APPLIED LOGISTICS FOR A DRILLING RIG TRANSFER AND MAINTENANCE ORGANIZATION

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ABSTRACT

This paper describes the problems of optimizing periodic drilling rig transfers from one site to another and the connected maintenance operations. Integrated Logistic Support Theory has been extensively applied and careful analysis of specific problems has led to suitable solutions.

1. INTRODUCTION

ENEL S.p.A. carries out its drilling operations on geothermal reservoirs through the use of over ten rigs, mostly within areas in the Tuscany and Lazio regions.
This entails transporting the drilling rigs over distances ranging from ten to hundreds kilometers.
Studies aimed at optimizing the organization of these transfers have been conducted.
This paper examines this optimization activity which, even if limited in time compared with the drilling operations, as a whole, is of considerable importance because of the amount of resources involved.
Since this subject is a new one, a particular effort has been devoted to defining the operational sequences and the equipment involved in order to make the disassembling, transportation and re-assembling operations as standard as possible, while neglecting the logistic and environmental constraints which change from location to location.
It is worth emphasizing that 90% of these analyses has been performed "in the field" by means of a systematic examination of the events.
The following synthesis was achieved both through repeated meetings with the working teams and the managers, and by constructing and optimizing a logical model.
In pursuance of this goal, a new equipment management philosophy was developed, leaning toward replacement of components rather than carrying out the maintenance directly at the drilling location.
This results in a continuos operational availability of the drilling rig and, at the same time, in an improvement in the scheduling of the workshop, which can plan its activities without being involved in emergency interventions.
In the following, the acronym STM (Smontaggio = disassembling, Trasporto = transportation, Montaggio = assembly) will be used to indicate the Drilling Rig Move.

2. STUDY

2.1 Study/Project Plan

The study began during a drilling rig move (the rig was a MAS 6000 type) from a site called Bruciano to another named Radicondoli 30 (Tuscany, Italy).

The development phases of the Study/Project were as follows:
- information gathering, on-site investigations at the drilling locations;
- data analysis and classification;
- choice of a suitable logical model for project development;
- discussion with the operators to improve the logical model;
- creation of the working reticular program (PERT, Project Evaluation and Review Technique) with the related calculation programs;
- testing of the results obtained from the computer simulation on an actual transfer;
- analysis of the results;
- organization proposals and operational choices.

These phases are shown in the flow chart of Figure 1.
The data acquisition phase was carried out "in the field' during the Bruciano-Radicondoli drilling rig move, while the testing on the results of the computer simulation was perfoxmed during a Selva-Bruciano move.

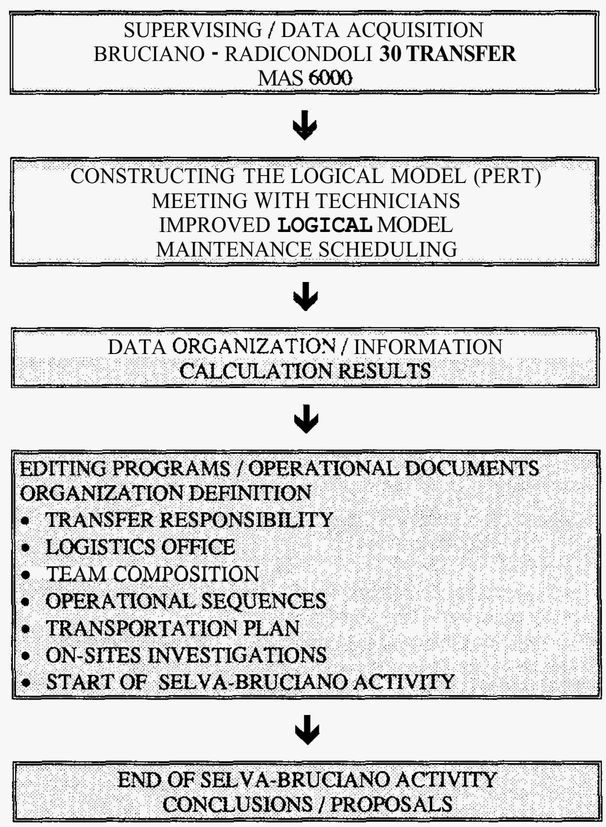

Figure 1

The periods were July-August 1992 for the first phase, and December 1992-January 1993 for the second phase.
The intervening period was used for discussion with the operators and for project improvement.

With this method observations and suggestions were collected directly during the work at the dnlling location in order to achieve an adequate data base for the subsequent scheduling.

2.2 Remarks on the Bruciano-Radicondoli Drilling Rig Move

From the analysis of all the events directly or indirectly connected with the observed transfer and the available information sources (that is, the technicians engaged in the transfer), the following characteristic aspects of this activity became evident:

- environmental factor: all the activity occurs in the open, far from the logistic base in Larderello (Tuscany, Italy), and sometimes under poor weather conditions;
- human factor: this concerned the interaction among the individuals working together in a team;
- organizational factor: involving both the operational sequences and the technical activities with the related planning and scheduling;
- management factor: the control and management of the whole transfer operation.

The problem to be solved is to clearly understand the relevance of all the tasks and to define their boundaries.
Indeed, the work is greatly influenced by these four factors and any change in their balance means a change in the quality and efficiency of performance.

2.3 Project Development

On the basis of the above considerations, we began the second project phase: analysis of the collected information.
First of all we defined the project goals:

The purpose of this study is to analyze all the actions and the resources in the drilling rig move from one location to another, with the aim of optimizing performance and achieving the maximum efficiency compatible with the available resources and with the environmental conditions.

The resulting project should define and indicate solutions suitable for the achievement of the above goals.
In practice, in accordance with Integrated Logistic Support Theory, the whole activity was considered as a "black box" which has to be analyzed in its various components.
The analyzing process went through the following steps:

- Fundamental or Primary Components:
  - disassembly
  - transportation
  - assembly
- Supporting Fundamental Components:
  - maintenance operations
  - controls
  - safety
- Secondary Connected Components:
  - support activities

The fundamental or primary components are those activities which directly contribute to the transfer operations.
The supporting fundamental components are the activities without which, once the main components have been executed, correct and safe functioning for production and for the workers could not be guaranteed.
The secondary connected components: are the activities that ensure a correct supply of services to the main activity (transportation, water supply, food supply, etc.).
The entire expense is made up of the sum of the expenses of the single components listed above.
Therefore, in order to achieve peak efficiency we identified which components can be taken as fixed components and which as variable ones. The larger the number of fixed components the simpler the scheduling.
As far as the main components are concerned, in first approximation the disassembly and assembly activities can be considered as constant ones in terms of time and resources.
Therefore, once the amount of human resources has been determined, it is necessary to identify the material supplies for assembly and then the shipment schedule in the disassembly phase.
From these considerations it is clear that in order to achieve these goals it is necessary to draw up a suitable shipment schedule for the material.
The unique variable is the amount of resources necessary for the transportation as a function of the distance between the two sites.
In others words, in order to ensure a steady supply to a given assembly team, it is necessary to make a predetermined number of daily complete shipments (load, trip there, unload, trip back). This way, if four daily complete shipments have been established, only two trucks are needed over a distance of 10km. Vice versa, for the same number of shipments over a distance of 60km, 6 trucks will be needed since one truck cannot do a daily complete shipment, but only a fraction of it.
The main result of these findings was to precisely determine all the disassembly and assembly actions with all the operational sequences and to draw up a daily shipment plan leaving to a Logistics Office the task of establishing the necessary number of trucks.
Later, a reticular program (PERT) was made. It was developed with a common commercial software on which the transportation activity was considered exactly like any other activity. This software, besides making it possible to do all the STM planning, also generated a detailed program (GANT), the operational documents and the progress checking routines.
This way the goal of planning and scheduling the STM activity in a homogeneous and uniform way was achieved.

2.4 Problems

Among the various aspects examined by our study, we find:

- Communications between:
  - involved departments
  - the drilling locations
  - the transport management and the drilling locations
  - the operators in the drilling location
- Scheduling and operational sequence.
- Size of the teams.
- Making available of the necessary equipment.
- Using special equipment to make the loading, the unloading and the movement of the material easier.
- Drawing up documentation on the initial and final field configurations.
- Carrying out efficient scheduling of all the necessary maintenance operations.

The practical solutions of the problems listed above led to the following results:

- scheduled utilization of the lifting machines;
- depersonalization of the activities;
- coordination of the workers' assignment in the drilling location;
- scheduling of the routine maintenance operations to be performed
- indications on the unscheduled maintenance operations to be performed.

2.5 Maintenance

Another important aspect which influences the STM is the necessity of performing maintenance operations while the conditions are optimal (the equipment is completely taken apart) and also because some operations may be urgent (failures occurrence).
Maintenance activity is classified among the "supporting fundamental components" and it seriously conditions the STM activity.
For maintenance as well, we decided to suggest separating execution and management from the rest of the activities, so as to facilitate scheduling.
In others words, it appeared to be fitting, in order not to interfere with the STM, to keep the maintenance operations out of the working cycle, and to keep the Transfer, the Storehouse and the Workshop as three almost completely separate operational flows.

That is, the maintenance operations must become just replacements of components shipped from the storehouse; defective components are shipped to the Workshop where they are examined to decide whether they can be repaired, and if they can be, they are. This is schematized in Figure **2.**

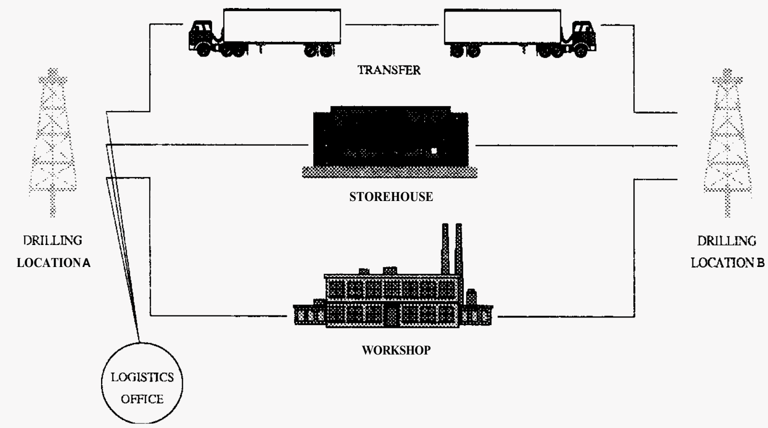

Figure 2

By so doing, the STM is not hampered by the maintenance requirements at all.
In order to achieve this goal completely a thorough technical-logistic analysis is reuuired, with the drawing up of a logistic tree, determining the failure rate of the various complex or simple components and the scheduling of maintenance and safety interventions.
These activities are still in progress.
It may be worth pointing out that drawing up the logistic tree brought to light the existence of two-hundred fundamental assemblies.

The first development levels of this tree are shown in Figures 3 and 4.

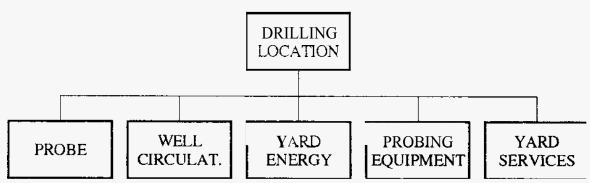

Figure **3**

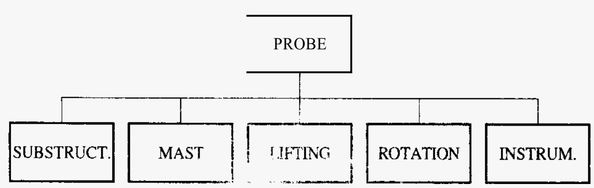

Figure 4

3. RESULTS

The field testing of the "Selva-Bruciano" transfer (see Figure 5) demonstrates an efficiency gain of about 20% compared to the previous mean transfer time (in hours).

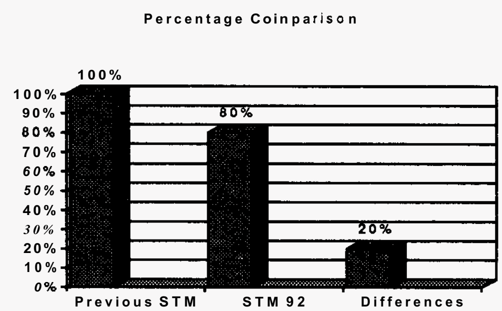

Figure *5*

The indications given by the test can be summarized in the following:

- management proposals
- organizational proposals
- operational proposals
- investment proposals
- proposals for further interventions and improvements

whose main goal is transforming the STM from an occasional and therefore vague activity, as far as methods and times are concerned, into a planned activity whose cost and resources can be scheduled and predicted, and whose efficiency and efficacy can be improved.
In particular, we estimate that, after new investments, a further 10% reduction in the STM times can be achieved.

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