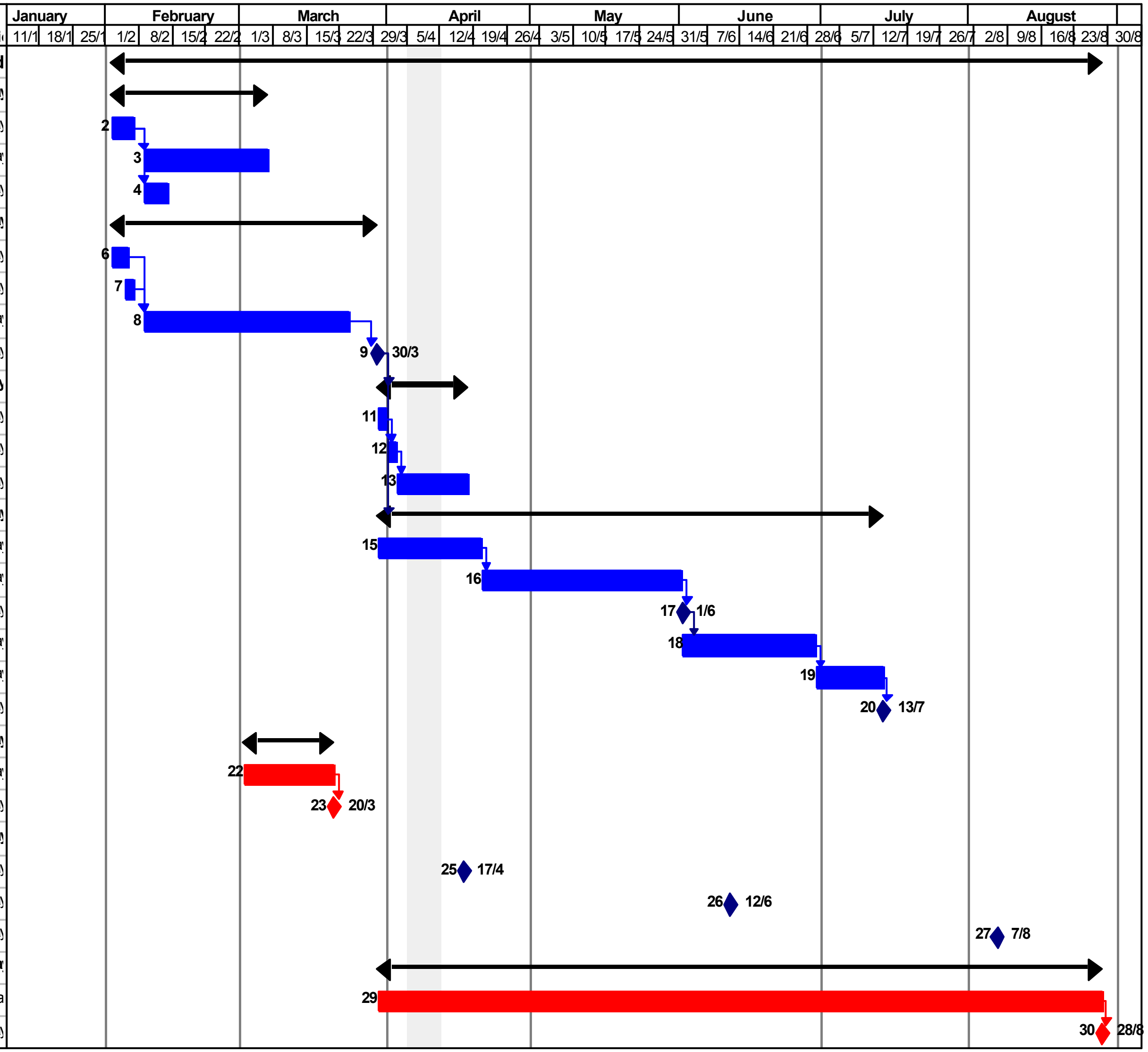


Figure 39 WBS of Thesis

Progress Reports

I have planned three progress reports: 17.April, 12.June and 7.August. These progress reports will be send to my supervisors in Trondheim and at CERN. These reports will also be a part of the final report which shall be finished 1.september 1998.
The progress reports shall include a roll-up of the gantt-chart according to progress. It shall comprise a summary of what have been done since last progress-report. It will also report any changes in the work-packages and adding of work-packages.

ID	WBS	Task Name	Durati
0	0	**Schedule Management**	144 d
1	1	**Litterature study**	25 day
2	1.	QAP-reports for ATLAS-Project	5 day
3	1.	General Litterature about PM	20 day
4	1.	WWW	5 day
5	2	**Making template for ATLAS-project**	40 day
6	2.	Analysing existing template	4 day
7	2.	Attending MS-Project course	2 day
8	2.	Experimenting and working out new template	31 day
9	2.	***New template***	0 day
10	3	**Implementation of new template**	9 day
11	3.	Feedback from target subsystems	2 day
12	3.	Writing instruction leaflet	2 day
13	3.	Implement template	5 day
14	4	**Follow-up procedures for ATLAS**	70 day
15	4.	Analyse ATLAS-project	10 day
16	4.	New procedures for follow-up system	30 day
17	4.	***Follow-up procedures finished and imple***	0 day
18	4.	Establish links between System Summary schec	20 day
19	4.	Automate and develop follow-up system	10 day
20	4.	***Automated follow-up system implementec***	0 day
21	5	**Pre-Study Report**	15 day
22	5.	Writing	15 day
23	5.	***Pre-Study Report Finished***	0 day
24	6	**Progress Reports**	80 day
25	6.	***Progress Report 1***	0 day
26	6.	***Progress Report 2***	0 day
27	6.	***Progress Report 3***	0 day
28	7	**Thesis Report**	104 day
29	7.	Writing report	104 da
30	7.	***Diplomathesis finished***	0 day



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1st Progress Report

20. April 1998

Schedule Management in
Globally Distributed Project Environment

Diploma Thesis

Stud. Techn. Marianne Kulseth

Prosjektstyring år 2000

Norges Teknisk Naturvitenskapelige Universitet
Institutt for Produksjon og Kvalitetsteknikk
Geneve 20.April 1998

1. WHAT HAS BEEN DONE SINCE THE START OF MY WORK AT CERN

- Finished the literature study. List of literature is included in the pre-study-report.
- Finished pre-study report which has been sent to my supervisors and Bachy.
- Worked out a template which has to be implemented in the ten systems
- Worked out a semi-automatic system for follow-up together with Gerard Bachy. Has to be implemented. The first follow-up test-period is being launched these days and the deadline for each system to answer is 22nd of April.

1.1 Description of the follow-up system:

Each system creates a schedule in Project 98 according to the template and the rules stated in the QAP-reports. The schedule shall include milestones for start and end of tasks, 10% finished tasks, 50% finished tasks and so on. The milestones of the schedules are filtered out and sent to Mr. Gerard Bachy and me. We filter out milestones for a given period, approximately three months. These milestones are included in a Report-form made in Excell (see Figure 40). The project-leaders of the sub-systems receive the report-form by e-mail where they have to fill it in with expected and, if milestone is rolled-up, achieved date. To ensure that the baseline for the milestones are correct, the project-leaders are also asked to check the baseline milestones. The reason for why they have to check the baseline date is due to a Microsoft "feature" which has a tendency to change the dates of the tasks in a project file when send by e-mail. Why this happens, are yet to be found out.

In case of delays, the project leaders have to explain why and make any comments they find appropriate.

ATLAS Project Follow-up

Request for information

"watched period" : from to

Base line date :
Date of sending : Sent to :
Reply deadline : Checked by :
EB Date for discussion :

System :
Sub-system :

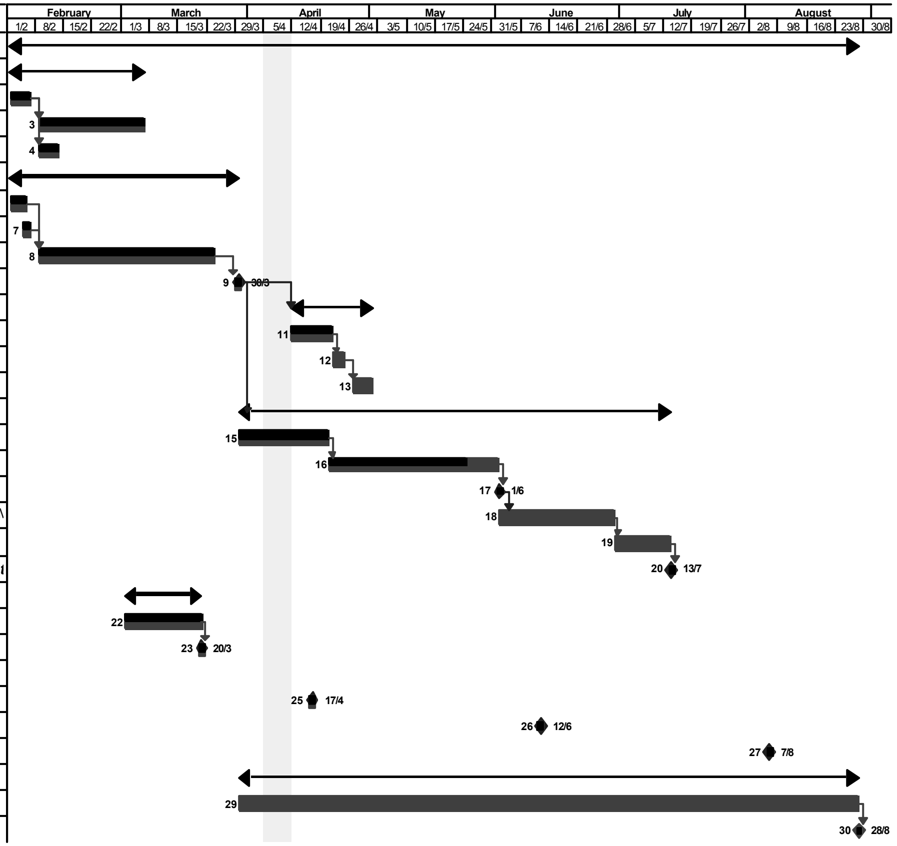
PBS Nr	Variant	Standard Task	Task description	Baseline Milestone Date	Expected Date	Achieved Date

Figure 40 Project Follow-up Form

2. FURTHER WORK

- Continue to improve the template in MS-Project 98
- Implement the template in all ten systems of ATLAS-project
- Prepare a users-guide for template
- Start writing on the thesis-report

ID		WBS	Task Name
0		0	**Schedule Management**
1	✓	1	**Litterature study**
2	✓	1.1	QAP-reports for ATLAS-Project
3	✓	1.2	General Litterature about PM
4	✓	1.3	WWW
5	✓	2	**Making template for ATLAS-project**
6	✓	2.1	Analysing existing template
7	✓	2.2	Attending MS-Project course
8	✓	2.3	Experimenting and working out new template
9	✓	2.4	***New template***
10		3	**Implementation of new template**
11	✓	3.1	Feedback from target subsystems
12		3.2	Writing instruction leaflet
13		3.3	Implement template
14		4	**Follow-up procedures for ATLAS**
15	✓	4.1	Analyse ATLAS-project
16		4.2	New procedures for follow-up system
17		4.3	***Follow-up procedures finished and implemented***
18		4.4	Establish links between System Summary schedules and M
19		4.5	Automate and develop follow-up system
20		4.6	***Automated follow-up system implemented in target***
21	✓	5	**Pre-Study Report**
22	✓	5.1	Writing
23	✓	5.2	***Pre-Study Report Finished***
24		6	**Progress Reports**
25	✓	6.1	***Progress Report 1***
26		6.2	***Progress Report 2***
27		6.3	***Progress Report 3***
28		7	**Thesis Report**
29		7.1	Writing report
30		7.2	***Diplomathesis finished***



ATLAS project	CERN	**Installation- and users guide to ATLAS-template for MS-Project 98**

ATLAS Project Document. No. *Project - System - Type - Sequential No.*	Institute Document No.	Created	Page
ATC-OS-SN-0001		28-May-1998	1 *of* 9
		Modified 28-May-1998	Rev. No. **1.0**

INSTALLATION AND USERS GUIDE TO ATLAS TEMPLATE FOR MS-PROJECT 98

Abstract

This document describes how to use and install a template for MS-Project 98. The template is to be used for making schedules within the ATLAS project. The purpose of the template is to make sure that all schedules within ATLAS are coherent.

Prepared by :	***Checked by :***	***Approved by :***
Marianne Kulseth	**Gérard BACHY**	

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Herman Ten Kate		

History of Changes

Rev. No.	*Date*	*Pages*	*Description of Changes*

Table of Contents

1. REFERENCES

[1] ATL-GE-CERN-QAP-0303.01
[2] ATL-GE-CERN-QAP-0303.02

2. PURPOSE

The purpose of the template is to make the schedules of the ATLAS project have the same layout and the same appearance. The scheduling of the project is intended to become easier for the schedule responsible person in the various ATLAS system with using this template. It will also ease the follow-up and control of the progress while consolidating the system schedules at the Master level. It is important to notice that this document is not a users guide to Project 98. It is a guide to install and use the template in Project 98.

3. INSTALLATION OF THE TEMPLATE

1. Save the file Global.mpt on your hard-disk (anywhere you can find it afterwards....).

2.

Not located at CERN:

- Find the icon for Project 98. Usually you can find it under the folder Program Files or W95. If you can not find it, try the Find-command which you can find on the Start-Menu for Windows 95. Now, follow the same procedure as for *Located at CERN*.

Located at CERN:

- The Project 98-icon can be found at C:\W95\StartMenu\1-Applications\00-OtherOfficeVersions.
- Click on this icon with the right mouse-button and drag the icon to the desktop.
- Let go of the right mouse button and choose the “copy here” command.
- Rename the icon to “Project 98 for ATLAS” or another name which reminds you that it is a special copy of MS-Project.
- Click on the copied icon with the right mouse-button and choose “edit properties”.
- Choose “Icon” and in the “Working Directory”-window, type the path to the Global.mpt-file (example: C:\Mariannes\Global98). You do not have to

write the name of the file, since as long as there is a file with the name Global.mpt in the set working-directory, it will choose this file as the global template.

3. To start the program with the ATLAS-template, just double-click on the icon on the desktop.

4. TEMPLATE DESCRIPTION

The template is build up of different views to display for example all tasks, only milestones, milestones for a different period, resource-assignment and so on. To access the different views, you can use the buttons described in the table on page 3 or you can choose the different views on the "View"-menu.

The difference between using the buttons and the View-menu, is that the buttons have built in macros which formats the Task-name column and adjust the column-with. This applies to  and . If you have many tasks in your project, it may be wise to use these buttons only before you are going to print the project because it takes quite a lot of time to scan all the tasks.

To read more about how to break down the project and code the different tasks, consult this document ATL-GE-CERN-QAP-0303.02 which can be found at the Technical Coordination Homepage: *http://atlasinfo.cern.ch/Atlas/TCOORD/TechCoord/Frame.html*.
Click on the document-button and here you can search for this document and download it to your computer.
The list of Standard Task Codes is included on page 4.
The PBS-Codes for each system can be found at this web-site:
http://www.cern.ch/atlas-bin/pbs?openNode=ATL

Those of you who have special needs, can just customise the template. Just remember NOT to change the ReportMilestone@Atlas-view, since this must remain the same because of the preliminary follow-up procedures.

TEMPLATE FUNCTIONS

Button	Name	Function
1	Enter Tasks	After you have entered the tasks, this button runs a macro that formats the Task-column and adjust the column-width. It also formats the bars of the Gantt-diagram.
2	Enter Resources	Displays the view where you can enter resources for the project.
3	Assign Resources	Displays a double-window view where you can assign resources to the given tasks.
	Print View	Prepares the schedule for printing. It colours the bars according to Standard task code and formats the Task-name column
	Milestones	Filters all milestones and displays them in a separate view. To get back to the view with all your tasks, you go to the Views-menu and choose Gantt Chart.
	Formats Task Name Column	Formats the Task Name Column for Milestone View only!
	Creates Milestones Report	Filters milestones according to given date-period and displays them in a report
	Filters and exports milestones	Filters milestones according to given date-period and exports them to the clip-board. It starts an excell-file where you can paste the information about the milestones. ***NB!*** *The filter for this macro must be copied from the global-file.* **Instructions:** - *Project-menu: Filtered For: -> More Filters* - *Choose Organizer-tab* - *Copy Milestones@Atlas FROM Global.mpt TO yourfile.mpp*
	Filters and Counts Milestones	Filters milestones according to given date-period and counts the actual milestones. It creates a new file on your hard-disk called: CountMilestones.mpp. When it has counted the milestones, you will have this file as active window. To get back to your project-file, choose the file-name on the Window-menu.
	Changes the time scale	Changes the timescale of the barchart. YQ: Years as major scale and quarters as minor scale. YM: Years as major scale and months as minor scale, and so on.

5. STANDARD TASK CODES

1st and 2nd ST Codes		*Standard Task Description*
M		**Management**
	MC	Configuration (Technical Co-ordination)
	MQ	Quality Management
	MS	Time Management (Planning and Scheduling)
	MB	Cost Management (Estimates and Budgets)
	ME	Impact Studies & Permitting
D		**Design**
	DC	Conceptual Design
	DB	Basic Design
	DD	Detailed Design
	DR	Redesign & Change Integration
P		**Prototyping**
	PD	Prototype Design
	PC	Prototype Procurement
	PF	Prototype Fabrication
	PT	Prototype Testing & Reporting
C		**Tendering & Contracting**
	CM	Market Survey
	CT	Tendering Process
	CV	Vendor Evaluation
	CF	Finance Committee Dossier
	CC	Contracting Process
F		**Fabrication and Tooling**
	FT	Tooling
	FM	Component Manufacturing
	FD	Delivery
A		**Assembly and Instalation**
	AO	Off-Site (Pre)Assembly
	AC	At CERN Assembly
	AI AIC AIF AIM AIP	In-Situ Installation In-Situ Cabling In-Situ Connecting In-Situ Mechanical assembly In-Situ Piping
T		**Testing & Commissioning**
	TO	Off-Site Testing and Commissioning
	TC	At CERN Testing & Commissioning
	TI	In-Situ Testing & Commissioning

ATLAS Technical Co-ordination organisation

ATLAS Technical Co-ordination *Hans Falk Hoffmann*	**Project Engineering Organisation** *Gerard Bachy*	**Scheduling**	
		Quality Assurance Plan -QAP	
		Engineering Data Management -EDMS *Nils Høimyr and Kathy Pommes*	
	Detector Integration *Gerard Bachy*	**Mechanical & Detector Integration** *Bertrand Nicquevert*	
		Service Integration, Experimental Area, Installation *Mark Hatch*	
		Support Structures, Access Structures, Maintenance, Tooling *Francois Butin*	
	Common Project Issues *Werner Witzeling*	**Common Project System** *Werner Witzeling*	**LAr Barrel Cryostat**
			LAr End-cap Cryostat
			LAr Cryogenic Plant
			Trigger DAQ/Control Processors
		Common Project General *Werner Witzeling*	**Radiation Shielding**
			General Facilities *Gregoire Kantardjian*
	Magnet Project *Herman Ten kate*	**Toroid Magnet** *Antoine Dael*	
		End Cap *Elwyn Baynham*	
		Solenoid *Akira Yamamoto*	
		Common Area *Lars Bjørset*	
	System Pre-Assembly & Testing *Werner Witzeling*		
	Test Beam *A. Henriques*		
	Safety *Hans Hoffmann & Gianpaolo Benincasa*		
	Liaison with LHC Machine *Hans Hoffmann*		
	Common Electronic *Issues*		
	Industrial Controls		

Standard Task codes for ATLAS project

1st and 2nd ST Codes		*Standard Task Description*
M		**Management**
	MC	Configuration (Technical Co-ordination)
	MQ	Quality Management
	MS	Time Management (Planning and Scheduling)
	MB	Cost Management (Estimates and Budgets)
	ME	Impact Studies & Permitting
D		**Design**
	DC	Conceptual Design
	DB	Basic Design
	DD	Detailed Design
	DR	Redesign & Change Integration
P		**Prototyping**
	PD	Prototype Design
	PC	Prototype Procurement
	PF	Prototype Fabrication
	PT	Prototype Testing & Reporting
C		**Tendering & Contracting**
	CM	Market Survey
	CT	Tendering Process
	CV	Vendor Evaluation
	CF	Finance Committee Dossier
	CC	Contracting Process
F		**Fabrication and Tooling**
	FT	Tooling
	FM	Component Manufacturing
	FD	Delivery
A		**Assembly and Instalation**
	AO	Off-Site (Pre)Assembly
	AC	At CERN Assembly
	AI	In-Situ Installation
	AIC	In-Situ Cabling
	AIF	In-Situ Connecting
	AIM	In-Situ Mechanical assembly
	AIP	In-Situ Piping
T		**Testing & Commissioning**
	TO	Off-Site Testing and Commissioning
	TC	At CERN Testing & Commissioning
	TI	In-Situ Testing & Commissioning

VB-codes for MS-Project

```
'Project 98

'This module containes macros that displays different views and entrymodes
'Created by Marianne Kulseth


' Macro Entryview_Atlas
' Macro Recorded Mon 2/2/98
' Created by Marianne Kulseth
' This Macro displays the Project in Gantt-chart view. Formats column with
' task names according to if it is a task, summarytask or milestone.
' Fits columnwitdh of all columns according to length of content.
' Formats Gantt-bars according to critical and type of task.

Sub Entryview_Atlas()

' Selects Gantt-chart view with single-pane window
   ViewApply Name:="Gantt Chart", singlepane:=True
' Runs Macro that changes time-scale
   Macro Name:="Time_Scale_YQ"
' Selects and goes to first task of active project
   SelectTaskField Row:=0, Column:="Name"
   GotoTaskDates
' Selects table named "Entry"
   TableApply Name:="Entry"
' Runs Macro that formats column "Name"
   Macro Name:="Format1stCol_Atlas"

'Changes width of column according to content
   ColumnBestFit Column:=1
   ColumnBestFit Column:=2
   ColumnBestFit Column:=3
   ColumnBestFit Column:=4
   ColumnBestFit Column:=5
   ColumnBestFit Column:=6
   ColumnBestFit Column:=7
   ColumnBestFit Column:=8
   ColumnBestFit Column:=9

'Runs macro that format GanttBars
   Macro Name:="FormatGanttBars_Atlas"

End Sub
```

```
' Macro Export_Milestones
' Macro Recorded Fri 3/20/98
' Created by Marianne Kulseth
' This Macro filters milestones according to dates given
' by the user and displays them in ReportMilestones@Atlas.
' Then it selects five columns and copies them to the clip-board.
' At the end it starts excel. The macro uses a message-box allow
' the user to choose if she wants to continue with the macro or not.

Sub Export_Milestones()

'Localizable strings
Const MSG_1 = "This macro will filter your milestones according to given start and end
dates"
Const MSG_2 = "Would you like to proceed?"
Const MSG_3 = "This macro will end now"
Const MSGBOX_TITLE = "Filtering and exporting Milestones according to dates"

Dim nMsgBoxResult As Integer
Dim sNewLine As String

'MsgBox Constants
Const IDOK = 1
Const IDYES = 6
Const MB_OK = 0
Const MB_YESNO = 4
Const MB_ICONSTOP = 16
Const MB_ICONQUESTION = 32
Const MB_ICONEXCLAMATION = 48


sNewLine = Chr(10) & Chr(13)

'welcome dialog, opportunity to quit or continue
nMsgBoxResult = MsgBox(MSG_1 & sNewLine & sNewLine & MSG_2, _
MB_ICONQUESTION + MB_YESNO, MSGBOX_TITLE)

If nMsgBoxResult = IDYES Then
  ViewApply Name:="ReportMilestones@Atlas", singlepane:=True
  SelectTaskColumn Column:="Text1", Additional:=5
  EditCopy
  AppExecute Command:="Excel.exe"
Else: MsgBox MSG_3, MB_OK + MB_ICONEXCLAMATION, MSGBOX_TITLE
   Exit Sub
```

```
End If

End Sub



' Macro Resourceview_Atlas
' Macro Recorded Thu 12/2/98
' Created by Marianne Kulseth
' This macro displays the project in Resource-view. It allows the user to
' assign resources to tasks.

Sub Resourceview_Atlas()

' Selects Gantt-chart view with a split window. The upper part is
' a Gantt-chart, the lower part with a table where the user can
' assign resources to the selected tasks.
   ViewApply Name:="Gantt Chart", singlepane:=False
' Runs macro that changes timescale
   Macro Name:="Time_Scale_YQ"
' Selects and goes to first task of active project
   SelectTaskField Row:=0, Column:="Name"
   GotoTaskDates
' Selects table named "Entry"
   TableApply Name:="Entry"

' Changes width of column according to content
   ColumnBestFit Column:=1
   ColumnBestFit Column:=2
   ColumnBestFit Column:=3
   ColumnBestFit Column:=4
   ColumnBestFit Column:=5
   ColumnBestFit Column:=6
' Creates double window
   PaneCreate

End Sub


' Macro Print_Atlas
' Macro Recorded Thu 19/2/98
' Created by Marianne Kulseth
' This macro displays a Gantt-chart view with a simplified
' table. It formats the bars according to standard task codes and
' it formats the column "Name".
```

```
Sub Print_Atlas()

' Selects Gantt-chart view named "Print_Atlas".
   ViewApply Name:="Print_Atlas", singlepane:=True
' Runs macro that changes timescales
   Macro Name:="Time_Scale_YQ"
' Selects and goes to first task of active project
   SelectTaskField Row:=0, Column:="Name"
   GotoTaskDates
' Selects table named "Print_Atlas"
   TableApply Name:="Print_Atlas"
' Runs macro that formats column name
   Macro Name:="Format1stCol_Atlas"
' Changes width of column according to content
   ColumnBestFit Column:=1
   ColumnBestFit Column:=2
   ColumnBestFit Column:=3
   ColumnBestFit Column:=4
' Runs macro that formats Gantt-bars according to standard task codes
   Macro Name:="PrintFormatBars_Atlas"

End Sub



' Macro Resourcesheet_Atlas
' Macro Recorded Thu 12/2/98
' Created by Marianne Kulseth
' This macro displays the resource-sheet where the user can enter all
' its resources. This resources sheet is used as a "database" when
' the user assigns resources to tasks.

Sub Resourcesheet_Atlas()

   ViewApply Name:="Resource &Sheet", singlepane:=True

End Sub

' Macro Milestones_Report
' Macro Recorded Mon 3/9/98
' Created by Marianne Kulseth
' This Macro uses Filter: Milestones@Atlas where the user can define for
' which days it wants the milestones to be filtered. Then it displays the
' chosen period of milestones in a customised report: Milestones@report
```

```
Sub Milestones_Report()

    ReportPrintPreview Name:="Milestones@ATLAS"

End Sub


' Macro Milestones_Atlas
' Macro Recorded Fri 2/20/98
' Created by Marianne Kulseth
' This macro displays all the milestones of the project. Formats milestones.
' Formats columns according to contents. Formats timescales.


Sub Milestones_Atlas()

' Selects Gantt chart view named "Milestones_Atlas"
    ViewApply Name:="Milestones_Atlas", singlepane:=True
' Selects and goes to first task of active project
    SelectTaskField Row:=0, Column:="Name"
    GotoTaskDates
' Runs macro that formats the milestones
    Macro Name:="FormatMilestones_Atlas"
' Runs macro that changes the timescale
    Macro Name:="Time_Scale_YQ"

' Changes width of column according to content
    ColumnBestFit Column:=1
    ColumnBestFit Column:=2
    ColumnBestFit Column:=3
    ColumnBestFit Column:=4
    ColumnBestFit Column:=5

End Sub


' Macro FormatMilestones_Atlas
' Created By Marianne Kulseth, 020398
' This macro formats milestone-bars according to criticality, achieved or not and
' if there is a baseline.
' The macro contains an error-handler that creates a new GanttBarStyle for
' for each iteration. Why this errorhandler is neccessary, one should ask
' Microsoft Support!
```

```
Sub FormatMilestones_Atlas()
On Error GoTo Errorhandler
GanttBarStyleEdit Item:="5", Create:=False, Name:="Milest. Baseline", _
        ShowFor:="Milestone", Row:=1, _
        startShape:=3, startType:=1, startColor:=0, _
        EndShape:=0, endcolor:=0, endtype:=1, _
        middleshape:=0, middlepattern:=0, middlecolor:=0, _
        From:="Baseline Start", to:="Baseline Start", leftText:="", rightText:=""

GanttBarStyleEdit Item:="2", Create:=False, Name:="NonCrit. Milest.", _
        ShowFor:="Milestone,NonCritical", Row:=1, _
        startShape:=3, startType:=0, startColor:=11, _
        EndShape:=0, endcolor:=0, endtype:=0, _
        middleshape:=0, middlepattern:=0, middlecolor:=11, _
        From:="Start", to:="Start", leftText:="ID", rightText:="Start"

GanttBarStyleEdit Item:="3", Create:=False, Name:="Crit. Milest.", _
        ShowFor:="Milestone, Critical", Row:=1, _
        startShape:=3, startType:=0, startColor:=1, _
        EndShape:=0, endcolor:=0, endtype:=0, _
        middleshape:=0, middlepattern:=0, middlecolor:=1, _
        From:="Start", to:="Start", leftText:="ID", rightText:="Start"

GanttBarStyleEdit Item:="4", Create:=False, Name:="Milest. Rolled Up", _
        ShowFor:="Milestone", Row:=1, _
        startShape:=12, startType:=0, startColor:=14, _
        EndShape:=0, endcolor:=14, endtype:=0, _
        middleshape:=0, middlepattern:=1, middlecolor:=14, _
        From:="Actual Start", to:="Actual Start", leftText:="", rightText:=""

GanttBarStyleEdit Item:="1", Create:=False, Name:="Summary", _
        ShowFor:="Summary", Row:=1, _
        startShape:=7, startType:=0, startColor:=0, _
        EndShape:=6, endcolor:=0, endtype:=0, _
        middleshape:=6, middlepattern:=1, middlecolor:=0, _
        From:="Start", to:="Finish", leftText:="", rightText:=""


GanttBarStyleEdit Item:="6", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="7", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="8", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="9", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="10", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="11", Create:=False, middleshape:=0
```

```
GanttBarStyleEdit Item:="12", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="13", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="14", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="15", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="16", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="17", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="18", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="19", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="20", Create:=False, middleshape:=0

Exit Sub
Errorhandler:
   GanttBarStyleEdit Item:="-1", Create:=True, middleshape:=0
   Resume
End Sub
```

```
' Macro Format1stCol_Atlas
' Macro Created Thu 12/2/98.
' Created by Marianne Kulseth
' Formates text in column "Name" according to type of task
' (milestone, summary, critical, non-critical etc.)

Sub Format1stCol_Atlas()

' Variable declaration
Dim oTask As Object
Dim tskProjTasks As Tasks

' Sets variable tskProjTasks to be tasks in active project
Set tskProjTasks = ActiveProject.Tasks
' Scans through all tasks in project
For Each oTask In tskProjTasks
  If Not oTask Is Nothing Then
   If oTask.Summary = True And oTask.OutlineLevel = 1 Then
     SelectTaskCell Row:=oTask.ID, Column:="Name", RowRelative:=False
     Font Bold:=True: Font Italic:=False: Font Size:="12": Font color:=1
    ElseIf oTask.Summary = True And oTask.OutlineLevel = 2 Then
     SelectTaskCell Row:=oTask.ID, Column:="Name", RowRelative:=False
     Font Bold:=True: Font Italic:=False: Font Size:="11": Font color:=1
    ElseIf oTask.Summary = True And oTask.OutlineLevel = 3 Then
```

```
     SelectTaskCell Row:=oTask.ID, Column:="Name", RowRelative:=False
     Font Bold:=True: Font Italic:=False: Font Size:="11": Font color:=1
    ElseIf oTask.Summary = True And oTask.OutlineLevel = 4 Then
     SelectTaskCell Row:=oTask.ID, Column:="Name", RowRelative:=False
     Font Bold:=True: Font Italic:=False: Font Size:="11": Font color:=1
    ElseIf oTask.Summary = True And oTask.OutlineLevel = 5 Then
     SelectTaskCell Row:=oTask.ID, Column:="Name", RowRelative:=False
     Font Bold:=True: Font Italic:=False: Font Size:="10": Font color:=1
    ElseIf oTask.Summary = True And oTask.OutlineLevel = 6 Then
     SelectTaskCell Row:=oTask.ID, Column:="Name", RowRelative:=False
     Font Bold:=True: Font Italic:=False: Font Size:="10": Font color:=1
    ElseIf oTask.Milestone = True Then
     SelectTaskCell Row:=oTask.ID, Column:="Name", RowRelative:=False
     Font Bold:=True: Font Italic:=True: Font Size:="8": Font color:=11
    Else: SelectTaskCell Row:=oTask.ID, Column:="Name", RowRelative:=False
    Font Bold:=False: Font Italic:=False: Font Size:="8": Font color:=0
   End If
  End If
  Next oTask
End Sub

' Macro Format1stColMile_Atlas
' Macro Created Thu 12/2/98.
' Created by Marianne Kulseth
' Formates text in column "Name" according to type of task
' NB! Only used for the view "Milestone_Atlas

Sub Format1stColMile_Atlas()

' Variable declaration
Dim oTask As Object
Dim tskProjTasks As Tasks

' Sets view to be "Milestone_Atlas"
ViewApply Name:="Milestones_Atlas", singlepane:=True
' Selects and goes to first task of active project
SelectTaskField Row:=0, Column:="Name"
GotoTaskDates
' Sets variable tskProjTasks to be tasks in active project
Set tskProjTasks = ActiveProject.Tasks
'Scans through all milestones in project
For Each oTask In tskProjTasks
  If Not oTask Is Nothing Then
  SelectTaskCell Row:=oTask.ID, Column:="Name", RowRelative:=False
  Font Bold:=True: Font Italic:=True: Font Size:="8": Font color:=11
```

```
  End If
  Next oTask

' Runs macro which formats milestones
Macro Name:="FormatMilestones_Atlas"
' Runs macro which formats the timescale
Macro Name:="Time_Scale_YQ"

' Changes width of column according to content
ColumnBestFit Column:=1
ColumnBestFit Column:=2
ColumnBestFit Column:=3
ColumnBestFit Column:=4
ColumnBestFit Column:=5

End Sub




' Macro FormatGanttBars_Atlas
' Macro Created Mon 16/2/98.
' Created by Marianne Kulseth
' Formats the GanttBars according to type and criticality.
' The macro contains an error-handler that creates a new GanttBarStyle for
' for each iteration. Why this errorhandler is neccessary, one should ask
' Microsoft Support!

Sub FormatGanttBars_Atlas()

 On Error GoTo Errorhandler
' Summary
GanttBarStyleEdit Item:="1", Create:=False, Name:="Summary", _
        ShowFor:="Summary", Row:=1, _
        startShape:=7, startType:=0, startColor:=0, _
        EndShape:=6, endcolor:=0, endtype:=0, _
        middleshape:=6, middlepattern:=1, middlecolor:=0, _
        From:="Start", to:="Finish", leftText:="", rightText:=""

' Tasks
GanttBarStyleEdit Item:="2", Create:=False, Name:="NonCrit. Task", _
        ShowFor:="Normal, NonCritical", Row:=1, _
        startShape:=0, startType:=0, startColor:=5, _
        EndShape:=0, endcolor:=5, endtype:=0, _
        middleshape:=1, middlepattern:=1, middlecolor:=5, _
```

```
        From:="Start", to:="Finish", leftText:="ID", rightText:="Finish"


GanttBarStyleEdit Item:="3", Create:=False, Name:="Critical Task", _
        ShowFor:="Normal, Critical", Row:=1, _
        startShape:=0, startType:=0, startColor:=1, _
        EndShape:=0, endcolor:=1, endtype:=0, _
        middleshape:=1, middlepattern:=1, middlecolor:=1, _
        From:="Start", to:="Finish", leftText:="ID", rightText:="Finish"

GanttBarStyleEdit Item:="4", Create:=False, Name:="Task Progress", _
        ShowFor:="Normal", Row:=1, _
        startShape:=0, startType:=0, startColor:=14, _
        EndShape:=0, endcolor:=14, endtype:=0, _
        middleshape:=2, middlepattern:=1, middlecolor:=14, _
        From:="Actual Start", to:="CompleteThrough", leftText:="", rightText:="Finish"

GanttBarStyleEdit Item:="5", Create:=False, Name:="NonCrit. Task", _
        ShowFor:="Normal", Row:=1, _
        startShape:=0, startType:=0, startColor:=0, _
        EndShape:=0, endcolor:=0, endtype:=0, _
        middleshape:=7, middlepattern:=1, middlecolor:=0, _
        From:="Baseline Start", to:="Baseline Finish", leftText:="", rightText:="Finish"


' Milestones
GanttBarStyleEdit Item:="6", Create:=False, Name:="NonCrit. Milest.", _
        ShowFor:="Milestone,NonCritical", Row:=1, _
        startShape:=3, startType:=0, startColor:=11, _
        EndShape:=0, endcolor:=0, endtype:=0, _
        middleshape:=0, middlepattern:=0, middlecolor:=11, _
        From:="Start", to:="Start", leftText:="ID", rightText:="Start"

GanttBarStyleEdit Item:="7", Create:=False, Name:="Crit. Milest.", _
        ShowFor:="Milestone, Critical", Row:=1, _
        startShape:=3, startType:=0, startColor:=1, _
        EndShape:=0, endcolor:=0, endtype:=0, _
        middleshape:=0, middlepattern:=0, middlecolor:=1, _
        From:="Start", to:="Start", leftText:="ID", rightText:="Start"


GanttBarStyleEdit Item:="8", Create:=False, Name:="Milest. Rolled Up", _
        ShowFor:="Milestone", Row:=1, _
        startShape:=12, startType:=0, startColor:=14, _
        EndShape:=0, endcolor:=14, endtype:=0, _
```

```
            middleshape:=0, middlepattern:=1, middlecolor:=14, _
            From:="Actual Start", to:="Actual Start", leftText:="", rightText:=""

GanttBarStyleEdit Item:="9", Create:=False, Name:="Milest. Baseline", _
            ShowFor:="Milestone", Row:=1, _
            startShape:=3, startType:=1, startColor:=0, _
            EndShape:=0, endcolor:=0, endtype:=1, _
            middleshape:=0, middlepattern:=0, middlecolor:=0, _
            From:="Baseline Start", to:="Baseline Start", leftText:="", rightText:=""


GanttBarStyleEdit Item:="10", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="11", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="12", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="13", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="14", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="15", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="16", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="17", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="18", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="19", Create:=False, middleshape:=0
GanttBarStyleEdit Item:="20", Create:=False, middleshape:=0

Exit Sub
Errorhandler:
  GanttBarStyleEdit Item:="-1", Create:=True, middleshape:=0
  Resume
End Sub

' Macro PrintFormatBars_Atlas
' Macro Created Thu 2/26/98.
' Created by Marianne Kulseth
' Formats Bars according to StandardTaskCode in column "Text2"

Sub PrintFormatBars_Atlas()

'Variable declarations
   Dim oName As String
   Dim oTask As Object
   Dim tskProjTasks As Tasks

' Sets variavle tskProjTasks to be tasks in active project
Set tskProjTasks = ActiveProject.Tasks
' Scans through all tasks in project
For Each oTask In tskProjTasks
```

```
    If Not (oTask Is Nothing) Then        'Blank Task
        If Not oTask.Summary Then         'Summary Task
         If Not oTask.Milestone Then      'Milestone
          'Management
          If (oTask.Text2 = "M" Or oTask.Text2 = "MC" Or oTask.Text2 = "MQ" Or
oTask.Text2 = "MS" _
          Or oTask.Text2 = "MB" Or oTask.Text2 = "ME") Then
          SelectTaskField Row:=oTask.ID, Column:="Text2", RowRelative:=False
          GanttBarFormat ganttStyle:=5, startShape:=0, startType:=0, startColor:=5, _
                EndShape:=0, endtype:=0, endcolor:=5, _
                middleshape:=1, middlepattern:=1, middlecolor:=5, _
                rightText:="Finish"

          'Design
          ElseIf (oTask.Text2 = "D" Or oTask.Text2 = "DC" Or oTask.Text2 = "DB" Or
oTask.Text2 = "DD" _
          Or oTask.Text2 = "DR") Then
          SelectTaskField Row:=oTask.ID, Column:="text2", RowRelative:=False
          GanttBarFormat ganttStyle:=2, startShape:=0, startType:=0, startColor:=9, _
                EndShape:=0, endtype:=0, endcolor:=9, _
                middleshape:=1, middlepattern:=1, middlecolor:=9, _
                rightText:="Finish"

         'Prototyping
         ElseIf (oTask.Text2 = "P" Or oTask.Text2 = "PD" Or oTask.Text2 = "PC" Or
oTask.Text2 = "PF" _
         Or oTask.Text2 = "PT") Then
         SelectTaskField Row:=oTask.ID, Column:="text2", RowRelative:=False
         GanttBarFormat ganttStyle:=2, startShape:=0, startType:=0, startColor:=2, _
                EndShape:=0, endtype:=0, endcolor:=2, _
                middleshape:=1, middlepattern:=1, middlecolor:=2, _
                rightText:="Finish"

         'Tendering & Contracting
         ElseIf (oTask.Text2 = "C" Or oTask.Text2 = "CM" Or oTask.Text2 = "CT" Or
oTask.Text2 = "CV" _
         Or oTask.Text2 = "CF" Or oTask.Text2 = "CC") Then
         SelectTaskField Row:=oTask.ID, Column:="text2", RowRelative:=False
         GanttBarFormat ganttStyle:=2, startShape:=0, startType:=0, startColor:=10, _
                EndShape:=0, endtype:=0, endcolor:=10, _
                middleshape:=1, middlepattern:=1, middlecolor:=10, _
                rightText:="Finish"

         'Fabrication & Tooling
```

```
        ElseIf (oTask.Text2 = "F" Or oTask.Text2 = "FT" Or oTask.Text2 = "FM" Or
oTask.Text2 = "FD") Then
        SelectTaskField Row:=oTask.ID, Column:="text2", RowRelative:=False
        GanttBarFormat ganttStyle:=2, startShape:=0, startType:=0, startColor:=11, _
                    EndShape:=0, endtype:=0, endcolor:=11, _
                    middleshape:=1, middlepattern:=1, middlecolor:=11, _
                    rightText:="Finish"

        'Assembly & Installation
        ElseIf (oTask.Text2 = "A" Or oTask.Text2 = "AO" Or oTask.Text2 = "AC" Or
oTask.Text2 = "AI") Then
        SelectTaskField Row:=oTask.ID, Column:="text2", RowRelative:=False
        GanttBarFormat ganttStyle:=5, startShape:=0, startType:=0, startColor:=12, _
                    EndShape:=0, endtype:=0, endcolor:=12, _
                    middleshape:=1, middlepattern:=1, middlecolor:=12, _
                    rightText:="Finish"

        'Assembly & Installation, In-Situ Installation
        ElseIf (oTask.Text2 = "AIC" Or oTask.Text2 = "AIF" Or oTask.Text2 = "AIM" Or
oTask.Text2 = "AIP") Then
        SelectTaskField Row:=oTask.ID, Column:="text2", RowRelative:=False
        GanttBarFormat ganttStyle:=2, startShape:=0, startType:=0, startColor:=12, _
                    EndShape:=0, endtype:=0, endcolor:=12, _
                    middleshape:=1, middlepattern:=5, middlecolor:=12, _
                    rightText:="Finish"


        'Testing & Commissioning
        ElseIf (oTask.Text2 = "T" Or oTask.Text2 = "TO" Or oTask.Text2 = "TC" Or
oTask.Text2 = "TI") Then
        SelectTaskField Row:=oTask.ID, Column:="text2", RowRelative:=False
        GanttBarFormat ganttStyle:=2, startShape:=0, startType:=0, startColor:=6, _
                    EndShape:=0, endtype:=0, endcolor:=6, _
                    middleshape:=1, middlepattern:=1, middlecolor:=6, _
                    rightText:="Finish"

         End If
       End If
      End If
   End If
Next oTask

End Sub
```

```
' Macro Count_Milestones
' Macro Recorded Fri 3/20/98
' Created by Marianne Kulseth
' This Macro filters milestones according to dates given
' by the user and displays them in ReportMilestones@Atlas.
' Then it counts the milestones and displays it in a window

Sub Count_Milestones()

'Localizable Strings
Const MSG_1 = "This macro will count your filtered milestones"
Const MSG_2 = "Would you like to proceed?"
Const MSG_3 = "This macro will end now"
Const MSGBOX_TITLE = "Counting Milestones according to dates"

' Variabel declaration
Dim nMsgBoxResult As Integer
Dim sNewLine As String

'MsgBox Constants
Const IDOK = 1
Const IDYES = 6
Const MB_OK = 0
Const MB_YESNO = 4
Const MB_ICONSTOP = 16
Const MB_ICONQUESTION = 32
Const MB_ICONEXCLAMATION = 48


sNewLine = Chr(10) & Chr(13)

'welcome dialog, opportunity to quit or continue
nMsgBoxResult = MsgBox(MSG_1 & sNewLine & sNewLine & MSG_2, _
MB_ICONQUESTION + MB_YESNO, MSGBOX_TITLE)

If nMsgBoxResult = IDYES Then
  ViewApply Name:="ReportMilestones@Atlas", singlepane:=True
  SelectSheet
  EditCopy
  FileNew
  FileSaveAs "C:\CountMilestones.mpp"
  EditPaste
  MsgBox "There are " & ActiveProject.NumberOfTasks & " Milestones for this period."
```

```
Else: MsgBox MSG_3, MB_OK + MB_ICONEXCLAMATION, MSGBOX_TITLE
   Exit Sub
End If

End Sub



'This module changes the timescales to the preferred values

' Macro Time_Scale_YQ
' Macro Recorded Fri 30/1/98
' Changes timescale to Years and Quarters
' Created by Marianne Kulseth

Sub Time_Scale_YQ()

   SelectTaskField Row:=1, Column:="Name"  'Selects the first task of the Project
   GotoTaskDates                      'Goes to the first task of the Project
   TimescaleEdit MajorUnits:=0, MinorUnits:=1, MajorLabel:=0, MinorLabel:=5, _
   MajorCount:=1, MinorCount:=1, MajorTicks:=True, MinorTicks:=True, _
   Enlarge:=100                      'Formats the timescale with Years as
                                'major unit and quarters as minor unit
End Sub


' Macro Time_Scale_YM
' Macro Recorded Fri 30/1/98
' Changes timescale to Years and Months
' Created by Marianne Kulseth

Sub Time_Scale_YM()

   SelectTaskField Row:=1, Column:="Name"  'Selects the first task of the Project
   GotoTaskDates                      'Goes to the first task of the Project
   TimescaleEdit MajorUnits:=0, MajorLabel:=0, MinorUnits:=2, _
   MinorLabel:=10, MajorCount:=1, MinorCount:=1, MajorTicks:=True, _
   MinorTicks:=True, Enlarge:=100         'Formats the timescale with Years as
                                'major unit and months as minore unit
End Sub


' Macro Time_Scale_MW
' Macro Recorded Fri 30/1/98
' Changes timescale to Months and Weeks
```

```
' Created by Marianne Kulseth

Sub Time_Scale_MW()

    SelectTaskField Row:=1, Column:="Name"  'Selects the first task of the Project
    GotoTaskDates                     'Goes to the first task of the Project
    TimescaleEdit MajorUnits:=2, MinorUnits:=3, MajorLabel:=9, MinorLabel:=17, _
    MajorCount:=1, MinorCount:=1, MajorTicks:=True, MinorTicks:=True, Enlarge:=100
                              'Formats the timescale with months as
                              'major unit and weeks as minore unit
End Sub


' Macro Time_Scale_WD
' Macro Recorded Fri 30/1/98
' Changes timescale to Weeks and Days
' Created by Marianne Kulseth

Sub Time_Scale_WD()

    SelectTaskField Row:=1, Column:="Name"  'Selects the first task of the Project
    GotoTaskDates                     'Goes to the first task of the Project
    TimescaleEdit MajorUnits:=3, MinorUnits:=4, MajorLabel:=13, MinorLabel:=20, _
    MajorCount:=1, MinorCount:=1, MajorTicks:=True, MinorTicks:=True, Enlarge:=100
                              'Formats the timescale with weeks as
                              'major unit and days as minore unit
End Sub
```

VB-codes for Excell

```
'
' Macro InsertData_Atlas
' Macro recorded 15/4/98
' Created by Marianne Kulseth
' This Macro inserts the data from the clipboard copied from MS-Project
' It formats the sheet with borders
' If the clipboard is empty = no milestones in Project, an error-handler
' pastes a message in sheet 1 stating "No milestones for this period"
'
Sub InsertData_Atlas()
On Error GoTo Errorhandler
    Worksheets("Sheet1").Activate
    'Sheets("Sheet1").Select
    Range("A16").Select
    ActiveSheet.PasteSpecial Format:="Text", Link:=False, DisplayAsIcon:= _
        False
    With Selection.Borders(xlLeft)
        .Weight = xlThin
        .ColorIndex = xlAutomatic
    End With
    With Selection.Borders(xlRight)
        .Weight = xlThin
        .ColorIndex = xlAutomatic
    End With
    With Selection.Borders(xlTop)
        .Weight = xlThin
        .ColorIndex = xlAutomatic
    End With
    With Selection.Borders(xlBottom)
        .Weight = xlThin
        .ColorIndex = xlAutomatic
    End With
    Selection.BorderAround Weight:=xlThin, ColorIndex:=xlAutomatic

    Range("A16:D69").Select
    With Selection
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
        .WrapText = False
        .Orientation = xlHorizontal
    End With
    Range("F16:H69").Select
    With Selection
```

```
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
        .WrapText = False
        .Orientation = xlHorizontal
    End With
    Selection.NumberFormat = "d-mmm-yy"
    Range("A16").Select
Exit Sub

' If clip-board is empty, there is an error. The errorhandler
' prints a message in sheet 1
Errorhandler:
    Sheets("Sheet1").Select
    Range("E16").Select
    ActiveCell.FormulaR1C1 = "NO MILESTONES FOR THIS PERIOD"
    Range("E17").Select

End Sub


'
' Macro OpenTemplate_Atlas
' Macro recorded 16/4/98
' Created by Marianne Kulseth
' This Macro opens a file with the name Global.xlt
'
Sub OpenTemplate_Atlas()

' Opens file
    Workbooks.Open Filename:="J:\MyDocs\Template\GLOBAL.XLT", Editable:=True
' Moves cursor to Sheet 1 and to cell A16
    Sheets("Sheet1").Select
    Range("A16").Select
End Sub




' Macro CountMile_Atlas
' Macro recorded 5/5/98
' Created by Marianne Kulseth
' This macro counts number of cells with contents and returns the number
' in cell G12
```

```
Sub CountMile_Atlas()

' Variabel declaration
Dim i As Integer
i = 0

' Scans through all the cells in range A16:A68 to check
' if the cells have a content. If the cell has a content
' the counter i is set to i+1
For Each Cell In Worksheets("Sheet1").Range("A16:A68")
If Not IsEmpty(Cell) Then
  i = i + 1
End If
Next Cell

' After all the cells have been scanned, cell G12 is assigned
' the value of i
Worksheets("Sheet1").Range("G12") = i
End Sub


' Macro CheckComments_Atlas
' Macro recorded 5/5/98
' Created by Marianne Kulseth
' This macro checks if the cells in "Expected Date Column have a content.
' If there is content, copies the content to a table in sheet2

Sub CheckComments_Atlas()

' Variabel declaration
Dim RowOfSheetB, column As Integer

Set SheetA = Worksheets("Sheet1")
Set SheetB = Worksheets("Sheet2")
RowOfSheetB = 8
RowOfSheetA = 16

' Checks if Cells in column G in sheet A is empty
' If cell is not empty, copies content to clipboard
' Pastes content of cells in sheet A to cells in sheet B
For Each Cell In SheetA.Range("G16:G69")
 If Not IsEmpty(Cell) Then
 SheetA.Cells(RowOfSheetA, 1).Copy
 SheetB.Paste destination:=SheetB.Cells(RowOfSheetB, 3)
 SheetA.Cells(RowOfSheetA, 2).Copy
```

```
 SheetB.Paste destination:=SheetB.Cells(RowOfSheetB, 4)
 SheetA.Cells(RowOfSheetA, 5).Copy
 SheetB.Paste destination:=SheetB.Cells(RowOfSheetB, 5)
 SheetA.Cells(RowOfSheetA, 6).Copy
 SheetB.Paste destination:=SheetB.Cells(RowOfSheetB, 6)
 SheetA.Cells(RowOfSheetA, 7).Copy
 SheetB.Paste destination:=SheetB.Cells(RowOfSheetB, 7)
 SheetA.Cells(RowOfSheetA, 9).Copy
 SheetB.Paste destination:=SheetB.Cells(RowOfSheetB, 9)
 RowOfSheetB = RowOfSheetB + 1
 End If
 RowOfSheetA = RowOfSheetA + 1
Next Cell

SheetA.Cells(12, 5).Copy
SheetB.Paste destination:=SheetB.Cells(4, 2)
Sheets("Sheet2").Select

' Formats sheet B with borders
Range("B4").Select
   Selection.BorderAround LineStyle:=xlNone
Range("A8:A29").Select
     With Selection.Borders(xlLeft)
       .Weight = xlMedium
       .ColorIndex = xlAutomatic
   End With
   With Selection.Borders(xlRight)
       .Weight = xlMedium
       .ColorIndex = xlAutomatic
   End With
   Selection.BorderAround Weight:=xlMedium, ColorIndex:=xlAutomatic
   Range("B8:B29").Select
   With Selection.Borders(xlLeft)
       .Weight = xlMedium
       .ColorIndex = xlAutomatic
   End With
   With Selection.Borders(xlRight)
       .Weight = xlMedium
       .ColorIndex = xlAutomatic
   End With
   Selection.BorderAround Weight:=xlMedium, ColorIndex:=xlAutomatic
   Range("C8:C29").Select
   With Selection.Borders(xlLeft)
       .Weight = xlMedium
       .ColorIndex = xlAutomatic
```

```
End With
With Selection.Borders(xlRight)
    .Weight = xlMedium
    .ColorIndex = xlAutomatic
End With
Selection.BorderAround Weight:=xlMedium, ColorIndex:=xlAutomatic
Range("D8:D29").Select
With Selection.Borders(xlTop)
    .Weight = xlThin
    .ColorIndex = xlAutomatic
End With
Selection.BorderAround Weight:=xlMedium, ColorIndex:=xlAutomatic
Range("E8:E29").Select
With Selection.Borders(xlTop)
    .Weight = xlThin
    .ColorIndex = xlAutomatic
End With
Selection.BorderAround Weight:=xlMedium, ColorIndex:=xlAutomatic
Range("F8:F29").Select
With Selection.Borders(xlTop)
    .Weight = xlThin
    .ColorIndex = xlAutomatic
End With
Selection.BorderAround Weight:=xlMedium, ColorIndex:=xlAutomatic
Range("G8:G29").Select
Selection.BorderAround Weight:=xlMedium, ColorIndex:=xlAutomatic
Range("H8:H29").Select
With Selection.Borders(xlLeft)
    .Weight = xlMedium
    .ColorIndex = xlAutomatic
End With
With Selection.Borders(xlRight)
    .Weight = xlMedium
    .ColorIndex = xlAutomatic
End With
Selection.BorderAround Weight:=xlMedium, ColorIndex:=xlAutomatic
Range("I8:I29").Select
With Selection.Borders(xlLeft)
    .Weight = xlThin
    .ColorIndex = xlAutomatic
End With
With Selection.Borders(xlRight)
    .Weight = xlMedium
    .ColorIndex = xlAutomatic
End With
```

```
    Selection.BorderAround Weight:=xlMedium, ColorIndex:=xlAutomatic
    Columns("F:F").EntireColumn.AutoFit

End Sub
```

Comments on missing progress reports

In the pre-study report, three progress-reports where scheduled. Only one of them were actually written and given to supervisor at CERN. This happened in late April.
The other progress reports were never written. This was due to the fact that when going through the plan again, the progress reporting was considered to be unnecessary considering the scale of the project with practically only one resource, me.
In the main report I have argued for follow-up systems that must be designed and adapted to the special nature of the project. This was not done in a proper way for my diploma thesis.