Mutual Consultants





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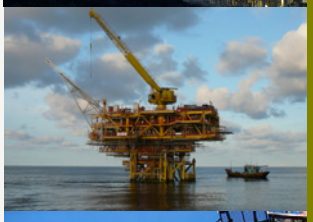
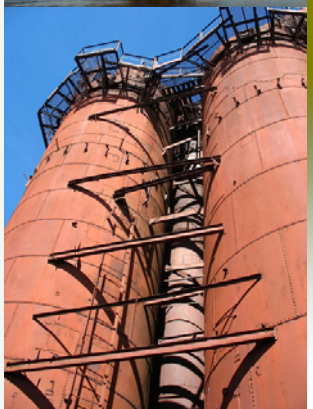
Railway Depot Modelling

RDM



"Simulation of most activities at an existing or proposed railway maintenance depot in order to predict depot and fleet performance for any given set of input parameters"

RDM

Overview of Railway Depot Modelling (RDM)

Pressures on Railway Depots

The effective development and management of a railway depot involves a regular re-evaluation of how best to respond to changing engineering, commercial and operational pressures such as increased depot workloads, revised depot layouts and new vehicle maintenance schedules

Depot Managers may face questions such as *"how can we alter the depot shift patterns to maximise staff utilisation?"* or *"how is the depot going to cope with the new fleet?"* or *"what would happen if ....?"*

Railway maintenance depots involve many complex inter-related activities. It is, therefore, not always obvious what effect a change in one area may have on the overall performance of a depot and its fleet of vehicles.

Managing the Change

We can help today's depot managers to ask and answer depot-related questions with the minimum of risk to engineering, commercial and operational performance. Our approach uses a modern sophisticated computer simulation package to model your railway maintenance depot. This computer model accurately simulates all your depot's and fleet's activities, carefully noting the net effects on performance caused by the interaction of a large number of variable factors. By using the software we provide the opportunity to test your ideas for change, and even fine tune them to your best advantage, before financial and other resources are committed in making the changes.

In summary, by using computer simulation we can investigate the very complex relationships between a large number of variable factors which ultimately govern the efficient operation of a railway depot.

Our Approach

We work closely with you in the following stages of a modelling project: Requirements Analysis, Data Gathering, Calibration, Simulation and Reporting. This approach enables us to investigate any number of "what if?" scenarios. Once set up, the model is easily re-run at a later date to assess future developments.

Benefits

The major benefit of Mutual Consultants' approach is that it provides you with the opportunity to test **rapidly and safely** a variety of possible changes that you may be considering in response to changing engineering, commercial and operating pressures.

In addition, being able to base your decisions confidently on our modelling output may mean, for example, the smooth introduction of a new fleet of vehicles or moving the right number of staff from nights to days, and still covering the morning peak.

Crucially, you will be able to test these ideas and even fine tune them to your best advantage, before committing financial and other resources to them and without incurring expensive mistakes.

Intentionally Blank

Mutual Consultants

Railway Depot Modelling

Contents

INTRODUCTION

The efficient operation of any railway vehicle maintenance depot is determined by the complex interaction of a large number of variable factors. A depot which is apparently "ticking over nicely" could easily become disturbed by inappropriate or poorly-managed changes. The effects on a depot caused by such changes can often be surprising, and even confusing, despite the best of intentions.

The effective development and management of a railway depot involves a regular re-evaluation of how best to respond to changing engineering, commercial and operational pressures.

This brochure describes our approach to the problem of determining what the most appropriate changes are, and what effects they will have on depot and fleet performance

IS YOUR RAILWAY DEPOT FULLY OPTIMISED?

Depot Managers considering minor or major changes to a depot or its fleet of vehicles will almost certainly be contemplating one or more of the following:

- increased depot workloads
- revised depot layouts
- different staffing skills, mix and levels
- different fleet sizes
- new vehicle maintenance schedules
- changing failure rates, etc.

Hence, the following are typical questions that Depot Managers may face:

- "operationally, where is the best place to put the new washing plant?"
- "how can we alter the depot shift patterns to maximise staff utilisation?"
- "exactly how will two more roads in the main shed influence depot capacity?"
- "how is the depot going to cope with the new fleet?"
- "can we realistically tender for that heavy overhaul contract and still expect to run next year's timetable?"
- "how many staff can we move from nights to days and still ensure we cover the morning peak?"
- "what about fuelling trains on the way out rather than on the way in?"
- "what would happen if ....?"

Depot Layout

Basic depot layout is a fundamental factor in determining overall depot performance.

How many sheds or “work areas” do you need and what size should they be? What roads are required within the sheds, and how long should they be? How should the roads be split into discrete bays? Which roads need to be electrified, and what do you need in the way of stabling sidings?

If a depot’s layout does not ideally suit its requirements then every day and every night will be a struggle for the depot staff and, in the long run, it will lead to inefficient operation of the depot

Depot Resources

Without the appropriate resources, even a well laid out depot will not perform adequately.

Are any of the following required, and where should they be sited?

- washing plant, toilet flushing/emptying facilities
- train cleaning equipment (e.g. side platforms)
- lifting facilities (overhead and/or in-pit)
- wheel re-profiling equipment
- electronics clean room
- stores space

Staffing

The performance of a depot depends absolutely upon its employees.

How many skilled staff are required? What types of staff should you have? What skill levels are needed? What shift patterns are most appropriate?

The problem is how best to determine the optimum staffing levels, skills, shift patterns, etc.

Maintenance Workload

How a fleet’s maintenance requirements are planned can dramatically affect a depot’s ability to complete its workload efficiently and effectively. A depot considering undertaking work on behalf of third parties needs to be confident that the capacity for that work either does or could exist.

A depot’s workload can be split into the following categories:

- scheduled running maintenance (should they be balanced or cumulative exams; should they be done during the day or overnight?)
- scheduled overhauls (should the work be done in-house or should it be contracted out?)
- unscheduled maintenance (repairs & failures)
- modifications (what if a major modification programme is required soon after entering service?)

Considering workload in combination with the depot raises two possible questions:

- how could the depot be developed in order to best cope with the existing workload?
- how could the workload be best adjusted to suit the existing depot?

OUR APPROACH

There are many alternative approaches that could be deployed to answer the questions raised in the previous section

Traditional Approaches

The following approaches have been used traditionally in railway depot development, with varying degrees of success:

- informed guesswork/"gut feel"
- building and operating scale models
- simulating the depot and fleets with a spreadsheet
- trying it for real to see what happens.

All the above approaches mean that changes are made on the basis of incomplete information, and they are, therefore, likely to have one or more of the following shortcomings:

- very expensive mistakes can occur
- depot development stagnates through fear of failure
- key staff are distracted from the day-to-day running of the depot.

Railway Depot Simulation Modelling

Our approach involves accurately modelling the depot and its fleet(s) in order to provide depot managers with the best possible information on which to base decisions for depot development.

We make use of a sophisticated railway depot simulation software package which is capable of modelling almost all activities at most railway depots. The model simulates as many days as are required using a comprehensive set of input parameters and then predicts likely depot and fleet performance.

We believe this approach is the only one which caters for and recognises that the efficient operation of any railway maintenance depot is determined by the complex interaction of a large number of variable factors

The Stages of a Simulation Modelling Project

Mutual Consultants Limited works closely with you at every one of the following stages of a simulation modelling project:

- assess resources required
- collect raw data
- format data for use in the model

- calibrate the model
- iterate to solution(s)
- report back.

Each of these stages is described in more detail in the following paragraphs.

Assess Resources Required

The purpose of this stage is to estimate what resources will be required in order to complete the modelling project; this will then enable you to assess whether the time, effort and money looks worthwhile.

First, it is necessary to define the overall objectives for the modelling project. For example, it may be stated as *"to determine the optimum size of the main shed extension"* (a relatively small project) or, perhaps, *"to provide predictions of depot and fleet performance for various alternative depot refurbishment schemes"* (a large modelling project).

Next, an estimate is made of the time and resources required to collect basic raw data about the depot and the fleet(s). This information is the core of the model and needs to be to a sufficient quality to ensure success of the modelling project.

A "strategy" is planned for performing the actual computer simulations. This means determining how best to present the data to the model, which input parameters will be altered between simulations and which key performance indicators are to be used to judge the success (or otherwise) of each simulation run.

We will then prepare a document which fully details the resources and costs required to build the model and run the simulations, enabling you to decide whether or not to continue.

Collect Raw Data

Once the decision has been made to continue, the next stage is to collect the raw data required. This data used to "drive" the model.

This involves our consultant working closely with depot (and other) staff as required to collect information about the depot, the fleet(s) of vehicles, the maintenance workload, and costs (where relevant).

Format Data For Use in Model

The raw data collected in the previous stage needs to be structured into a format acceptable to the simulation model. This entails writing structured text files that the model can read and understand.

The data will be split into several categories, and there could be a large number of text files depending on the complexity of the modelling project. The data categories are:

- global information
    - depots/stations
    - staff types
    - vehicle types
    - job names

- depot information
  - work areas
  - roads
  - bays
  - bay capabilities
- staff information
  - shifts
  - turns
- train running information
  - diagrams
  - journeys
- vehicle maintenance information
  - scheduled running maintenance
  - scheduled overhauls
  - unscheduled maintenance (repairs/failures)
  - modifications.

Calibrate the Model

Where possible, the simulation model will be “calibrated”.

In this stage, a simulation (of the depot in its existing state) is run and the resulting output is compared with actual depot and fleet performance to confirm that it looks sensible and that discrepancies can be explained.

If the output is not sensible or discrepancies cannot be explained then the input data is re-examined in order to determine the root of the problem.

The purpose is to ensure that the model behaves in a sensible way and, that where there are discrepancies between model behaviour and reality these can be satisfactorily explained.

Confidence in the model output is much greater once it has been calibrated in this way.

Iterate to Solution(s)

The data which has already been prepared can now be processed by the computer simulation model. One or more sets of simulation “runs” are made according to the strategy determined in the first stage of our approach. Each individual run produces several output data files.

This output is examined and interpreted. Extreme scenarios are quickly dismissed, leaving an area of “middle ground” which warrants more detailed investigation.

For example, a project may be investigating the effects of varying the number of skilled staff available each day in a shed which currently has 50 employees. Several runs may have been set up which tested the following numbers of staff: 10, 20, 30, 40, 50, 60, 70. It would be expected that 10 staff would cause the depot to “grind to a halt” and

that 70 staff would give unacceptably low staff utilisation - these are the “extreme scenarios” referred to above. The results may well indicate that it would be worth considering a second series of runs with staff numbers varying in smaller increments between 30 and 50.

In this way, the data is “fine tuned” and re-run and the model “zooms in” on the optimum solution.

Report Back

All the above steps are documented in summary and in full detail, providing you with the best possible information on which to base your final decisions for change.

BENEFITS

The major benefit of Mutual Consultants Limited’s approach is that it provides you with the opportunity to rapidly and safely test a variety of possible responses to changing engineering, commercial and operational pressures.

Furthermore, the investment in the initial simulation modelling project can potentially “pay back” many times. A depot will continue to develop in response to changing needs over time; the data gathered and modelling expertise developed during the initial project remains available for use in future projects. Future projects will, of course, require considerably less time and resources.

More specific benefits are listed below, under the headings of financial and physical benefits.

Financial

Using our approach may, for example, mean that one less member of staff is employed at the depot than would otherwise have been the case.

> If we say the cost of employing that person is £30k pa, then over, say, 15 years this would save £450k.

Using our approach may, for example, mean avoiding a failure to cover one train diagram per week.

> If the average financial penalty for not covering a train diagram is, say, £5k (totalling £250k pa), then over, say, 15 years this would save £3.75m.

Using our approach may, for example, mean that, where a fleet’s maintenance workload is split between two depots, one less movement of trains between the two depots per week is required than would otherwise have been the case.

> If the average cost of a movement to another depot is, say, £500 (totalling £25k pa), then over, say, 15 years this would save £375k.

Physical

Simulation modelling highlights the complex interactions between all the variable factors which determine overall depot and fleet performance. This cannot be achieved realistically by any other method.

Our approach provides you with a zero-risk environment in which to test all the effects of your proposed changes.

By testing various possibilities, you can quickly determine optimum solutions for:

- depot layout
- depot resources
- depot staffing
- maintenance workload.

You are provided with comprehensive simulation modelling project reports which present you with the best possible information on which to base your final decisions for change. This creates an audit trail for your decisions, making them both *sensible* and *defensible*.

MUTUAL CONSULTANTS' ROLE

Our role is to work closely with clients to understand fully how the existing/proposed depots/fleets operate in order to enable us to build the best possible model that can, therefore, accurately predict depot/fleet performance given any set of input parameters.

CONCLUSION

By adopting a structured approach to railway depot simulation modelling, many parameters can be varied (either simultaneously or individually) allowing us to investigate may "what if?" scenarios. Furthermore, once the data has been gathered and a model set up, we can re-run the simulation in the future as new developments need to be assessed.

You will be able to test ideas for change, and even fine tune them to your best advantage, before committing financial and other resources to them and thereby avoiding expensive mistakes.

For More Information Please Contact

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