Chapter 6
Case Studies

In this chapter I describe two scenarios where I have made full use of planning and management tools. The first is a major infrastructure rebuild, where the requirements of the project necessitated full plans. The second is a recently completed project to bring together a wide range of information about the seismological structure of the Australian region to produce a 3-D digital reference model.

The two cases represent different styles of planning, but illustrate the value of using management tools to set the scene, so that effective responses can be made to future eventualities.

6.1 Major infrastructure upgrade

This first case shows how planning tools were used in the redevelopment of the Warramunga Seismic Array in remote outback Australia. The array had been operating since 1976 with a major role in the detection of underground nuclear explosions. In consequence it was designated as one of 50 primary seismic stations in the monitoring network of the 1996 Comprehensive Nuclear-Test-Ban Treaty. The Preparatory Commission for the Treaty (CTBTO) produced a request for a proposal for the physical development of the site, which required a comprehensive plan for the work to be completed within the 1998 calendar year. The array was the first to be upgraded around the world, and so the CTBTO had not yet developed its procedures in full.

The Warramunga array lies in the savannah belt of northern Australia, with two main seasons and occupies a substantial area with stations at up to 25 km from the central recording station. The monsoonal ‘wet’ occurs in the Austral summer, with a start in late October or November with major electrical storms. The level of rainfall is unpredictable, but the access road to the site may well be flooded at any time after the start of the wet until March or even early April. During this period it is difficult to get heavy equipment to the site. Temperatures rise at the end of the ‘dry’ season and thunderstorms are common before the rain arrives. These weather considerations dictate the window over which work can be guaranteed.

6.1.1 Specification

With the signing of the 1996 Treaty the entire seismic array has to be refurbished with a complete replacement of all seismometers, data recording and data transmission to bring it up to Treaty standards. In the
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Figure 6.1: Configuration of array, with new stations shown in green.

process, the array is to be enlarged from 20 stations in an L-shape (B., R.) to include a central cluster of 4 new stations (C.), as shown in Figure 6.1. This configuration had been developed following discussions with the CTBTO in Vienna.

The equipment for the upgrade is to be provided by CTBTO, but all site preparation and works have to be organised ahead of installation. The net result is to be an entirely new array, but with the previous geometry included to allow comparisons with prior data.

The start time of the project was specified by CTBTO with the expectation that the work would be completed by the end of 1998. In consequence the planning focused on setting up a time line that would allow completion in October, ahead of the ‘wet’. A project plan was required as part of the development proposal, together with a detailed budget in U.S. dollars.

Because this was the first site in a major international investment, there were still uncertainties in the specification of the facilities to be provided by CTBTO at both the central recording facility and the individual sites, since contracts were being arranged in parallel with the site work. The central recording facility is to be maintained in an existing building near site B2 where generator power was available. The data from the remote sites is transmitted by digital radio telemetry to the central recording facility. This meant that line-of-sight communication is required, and the curvature of the earth starts to be important for the trajectory to the outlying elements.
6.1 Major infrastructure upgrade

At each remote site, new equipment and fencing will need to be installed, with the possibility of drilling to emplace seismometers. Thus heavy equipment has to be able to access each site. Because of the weather conditions this gives a limited window for which such access can be planned. Ahead of the ‘wet’ season, substantial thunderstorm activity builds up, with lightning likely. Yet, at the same time, the near surface is at its driest and so electrical grounding becomes a major issue.

The team available to carry out the site work comprised the two staff at the array, with extra local help to be hired, and a contract manager in Canberra to secure procurement of necessary goods and services. As mentioned the proposal was required to provide a full project plan, and this proved to be valuable because it identified a number of issues that had not been anticipated in the initial thinking.

6.1.2 Planning

The task was broken into a number of discrete elements associated with the different phases of the work, with time relations dictated by appropriate priorities. Thus, it was necessary to upgrade the tracks before heavy equipment could be brought in to drill new seismometer holes, or concrete pads could be laid at each site. Work at the central facilities could start later than at the outlying sites, but all would have to be ready for the arrival and installation of equipment.
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Figure 6.3: Personnel deployment for project elements, with multiple people used to move forward the different aspects of the projects.

The Gantt chart and personnel resources chart for the project plan are shown in Figures 6.2 and 6.3. The grey areas indicate where some leeway was allowed for the project component.

The analysis indicated that drilling would need to start as soon as practicable, but we could not engage a drilling contractor until the contract was signed with CTBTO. Nevertheless we were able to establish the earliest availability of drilling. The next issue was the critical role played by the concrete work. To stay on an October completion schedule, less than one day could be allowed at each site. This meant that the contractor would have to enlarge his team so that form work and concrete pouring could proceed in parallel.
Figure 6.4: Critical path analysis for upgrade project.
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The critical path analysis is shown in Figure 6.4, and it became very clear that it would be difficult to have everything ready by the beginning of August so that equipment from CTBTO could be installed. By design, the completion data was set at mid-September to allow the possibility of some slippage and still stay ahead of the ‘wet’.

6.1.3 WRA project in practice

The project plan was accepted by CTBTO, but then there were substantial delays in processing of the proposal and budget approval. An immediate consequence was that the timeline would have to be started later, but this then impacted on weather conditions. This was a period of volatile exchange rates and we had some anxieties about the costing in U.S. dollars when expenditure was in Australian dollars.

One of the problems that emerged when the project had been approved to begin, was that the original specifications from CTBTO, included in the request for proposal, had been changed once the actual contracts for the equipment were drawn up. In particular the data acquisition units for the remote sites had double the original power consumption. This required both a new concept for housing to reduce the effect of external heating from the sun (day-time temperatures can easily reach 40°C in summer), and increased battery capacity required for the solar power system. Both changes increased the costs per site.

The original concept for the central data receiver tower was too vulnerable to wind, and was replaced by a 21 m self-supporting structure raised by professional riggers. Thanks to the high central tower, line of sight to the far stations was achieved with 12 m masts at these sites.

The originally proposed timeline for preparing the concrete slab, mast footings and fencing at each of the seismometer sites was too tight, but this was accommodated in the revised plan. The delays in approval caused complications in the availability of the drilling contractors needed for the new sites and mast footings, but fortunately the weather held and the work was completed before any rain came.

The delivery times for the site masts and batteries was much longer than anticipated, so the original timetable could not have been met. However, the delays meant that the design and build of data acquisition housing was feasible because of suspension of work over the ‘wet’.

The actual completion date was in September the following year, a full year later than originally indicated. However, CTBTO equipment was not available before July of the second year so the original required time frame was unreasonable.

Fortunately, the project plan had correctly identified the elements of work
6.2 Analysis of a research project

to be done, and the necessary sequence, and provided a good basis for organization. Sufficient contingency funding had been included so that unexpected costs could be absorbed. Careful bulk purchasing and tight control kept costs in check.

6.1.4 Lessons from project

A clear project plan was required as part of the proposal, but this proved to be a valuable tool. The recognition of the dependencies between the components of the project at an early stage helped to eliminate bottlenecks. Delays to aspects of the project due to external factors can be dealt with more easily when linked to a project plan. The most complex issue was changes in the specifications of the requirements during the course of project. This arose because of the separation of site preparation and hardware procurement.

For this project, undertaken at a remote location, clear communications were important. The contract manager in Canberra was in regular communication with the staff on site, and kept track of the procurements and overall project status. He reported to me as project manager, and together we were able to update the project plans and monitor expenditure against the budget. Visits to the site each year helped us to understand the situation, to rectify small problems, and consolidate the team working on the project.

Up to this point I had used informal planning for projects. I was initially disconcerted to be required to develop formal plans, but rapidly appreciated their value in forcing detailed thinking about the project, and providing a clear framework for management. I have since made substantial use of such approaches.

6.2 Analysis of a research project

The second case study is for the Australian Seismological Reference Model (AuSREM), a project to develop a 3-D model of crustal and mantle structure beneath the Australian region. The model was designed to build on existing work, integrating a wide range of different classes of data and depending on a broad network of collaborators.

The project was first suggested in April 2010 to provide a showcase of work on Australia that could be presented at two major international meetings, which were being held in Australia in the following two years: the General Assembly of the International Union of Geodesy and Geophysics (IUGG) in Melbourne in July 2011, and the International Geological Congress (IGC) in Brisbane at the end of July 2012. Funding
Table 6.1 Basic structure of AuSREM project.

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<th>Topic</th>
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<th>End date</th>
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<tbody>
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<td>Data Collection</td>
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<td>Completion</td>
<td>09/10/12</td>
<td>14/12/12</td>
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Milestones

- IUGG Melbourne: 27/06/11
- IGC Brisbane: 30/07/12
- End of Project: 20/12/12

was sought to be able to have the reference model presented in full at the IGC meeting in 2012, with publication as soon after as was practicable.

Joint investment from the AuScope infrastructure project and the Australian National University provided support for a research associate for two years and some travel support for collaborators. A recent project funded by the European Union provided a useful background, and some confidence that the work could be completed in a two-year time frame.

The research associate was able to start work on the project in November 2010, and then the first task was to make sure that we had a clear definition of the nature of the model and the way in which it would be constructed. Basic plans had been needed for the project proposal, but the concept of the nature of the work had evolved somewhat before the major effort got underway. The model would comprise crustal and mantle components with a horizontal resolution of 0.5 degrees in latitude and longitude, and be grid based so that interpolation would be able to provide physical property values (e.g., seismic wavespeed) at any point in three-dimensions.

The AuSREM model was intended to build extensively on existing data sources and models, which required the collection of information from a wide variety of sources and subsequent assembly into new products. I was fortunate in securing strong support from a number of collaborators who had worked on different aspects of the structure beneath Australia, and the challenge was to bring all the available information together and capture it in digital form. The clear deadline for presentation in July 2012 meant that the model had to exist some time before, and this guided the overall time-line for the different aspects of the project.
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Figure 6.5: Basic structure of AuSREM project with milestones.
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The general structure is shown in Table 6.1, and in the form of a Gantt chart in Figure 6.5. From early in the project we established a website where information on the project was provided and products could be made available as they were completed. Model delivery thus formed a constant theme in the project.

An important decision in the model definition process was to decide to build a model for the Australian crust separate from that for the mantle beneath, with connection through a representation of the Mohorovičić discontinuity (Moho) at the base of the crust. The research associate took primary responsibility for the crust and I looked after the Moho and mantle, but there was considerable feedback between the components.

For the crust a new model was constructed using a wider range of information than had hitherto been available. This required considerable collection and assembly of data of different types, followed by the merger of the various classes of information into a suitable model.

For the mantle a different approach was taken, with the model being built on the foundation of a number of exiting studies. It proved possible to get the authors of a number of recent models for the Australian mantle together just before the IUGG meeting in Melbourne. The discussions illuminated the needs, and the final AuSREM mantle model was able to build on updates made by the participants.

From the beginning a detailed project plan was developed using full project tools, which were used to identify the necessary sub-components. Figure 6.6 shows the final development of the project. The earlier versions started with approximately the same start dates for the different elements, but used rather shorter durations until it became clearer how much work was required.

The interaction between project elements is more complex than indicated in Figure 6.6, and some aspects of the work do not fall neatly into a single box. Nevertheless the Gantt chart provides an idea of the complexity of the total effort, and the consequent need to keep track of progress so that the milestones could be met.

In the lead up to the presentation at the IGC in Brisbane, considerable effort was put in to assembling a group of papers to describe the model and its construction. An overall summary paper was prepared for the *Australian Journal of Earth Sciences*, and detailed papers on the crust and mantle model provide details of the techniques used. A new model for the depth to Moho was published separately in late 2011. The publication dates of the materials are indicated by displaced blocks added to the basic Gantt chart.
Figure 6.6: Detailed structure of AuSREM project, including sub-components.
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The presentation of the results and the preparation of the publications did not constitute the end of the work. Considerable effort remained to set up suitable ways for the model to be used, via interactive visual displays as well as model downloads. We had fortunately recognised the class of commitment that would be needed, and so were able to achieve full delivery in the two-year funded span.

In this case the use of the project tools was of considerable importance early on, because it forced attention on the various facets of the work that needed to be addressed, and the way that they interacted. The initial draft concentrated on the identification of the elements, and then the time relations were refined. The plan was then an important tool for tracking progress and its existence played a major role in the success and timeliness of the entire project.

6.3 General considerations

Starting to prepare a detailed project plan forces you to think carefully about a broad range of issues. Nearly always some features or interrelations emerge that were not apparent in advance. With a modest investment of time in a plan, but consequent concentrated thought, you will have a clearer idea of how the desired outcomes can be achieved in a timely manner. This is already a major return on your effort.

Both of the projects used in the case studies involved interaction with a large group of people. The project plans helped with communication of needs and expectations so that there were few surprises, even when delivery slippages required adjustment.

When you are able to communicate your goals and the way in which you propose to achieve them clearly, your team is able to respond effectively. Their thoughts can be important and can reveal aspects of the project that you have not considered. Do not be dismissive, but see whether you can improve the plan and its management.