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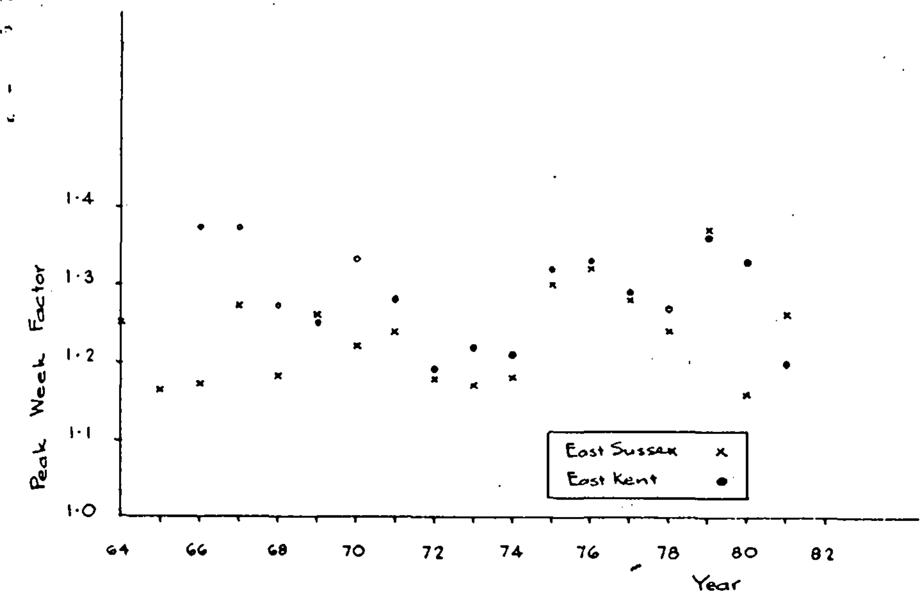

Fig. 8. Peak week factors: East Sussex and East Kent Divisions, Southern Water Authority

during 1964-74, then a further decline under the "new rules" from 1975-81. There was however, too little data to make any overall comment, since in any event the "droughts" of 1973, 1976, and 1980 had all assisted in depressing the peak demand in the following year in East Kent.

He wholly agreed with the author of the paper about the need for more information on garden use of water, but this must be related to the degree of financial constraint applied by the particular water undertaker.

THE APPLICATION OF A MANAGEMENT MODEL TO A RURAL WATER SUPPLY PROJECT IN MALAWI

By C. F. Palmer, MSc, MIProdE

INTRODUCTION

The objective of the particular project was to provide safe drinking water supplies to 60 000 people per year in Malawi, through the construction of 600 hand-dug wells, each serving a population of about 100.

Apart from the obvious financial, manpower, and material requirements, the overall success of the project depended upon community participation. Fortunately, there were no real problems in this respect, because the wells were to be constructed at the request of the villagers and groups of people, who readily provided the enthusiasm and commitment necessary for the successful completion of the work.

Unfortunately, targets had not been met during the first year of operation, and the project team considered the elementary use of systems analysis and quantitative planning methods in an attempt to meet the required production programme. The paper presents the outcome of the implementation of such methods and techniques.

THE PROJECT

The project was implemented by the Wells Section of the Water Ministry in Malawi, and included the manufacture of the concrete well-lining rings and the steel pumps at their central workshop in the capital city. The concrete rings were made from locally available materials, but the pumps were assembled from imported component parts.

The overall responsibility for managing the project came under the wells engineer. The organizational structure for the project is shown in Fig. 1.

The project was spread over a three-year period (1980-82), with a total target of 1 800 wells, i.e. 600 per year. All the necessary surveys had been undertaken in advance, so that the wells were only dug in areas where a sufficiently high water table existed.

The initial capital outlay for equipping the central workshop and the construction crews, and for providing most of the transport, had already been made before the work commenced. However, it was necessary to purchase further vehicles each year in order to cope with the growth of the project.

A vital requirement for the success of the project was for the voluntary community to be properly organized in order to have the well digging completed before the arrival of a skilled crew to carry out the well-lining and the installation of the pumps.

The final stages of the well digging and all the lining and pump installation was done by ten trained well-construction crews, who were equipped with the necessary supplies and tools. This work force came under the general supervision of two highly mobile technical officers (TOs). A total of 20 "water project assistants" organized the community labour in advance of the construction team, and they also undertook the maintenance work after the completion of the project. The organizational model is shown in Fig. 1.

This paper was received on 10th May 1983 and was accepted for publication on 9th June 1983. The author is a Lecturer in Management Science, Institute of Local Government Studies, University of Birmingham.

In: Journal of the Institutions of Water Engineers and Scientists: vol. 37 no. 6 (1983)

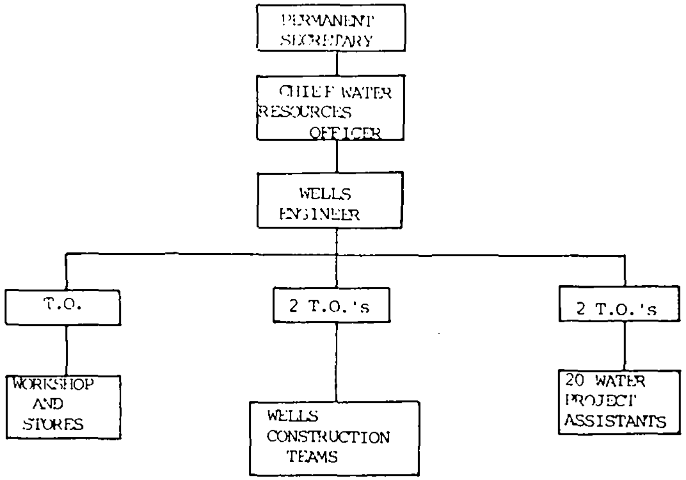

Fig. 1. Organizational structure for the rural water supply project

PROJECT APPRAISAL AND CONTROL

At the beginning of the project a logical model framework was devised by the project team (Fig. 2) to incorporate the objectives of the project with a system for monitoring and evaluation.

The project objectives were not achieved by the end of 1980 and a further reassessment of the organizational model and the logical framework and matrix with the monitoring system was carried out. The main reasons for the failure could be attributed to poor

OBJECTIVES	INDICATORS	SOURCE OF VERIFICATION	UNDERLYING ASSUMPTIONS
TO REDUCE THE INSTANCES OF WATER BORNE DISEASES BY PROVIDING SAFE WATER TO 180,000 PEOPLE.	NUMBER OF PEOPLE AFFECTED BY WATER BORNE DISEASES	MINISTRY OF HEALTH ADMINISTRATION STATISTICS	PEOPLE WILL UTILISE NEW PROTECTED WELLS

BY

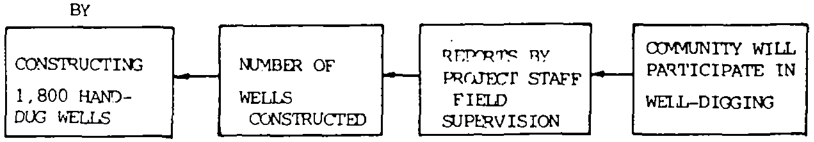

Fig. 2. Logical framework matrix and system for monitoring and evaluation of rural water supply project

management and particularly to the control aspect, despite the assistance of the logical framework and system adopted for monitoring referred to in Fig. 2.

The project team developed a control system which was due to be incorporated into the plan for constructing at least 600 wells for the following year, 1981. A further review of all systems was again to be made before undertaking the final year of the programme (1982). Fig. 3 shows the system adopted.

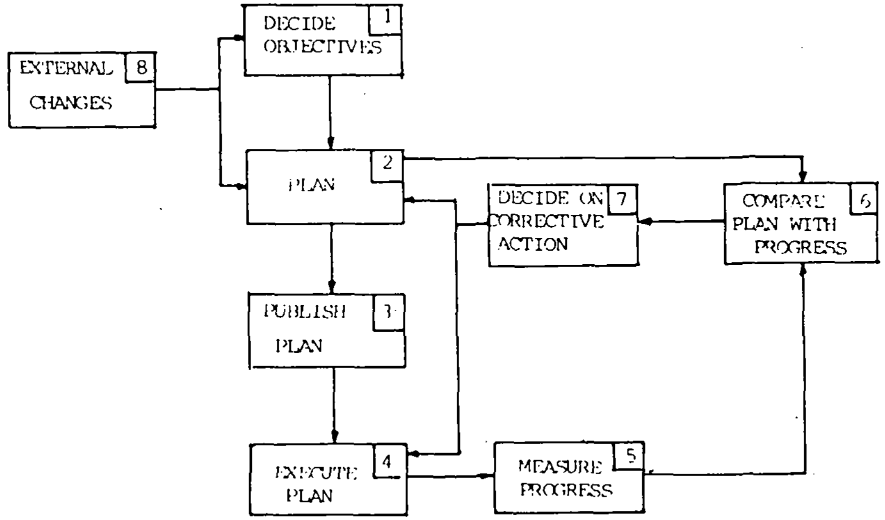

Fig. 3. The control cycle for the rural water supply project

The project team felt that the method or technique of network planning would be appropriate to use, including bar charts. This method was chosen because all the eight areas indicated in the boxes in the central cycle (Fig. 3) could be incorporated.

Box 1. An objective was the prerequisite of any plan and in this case it was at least 600 wells in 1981. Network would show target after analysis.

Box 2. Production of the plan by constructing the logic network.

Box 3. Publication of the plan. Here it was considered important and necessary that the people who had to operate it understood their part in the plan. All members of the project team could observe this on the network.

Box 4. The execution of the plan. Earliest and latest times for all activities could be seen and schedules prepared from the network.

Box 5. Measurement of progress. If control was to be exercised it was necessary to measure progress in order to find out how much had been accomplished. Weekly feedback of progress checked against the network and bar chart.

Box 6. Compare progress against the plan. Noting and reporting excessive variances.

Box 7. Deciding on corrective action. This, it was decided, could take two forms:

(*a*) an alteration to put performance back in accordance with the plan: and
(*b*) an alteration to the plan if it was decided by the project team that the original plan was no longer possible.

Box 8. "External Changes". Changes could occur through external reasons and any replanning that might be necessary could be seen by examination of the schedule bar chart.

From experience of the past year the project team felt that unless the schedule was constantly updated it would soon become meaningless and would fall into disuse, with the benefit of the planning stage being lost. Also, as much attention must be given to the control and reporting procedures as was given to the planning.

Before listing the distinct project activities, it should be clarified that the actual physical task of digging and protecting the wells could only be done during the dry season, which extended from May to November. This was also the period when the villagers were free from their tasks of cultivating and harvesting. It was also the time when the water table was likely to be at its lowest, thereby ensuring that the wells were dug to an adequate depth and did not run dry at the height of the dry season. It was vital, therefore, that the wells project team had all the necessary preparatory work done and were ready to start work in mid May, after the harvest had been gathered. any delay in this respect and the work target was in immediate jeopardy, which is precisely what happened in 1980. To avoid a recurrence of this situation in 1981 and 1982 it was necessary for the wells engineer and his team to have the start planned and a scheduled programme in the November 1980 when it was realized the target level was not to be reached under the present system.

It was at this stage that network planning and control was considered to be suitable, to enable an understanding of the sequence and logic of activities and events to be made and hopefully lead to a greater control of the complete project.

The following is a listing of the 13 district tasks which were to be performed:

Activity Code	*Description*	*Duration, days*
A	Prepare and place order for pump component parts	14
B	Prepare and place order for well construction materials (sand, cement, etc.)	2
C	Prepare and place order for new project vehicles	1
D	Delivery time of import order for pump components	130
E	Delivery time for well construction materials	10
F	Delivery time for new project vehicles	7
G	Organize community labour for well-digging	150
H	Communities dig 600 wells	150
J	Manufacture concrete rings and slabs for 600 wells	150
K	Assemble 600 pumps in central workshop	150
L	Deliver pumps, rings, and slabs to well sites	150
M	Line 600 wells with concrete rings	170
N	Install pumps	170

Following this listing of activities, the network planning team, which composed the chief water resources officer (representing senior management), the wells engineer, and five technical officers, all working together, constructed the network shown in Fig. 4.

Targets were achieved by the end of 1981 and a review of the systems and models adopted was then made to show the advantages and limitations, together with changes that were considered necessary to achieve the objectives.

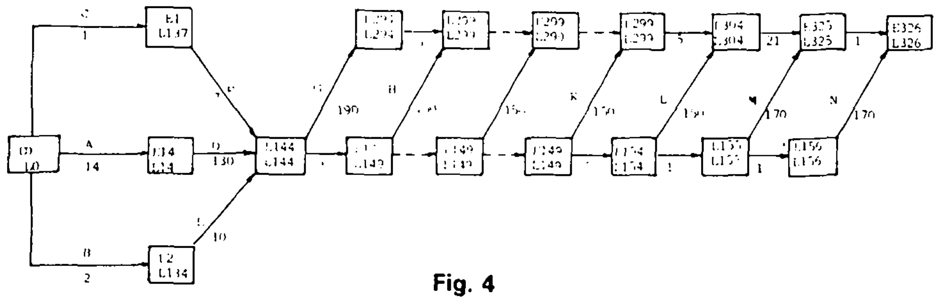

Fig. 4

Notes

1. Pump component parts cannot be ordered before 1st January, for budgetory reasons
2. The time shown is *days*, not man days
3. G requires 5 days lead time before H can start. J and K can start at the same time as H. H, J, and K need 5 days start on L. L requires 1 day on M and M requires 1 day on N
4. The broken lines between H and K represent dummy activities", with zero time

ADVANTAGES OF NETWORK PLANNING

The main advantages of the use of network planning as applied to the project were:

(1) The construction of the network imposed discipline and clarity of thought upon the project team members.

(2) It promoted a spirit of teamwork and, particularly, gave the more junior members of the team an invaluable opportunity to particpate in project planning.

(3) The analysis of the network clearly idicated the component activities to be undertaken and the critical activities which had to be closely monitored and supervised which was lacking in 1980.

(4) Changes in activity duration and in early/late event times was reflected on the network and decisions taken as to appropriate adjustment to other activities in order to keep within the overall time target.

(5) The network clearly displayed to each member of the team his area of responsibility and his time schedule.

(6) Experimentation with variations of activity durations and early/late times could be carried out on the network without affecting the project itself.

(7) The network clearly showed the logic, the inter-relationships, and the inter-dependencies of the various project activities.

(8) The network could, and was, used as a control as well as a planning technique.

(9) Float times could be calculcated to give each member a clear picture of the amount of time, if any, in hand for each activity.

(10) The network promoted co-ordination during the implementation phase.

The main limitations and alterations necessary to make the system effective were:
(a) The progress of the work could not be recorded on the diagram and for this purpose it was necessary to complement the network presentation with a Gnatt (bar) chart.
(b) The network diagram reflected the duration of the activities but did not show the requirements of manpower, finance, equipment, and materials. To illustrate these requirements bar charts were constructed to show the resource requirements and availability.
(c) The network obviously did not show geographically the location of the wells, and a large scale map with coloured pins adjacent to the network was created.
(d) The length of the arrows did not represent time on the network, unlike a Gnatt chart. But a combination of both was very effective.

It was clear from the foregoing that the use of the network technique was a great success, particularly when used in conjunction with complementary management aids such as the Gnatt chart and resource bar and histogram.

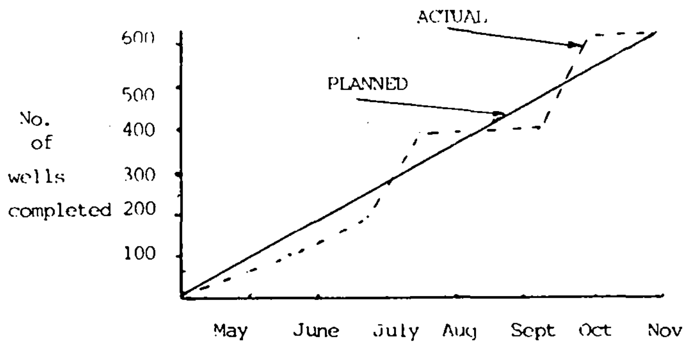

Fig. 5

In addition, a simple but very effective progress chart (as shown in Fig. 5) was used for information purposes. It became an easy reference for other senior members outside the project team and was easily monitored.

In assessing the value of the models and systems used, the overall conclusion of the project team was that it would have been very difficult to have achieved the target levels without them, and that they provided a sense of control.

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PRELIMINARY ESTIMATES OF LOADS CARRIED BY RIVERS TO ESTUARIES AND COASTAL WATERS AROUND GREAT BRITAIN DERIVED FROM THE HARMONIZED MONITORING SCHEME

By J. C. Rodda, DSc *(Member)*, and G. N. Jones, BA

INTRODUCTION

Over the last 10 to 15 years, national systems for the monitoring of river water quality have been developed in a number of countries. Such initiatives have usually resulted from international collaborative exercises, for example the Global Environmental Monitoring System (GEMS); or from the requirements of supranational bodies, such as the European Economic Community[1]: or from the needs of governments for water data for their own policy and planning purposes[2].

The Harmonized Monitoring Scheme is the British system for the routine collection, analysis, archiving, and publication of data on river water quality[3,4] which commenced operation in 1974. Before that time most of the routine monitoring was undertaken for local or river basin purposes[5]: hence there was no urgent and compelling reason for concern about differences in methods of sampling and analysis from one part of the country to another. However, such differences were recognized to be important to a national monitoring system, so an essential feature of the Harmonized Monitoring scheme is the inter-laboratory calibration programme. This programme is designed to produce comparable results of demonstrable accuracy so as to meet the objectives of the scheme, namely:

(1) To enable estimates to be made in connection with the United Kingdom's obligations, of materials carried down rivers into estuaries.
(2) To enable long-term trends in river quality to be identified.

This paper is concerned with the first of these objectives: it provides preliminary estimates of the loads of eight chemical determinands carried by the rivers draining Great Britain. It does not deal with discharges made directly to the sea.

RIVER LOADS

Rivers carry a wide variety of materials in solution, in suspension, and by saltation. Some of this material originates from natural sources, the remainder is from sources dependent on man and his activities. Some sources, both natural and man-made, are diffuse, while others are point sources. Assuming the availability of material for transport, then the flow of the river is the chief control of the total quantity of load and of the proportions of bed, suspended, and dissolved load.

This paper was received on 14 April 1983 and was accepted for publication on 9th June 1983. Dr. Rodda is Head of Data and Information Services, Institute of Hydrology. Mr. Jones is Systems Programmer, Computing Division, Department of the Environment.