Project Overview

The Great Man-made River Project is one of the world’s largest construction projects. Involving many thousands of separate activities, professional project management techniques, tools and procedures are invaluable in helping maintaining control of the overall project.

The Sahara Desert is one of the hottest and driest places on earth. Yet some 500-600 metres beneath the surface are vast aquifers (water bearing rocks), dating back to the Ice Age, which were discovered during oil exploration in Libya in the 1960s. While the aquifers, which hold thousands of cubic kilometres of water, are located far from the populated coastal regions, after extensive feasibility studies, it was decided to convey the water to the populated coastal areas.

In 1983, the Libyan government initiated the Great Man-made River Project (GMRP), part of the country’s ‘Green Revolution’ designed to enable agricultural self-sufficiency. Planned to be implemented over five phases, and estimated in the mid 1980s to cost around US $25 billion, the scheme is currently well into Phase II. Phase I is now substantially complete, with Phase II scheduled for completion at the start of the next millennium after ten years of design and construction.

Regarded as probably the world’s largest single contract civil construction project, this 25 year scheme involves developing wellfields in the desert and supplying water to the coastal plains and upland areas between Tripoli and Benghazi, via thousands of kilometres of large diameter, buried pipelines.

No matter how the GMRP is described, it is difficult to convey its vast scale. Dubbed as one of the world’s eight man-made wonders, Phases I and II of the GMRP will each respectively provide two million cubic metres of water per day to Libya’s coastal areas. Phases III to V will provide for interconnections, expansion in capacity and extensions of the water supply to other locations.

Phases I and II include two major sub-systems. Phase I began in 1983, and is located within the eastern sector of Libya linking the two wellfields of Sarir and Tazerbo with Sirt and Benghazi. The two conveyance pipelines progress in parallel towards the coast, with interconnections provided between, and divide in a ‘Y’ shape westwards and eastwards towards Sirt and Benghazi respectively. Phase I is already delivering water to coastal reservoirs via 1850 km of 4m diameter pipeline.

Phase II comprises of the ‘Western Jamahiriya System’ that includes works required for the abstraction and collection of two million cubic metres of water per day from wellfields to the east and north-east of Jabal Hasouna and conveyance by pipeline to a terminal point outside Tripoli. Originally a tunnel was also included, however, by including some of Phase III work, this has now been eliminated. Approximately 1650 km of pipeline are included in Phase II.

Phase II has a milestone target to start supplying water to Tripoli in September 1996 at up to 16% of the design capacity, with final Phase II completion scheduled for mid year 2000. The combined Phase I & II capacity is believed to be equivalent to London’s annual water consumption.

The pipes which are specifically designed for their location within the pipeline are each 7.5 metres in length weighing up to 80 tonnes, and are transported from the pipe manufacturing facilities by fleets of large specially made lorries on the many thousands of kilometres of roads constructed as part of the project. All this takes place in one of the most environmentally inhospitable parts of the world.

Project Management and Planning

The Great Man-made River Authority (GMRA), as the ‘Owner’ and client, is the autonomous organisation responsible for the conception and overseeing the implementation of the project on behalf of the Libyan Government. They appointed Brown & Root as their project management consultant, and Dong Ah, the leading South Korean industrial and construction company, the contract for the complete design and construction of Phase II, after their major involvement in Phase I as the main civil contractor.
Brown and Root specified that Welcom Software Technology’s Open Plan should be used exclusively to help plan and control the thousands of activities involved in the GMRP. The sole use of Open Plan across the various parties involved in the GMRP would enable the transfer of project data between these groups without the necessity to convert data files to differing structures. Planning, control and reporting requirements were specified within the contract, after which Dong Ah were required to develop the necessary procedures and systems to the approval of the client and Brown & Root.

As one of Korea’s leading contractors, with 15 subsidiary companies and a multi-billion Dollar annual turnover, Dong Ah is no stranger to large-scale, multi-project construction work. The company builds bridges, tunnels, subway lines, harbours, industrial plants and dams and currently has more than 30 major projects world-wide under construction.

Charles Langley of Brightyork Ltd., the Planning and Project Management Consultant to Dong Ah at their London offices, puts the project into perspective: “This GMRP includes all the Engineering disciplines and specialities you can imagine. In terms of the overall scheme, it is bigger than the Channel Tunnel, and ranks as one of the world’s largest projects. To give the first two phases a perception of scale, consider two parallel pipelines running from Rome to Edinburgh, and most of that large enough through which to drive a coach.”

Langley’s experience of using Open Plan was one of the key reasons he was brought into Dong Ah as a consultant on the GMRP. He comments: “Quality control and assurance affect every aspect of Dong Ah’s activities on this project. The company has to submit to the GMRA and Brown and Root all hierarchy of documents covering the project. This includes all procedures, design documents, planning schedules, proposed vendor lists, material specifications and purchase orders etc. It would be virtually impossible to coordinate all of the planning and reporting requirements without high-end project management planning tools.”

Dong Ah are contractually required to cover the complete scope of work for the life-span of the project. This results in excess of 30,000 activities for the whole project, so Langley relies on extensive work breakdown structure capabilities and structured numbering systems. He comments: “Planning is carried out at four levels
of detail, with Open Plan being the nucleus at Level III, supplying the time scheduling aspects; which are directly related to the detail at Level IV.”

“The overall project is divided into approximately 34 sub-projects, which make up a multi-project for the total scope. These sub-projects are generally based upon differing areas of work, such as one sub-project covering all pump stations or another for all regulating stations. These are then further broken down into two further sub-projects – construction in Libya, and design and procurement in the UK. Each of these sub-projects are generally self contained projects in their own right, and the many interfaces between them are entered into and controlled from the multi-project. This structured approach makes a large planning operation like this easier to control and manage.” he continues.

“Systems were developed to interface Open Plan with our various other systems. Several registers at Level IV contain the everyday detail of documents, materials, all aspects of construction etc. The progress of each of these items is continuously entered, and these are then ‘packaged’ to relate to the Open Plan Level III.”

“We have an agreed system of progress measurement, and before any monthly multi-project time analysis is run, we have our own system that collects this progress information and enters it into Open Plan electronically. This also provides us with reports of additions or deletions of ‘packages’ from the registers. These then need to be updated in the Open Plan Level III sub-projects files, and any other revisions are also made. The idea is that the plan is dynamic and always represents the best information at any time, improving in its accuracy monthly. This is then always compared to an approved ‘Baseline’ version of the multi-project for progress performance reporting. After a final monthly time analysis has been run, current forecast dates are feed back into the registers.” he explains.

**Levels**
The GMRP is broken down into multiple levels. Based on matrices of work breakdown coding, differing views at eight levels above the Level III are practically possible, utilising the breakdown coding. However, only four different levels are issued officially, as indicated below. Other levels are produced and provided on a request basis.

**Level Four** includes items such as: document registers, which record details of the currently more than 60,000 identified main documents used for the project with nearly half a million issues; the procurement register, detailing all purchases relating to the project; materials register listing all materials and equipment items; and detailed construction ‘work plans’ (done out in the field in Libya). Some of these registers have their own time calculating system to schedule each of the items within the ‘package time window’ produced at Level III.

**Level Three** is where Open Plan becomes involved. The documents and procurement registers are ‘packaged’ and each package is represented as an activity in Open Plan. Langley explains: “We feed actual progress into the registers (eg, when a document has been issued, responses, approved etc.), then progress is fed into Open Plan, a time analysis is run and the forecast results are fed back from Open Plan to the registers.”

**Level Two** is where project data is rolled up the into a structured WBS and OBS coding combination. “While at Level III there are around 30,000 activities, Level II allows us on the basis of a WBS and OBS matrix combination, to produce around a 15-page bar chart which shows the main aspects of work for each main area/scope of work of the project. There are a number of differing views at Level II, each to suit a specific need, and are easily produced by using WBS type coding matrix combinations,” explains Langley.

**Level One** is related to a contract programme and is also based on a structured WBS and OBS coding combination, but at a higher level within the structure than for the level two. It rolls up to a two-page A1 size bar chart just giving the main contractual aspects, and representing the ‘Contract Programme’. “Contractually, Dong Ah is required to supply information from all four of the above project levels to the GMRA on a monthly basis, so the ability to go from detail on one of the 30,000 activities to the two page overview is the key strength of Open Plan.” he adds.
Reacting To Change

As with most large-scale, long-term projects, not everything progresses to plan, and the ability to react to change is essential, as Langley explains: “During 1993, the whole scope of the work was amended, the project scope substantially increased, and new milestone completion dates were agreed. Instead of having a pipeline running through a mountain area, it was decided to run the pipeline around it and include work which was originally planned for Phase III. This involved a great deal of extra effort because of additional pipeline installation, pump and regulating stations, revised hydraulics and new geotechnical surveys etc. This required a complete re-planning exercise for Phase II, carried out over a few months. This new programme schedule, after review by GMRA and Brown and Root was finally approved and became the new baseline against which we are currently working.”

Open Plan’s dBase structure and ‘openness’ is one of its major assets on this project, Langley explains: “The fact that we can write our own programs to link up with our other systems is one of the key strengths of Open Plan. It allows us to tailor the system to meet the project and client’s needs, and it is simpler and more cost-effective if we can make system alterations ourselves.”

Whilst Dong Ah as the main contractor is doing most of the construction itself, there are three major aspects of the work which are sub-contracted: the drilling of the wells, the permanent control and communications system and the design. “In all these cases, we have specified that the sub-contractors must operate compatible systems, allowing easy data interchange which we can plug straight into our system.” says Langley.

Undertaking project management in different locations is one of the project’s biggest difficulties. Because of unreliable data links between London and Libya, couriers take project data disks back and forth. “We both put the copies together, roll-up the information into the multi-project plan, check with each other and ensure we have the same results. With just two weeks to update the reports each month, it is tight – but we manage it.” he says.

Communication problems aside, Langley is positive about the way Open Plan handles the world’s largest single civil construction contract. He concludes: “With a project of this size and scale, it is difficult to have a firm grip of the whole thing without good project management tools - it is just too big. With Open Plan and carefully thought out work breakdown structures, we can look at minute detail, or step back and easily look at the whole picture.”

End

Publication Details:

Project Manager Today Magazine - April 1995
Gulf Construction & Saudi Arabian Review - May 1995
Pipes and Pipelines International - July/August 1995
World Water & Environment Engineer - July/August 1995

Contact: Mr. C. J. Langley
Brightyork Ltd
England
Tel & Fax: (01869) 325592
Email: CLangley@brightyork.com