ABSTRACTING LIFT MANAGEMENT INFORMATION FROM ACQUIRED DATA

J.R. Beebe, Ph.D., M.Sc., B.Sc., C.Eng., M.I.E.E., M.B.C.S.
Lift Innovations Ltd., Bolton, BL9 5NF, England.

ABSTRACT
Automatically acquiring data from lifts involves two processes. The first is the transmission and subsequent storage of data from a remote lift installation to a central management point. The second process involves the identification of the important management information from the vast quantity of data received.

This paper discusses the second process and presents ideas on the practical implementation of a management system. Particular emphasis is given to providing information to the building manager in an easily accessible and assimilated form.

1 INTRODUCTION

With the falling prices an increasing sophistication of small computer systems the use of computers in the management of large numbers of lifts has become a practical reality. This paper defines lift management and its benefits. Practical considerations are then summarised, including performance analysis, supervision of maintenance, integrated building management. Finally, important implementation issues are addressed.

2 WHAT IS LIFT MANAGEMENT?

The operation of groups of lifts within one or more buildings can be thought of as a hierarchy of functions (see Figure 1). At the bottom of the hierarchy, the most basic function is to move a single lift from floor to floor responding to calls registered by passengers. At the next level, that of group control, passenger calls on different landing levels are assigned amongst the individual lifts in a group of lifts according to pre-programmed rules (known as an algorithm).

Lift management is the long term process by which the operation of all lifts in several groups is optimized and then maintained at a peak of performance. Lift management is thus the top level of the hierarchy and allows the operation of the lifts to be "tailored" to the building in which they are located. Without lift management, the occupants of the building must "tailor" their requirements to the service provided by the lifts.

Lift management can be broken down into two tasks:

TASK 1: Data capture/transmission/archiving-
ie getting the information

TASK 2: Data analysis/filtering/presentation-
ie showing what's there

There is nothing magical about a computer. Both the above tasks can be done by humans but it is much more effective and efficient to use modern, powerful computer technology.

Many lift manufacturers have developed remote reporting systems to perform task 1 which is a primary requirement for lift management. None has really addressed task 2. Perhaps lift companies view these systems as essentially a tool for supporting routine maintenance work and fault diagnosis and do not see a need to fully develop the functions of task 2.

Task 2 is orientated towards the needs of the lift owner and users and comprises the following:

1) Analyse incoming data at a central point.

2) Show clearly and concisely current status of all lifts.

3) Evaluation of service provided to passengers in terms of response to calls and lift availability.

3) Statistical analysis of malfunctions showing correlations across different types of lift or periods of time (historical perspective).

4) Use correlations to locate unreliable components (expert system).

5) Supervise repair/maintenance work with reference to acquired data

3 BENEFITS TO THE OWNER/USER

Ideally a lift management system should be operational at the time a building is first occupied and during the defects liability period of the lifts:

1) To measure the lift service provided in comparison to the design specification.

2) To establish a characterisation of satisfactory lift performance acceptable to both manufacturer and owner, against which future performance can be measured to ensure that the lift service is constant over the life of the lift system.

3) To set up routine maintenance schedules which make allowance for the most worked or least reliable parts of the lifts.

4) To oversee the conscientious and efficient execution of maintenance and unscheduled call-outs.

5) To commence archiving of data for historical records/analysis, thus providing irrefutable evidence of performance.

4 PERFORMANCE

4.1 How to Measure Performance

Many methods of measuring lift system performance have been suggested. What is needed is an all encompassing characterisation which takes into account duty, size of lifts, response times (to passenger calls), downtime and so on. A single lift such performance index does not yet exist. However, all these factors can be considered separately and then combined to give a global picture.

4.2 How to Analyse Performance

Some existing systems measure response time to landing calls as an indication of passenger waiting time. However, the wealth of useful information contained in this data is often lost by preparing a single figure of average response time over some pre-defined (usually long) period. The spread of values of response time (showing how consistent the service is) is just as important as is the effect of demand intensity.

4.3 How to Present Performance

The presentation of information should be concise and clear. Faults and important trends should be highlighted. Tables of figures are of little value because they tend to obscure patterns and trends in the data. Graphics are preferable eg. Cartesian plots, Kiviat diagrams, Percentile distributions of landing call response times. Colour displays allow a more concentrated presentation of information and are more interesting to the human eye. Sequences of graphs displayed in quick succession can be used to identify developing trends (for example, of both lift usage and occurrence of malfunctions).

5 SUPERVISION OF MAINTENANCE

Computerised supervision of maintenance can operate much as any other business software package following each item through a standard sequence of operations and recording the conclusion:

1) Activate automatic paging devices to alert staff and/or maintenance contractor automatically on detection of fault.

2) Record self generated fault diagnosis.

3) Monitor response of staff to paging.

4) Alert alternative maintenance staff until response is obtained.

5) Accept job-sheet reports of fault diagnosis and remedy.

6) Match data to invoices and report discrepancies.

7) Keep records of time-to-respond and time-to-repair faults.

6 INTEGRATED BUILDING MANAGEMENT

High performance microprocessor controlled lift systems are capable of delivering maximally efficient service if properly tuned to the patterns of population and passenger travel of the building. Lift management systems can provide an easy to use central facility for building managers to enter data on:

1) holidays
2) working hours
3) canteen hours
4) conference schedules
5) access security control

as well as automatically accumulating data for the designation and re-ordering of priority service floors. Lift management is a complementary (though technically more complex) operation to management of other building services - heating ventilation etc. and is often carried out by the same personnel. Therefore, efforts are being made towards the integration of lift and other building services management equipment to reduce cost and save office space. The resulting management system may still involve the use of several computers but these would be linked into a coherent network of communicating devices which would appear as a single system to the user.

7 IMPLEMENTATION OF LIFT MANAGEMENT- Practical Considerations

7.1 TASK 1: Data Capture/Transmission/Archiving

These subject are being covered in related papers so only brief a brief mention will be made here.

7.1.1 Data Capture

A common standard for computer interface to lift controllers is urgently required. Covering hardware and information content for output.

7.1.2 Data Transmission

Networks already mentioned allow economic use of cabling.

7.1.3 Data Archiving

The process of immediately storing new data should be continuous and automatic and should not be interrupted regardless of any functions which might be requested from the users of the lift management system (The ability to do this is referred to as multitasking). A backup copy of all data should be kept at a separate location to protect valuable information against loss due to fire/ flood/ accidental-erasure etc. The backup data can also be used as an archive for old information which can be removed from the lift management system to provide space to store new information.

7.2 TASK 2: Data Analysis/Filtering/Presentation

The operation of the lift management central computer must be simple. Choices of action must be clearly described to help new users while offering easy and fast access to the facilities of the system for familiar users. The controls of the system must be consistent throughout all the various facilities and must not require the user to interchange storage disks to offer different parts of the program, or require strange combinations of keys to be pressed or suddenly break from normal operation to display an unintelligible message if some malfunction occurs. Above all, the system components of the lift management system must be totally reliable and supported by a competent and efficient service and repair organization. There is little point in installing performance monitoring equipment if its own performance is substandard.

7.2.1 Data Analysis

The lift manager is likely to be responsible for several other building utilities and therefore will require that the lift management system analyses incoming and stored data to allow decisions to be made quickly and easily. Thus it is not sufficient for the computer merely to present the data, it must also provide analysis facilities to guide the user towards the correct decisions. The computer must therefore be programmed by and mimic the thought processes of a human expert lift manager. Analysis should cover the ares of interest previously mentioned ie, performance, reliability and maintenance.

7.2.2 Data Filtering

An enormous quantity of data is available from a lift controller all of which is potentially useful but only so if it is possible to isolate specific events of interest from the mass of other information. Thus some sort of automatic filtering process is required to allow the user to concentrate on a defined area of interest. For example, to locate floors at which response time to calls exceeds a defined value or a lift which suffers more than twice the average number of door reversals.

7.2.3 Data Presentation

The human eye is adept at identifying patterns, even those which are embedded in random arrangements of colour and shade. Thus colour graphical presentation of data is an ideal method of presenting the large quantities of data which are handled by a lift management computer system. The ability to overlay different graphical presentations in quick succession allows another facility of the human eye, that of movement detection, to be used to advantage.

8 CONCLUSIONS

The advantages of lift management to owners and users and those involved in maintenance of lifts has been discussed for many years. The hardware technology is available now for sophisticated and efficient lift management. The software can and is being developed. This paper has examined the desirable features and processes which this software should embody.

9 BIOGRAPHICAL NOTES

J.R. (Jonathan) BEEBE conducted research for his Ph.D. Thesis at the University of Manchester Institute of Science and Technology from 1977 to 1980 in the use of computers for Lift Management and Control. Subsequently, whilst working with LDP (Lift Designers) Ltd (1980 - 1984) this research was implemented in a high performance computerized lift control system using the CGC algorithm which included some lift management facilities. He is now the Managing Director of Lift Innovations Ltd, a company specialising in the design of lift management systems.

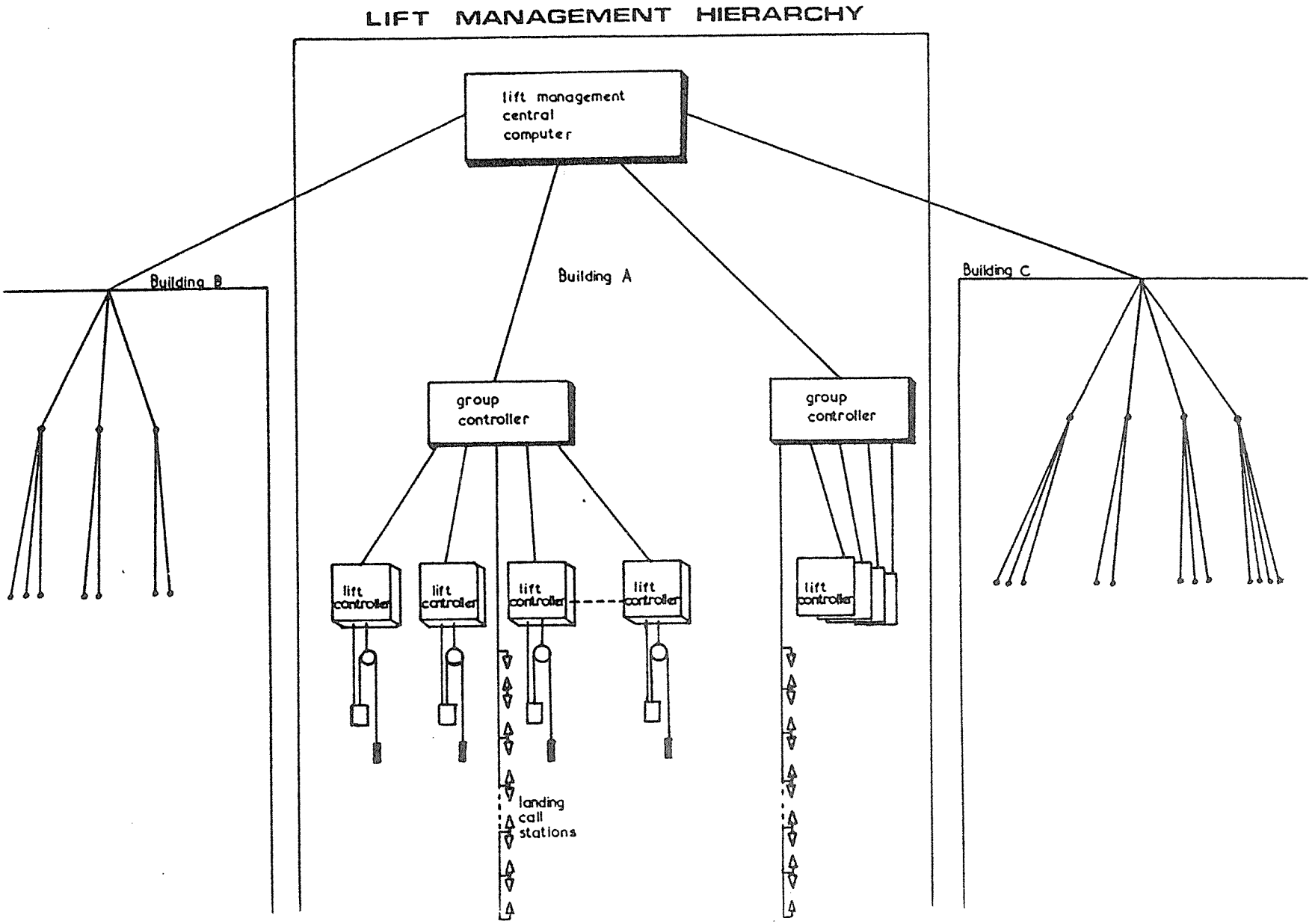
LIFT MANAGEMENT HIERARCHY
lift management central computer
Building B
Building A
Building C
group controller
group controller
lift controller
lift controller
lift controller
lift controller
lift controller
landing call stations

FIGURE 1.