Is Management Science doing Enough to Improve Healthcare?

Lalit Garg, Sally McClean, and Maria Barton

Abstract—Healthcare issues continue to pose huge problems and incur massive costs. As a result there are many challenging problems still unresolved. In this paper, we will carry out an extensive scientific survey of different areas of management and planning in an attempt to identify where there has already been a substantial contribution from management science methods to healthcare problems and where there is a clear potential for more work to be done. The focus will be on the read-across to the healthcare domain from such approaches applied generally to management and planning and how the methods can be used to improve patient care. We conclude that, since the healthcare domain significantly differs from traditional areas of management and planning, in some cases there is a need to modify the approaches so as to incorporate the complexities of healthcare, and fully exploit the potential for improvement.

Keywords—Management science, management and planning, transforming services, healthcare.

I. INTRODUCTION

OVER recent years there has been increasing activity with regard to using methods from management science in healthcare domains. Within the NHS, such ideas have been championed by such bodies as the NHS Institute for Innovation and Improvement. However, healthcare issues continue to pose huge problems and incur massive costs. In this paper, we describe an extensive scientific survey of different areas of management and planning in an attempt to identify where there has already been a substantial contribution from management science to healthcare problems and where there is a clear potential for more work to be done. The focus will be on the read-across to the healthcare domain from approaches which have been applied generally to management and planning and how the methods can be used to improvement healthcare processes and patient care.

Our approach is based on an extensive survey of management and planning methods that have been used in other areas and also to improve healthcare. To carry out this survey, first a classification scheme was developed to categorise the popular management and planning methods. We classify management and planning methods into the following categories: (i) manpower planning methods, (ii) material management and demand forecasting, (iii) inventory planning and supply chain management, and (iv) planning, process improvement and quality control.

We have employed Scopus and Google Scholar (mainly for academic papers); also Google web, Scopus web and Scopus patent database (mainly for the grey literature). We then obtained the number of research articles available in all areas and in healthcare areas, using these databases. This provides us with an idea of the academic interest in each of the methods in healthcare and non-healthcare areas respectively. Similarly the grey literature was explored using Google web search, Scopus web and Scopus patent database. This gives an idea about the popularity of each method among the non-academic community (mainly industry, government and the user community).

We then analysed each method for its application to management and policy design. Relevant graphs presenting comparison of the popularity of various methods are also provided. Finally, popular articles (in terms of citation) were selected, using stratified random sampling) to exemplify each method and to provide a source of further information. In order to obtain the full spread of articles published using each method we have included all alternative keywords. In each case we cite a few of the most popular papers so as to provide the reader with key references.

III. HUMAN RESOURCE PLANNING (HRM)

From Table I and Fig. 1, we conclude that in the academic literature there is proportionately less published work on more complex methods (stochastic models, mathematical programming and artificial intelligence) than simpler approaches (simple statistical methods and simulation). However, this does not hold for the industrial/practitioner literature where a large proportion of the publications are from healthcare across all methods (see Fig. 2). In addition the most popular methods in both academic and non-academic outlets...
are simple. Also most patents have been obtained for stochastic methods.

TABLE I

<table>
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All: All industries, H/C: Healthcare industry only

IV. MATERIAL MANAGEMENT AND DEMAND FORECASTING

In the case of material management and demand forecasting we see from Table II and Fig. 4 that generally quite high volumes of papers come from the healthcare area across the different methods. However, there are generally less academic papers concerned with healthcare (see Fig. 3). Again, simple approaches are the most popular across the board. In this case, most patents are for simple statistical methods.

TABLE II

<table>
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<th>Method type</th>
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Simulation techniques have been applied to manpower planning and scheduling in call centers [2]. Stochastic models, especially queueing models, have been successfully used in manpower planning under uncertainty [3]. Artificial Intelligence has also been used for human resource management, e.g., genetic algorithms for cabin crew scheduling [4].

Using regression analysis [1] the effect of nurse staffing policy on the quality of care was analyzed in a healthcare unit.
A heuristic search technique for material requirement planning (MRP) has been proposed [5]. Mixed integer linear programming was used for MRP systems in the manufacturing industry [6] whereas simulation has been employed for a MRP system [7]. Stochastic models include queueing methods [8].

V. INVENTORY PLANNING AND SUPPLY CHAIN MANAGEMENT (SCM)

As for material management and demand forecasting models, inventory and SCM methods have not been of much academic interest in healthcare (see Fig. 5). However, as we see from Table III and Fig. 6, generally these topics are popular in healthcare. Again, simple approaches are the most popular across the board. In this case, most patents are for Mathematical Programming approaches.

<table>
<thead>
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A simulation based approach has been proposed to evaluate an information sharing policy in a supply chain management system [9]. Stochastic models are also an attractive choice for modelling supply chains with stochastic demand [10]. Mathematical programming approaches are also common e.g., dynamic programming has been used for dynamic lot size inventory planning [11].

VI. PLANNING, PROCESS IMPROVEMENT AND QUALITY CONTROL

In Table IV and Fig 8, we see that generally a lot of agile methods in use are in healthcare. However six sigma, TQM and lean have not had such a good take up in healthcare, relative to other industries (see Figs. 7 and 8).

Naylor et al. [12] discussed how agile methods can be integrated into the total supply chain whereas a six sigma implementation has been described in [13]. Total quality management and its impact on organization efficiency is an important area [14]. Likewise lean manufacturing can have a big impact on organizational performance [15].
TABLE IV

<table>
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<tr>
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VII. RESULTS AND DISCUSSION

Our survey has found high proportions of publications in the healthcare area across a range of different methods, with some notable exceptions. In particular, more complex methods (stochastic models and mathematical programming) are less common in the academic healthcare literature. This is a rather surprising finding which may indicate that practitioners can learn from academics that simple approaches may be adequate and complexity is not always necessary. Also significant improvements may be made by academics focusing more on complex approaches with corresponding knowledge transfer to healthcare practitioners.

Our study shows that the take-up of process improvement methods such as six sigma, TQM and lean thinking within healthcare is disappointing. We believe that there are three key dimensions to value in healthcare: clinical, operational, and experiential, and the absence of a single customer with a clear concept of value is perhaps the most important issue for the successful adoption of these methods for healthcare. Therefore, in order to fully incorporate such approaches into healthcare, we should engage with these multi-dimensions of value and modify the concepts accordingly.

VIII. CONCLUSION AND FUTURE WORK

The results of this survey demonstrate that there are areas where healthcare practitioners and academic researchers are using management science approaches in a similar way to other service and manufacturing industries. However, there is still there is a gap which require urgent attention to help improve healthcare service management and planning decisions. Academic researchers can hugely contribute to such developments by properly identifying the concepts and need for improvement and suitably adapting the management science methods for healthcare problems.
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REFERENCES


