Analysis and optimization of patient flow at the Clinic of Orthopedics at Skåne University Hospital

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Historically there has been an attitude amongst medical professionals that methods used in the industrial sector aren't applicable to their field of work. This article challenges this view through the creation and evaluation of a forecasting model based on historical data gathering. The research conducted involves a literature review, collection and analysis of empirical data, creation of a capacity planning model and a review of this model.

Keywords: Forecasting, Capacity Planning, Service Management, Health Care

INTRODUCTION

This article is a result from a close collaboration between the department of Industrial Management & Logistics, the Clinic of Orthopedics at SUH and the author. It is written as a part of the author's education in Industrial Engineering.

The clinic has during some time been affected by an increase in queue lengths to all their departments. The head of the clinic wants to improve the understanding of why the increase occurs and which the driving factors to the increase are. They do also need to increase their understanding of the importance of capacity planning and if improved capacity planning in fact can have an effect on overall patient satisfaction. As a result of the current inadequate knowledge, the clinic has let the author of this article make an analysis of the problem.

The purpose of the analysis is mainly to improve the capacity planning to free resources and reduce waiting times. A wanted outcome is also to locate which data is necessary to in an effective and efficient way evaluate the operations to better cope with the current work load.

The questions to be answered are:

- Why do queues arise and is there any difference in the underlying factors between the departments?
- Is it possible with the current data registration to create a model to forecast the future demand of the departments and use this model to improve the capacity planning?

As the study has proceeded, some delimitation has been necessary to ensure a high quality analysis. The main limitation has been do disregard all departments in Trelleborg and focus on those located in Lund and Malmö. The data registration in Trelleborg differs from the other two and the patient flow is considerably smaller which motivates this limitation.

METHOD

During the research, focus has been on creating a highly valid report that is reliable and objective. To ensure this, the gathered data has continuously been presented and validated by the supervisors at the clinic of orthopedic. The data that has been analyzed hasn't been tampered with in any way and the source data files have been used. In order to ensure the patient confidentiality all social

security numbers has been substituted with a random serial number. The data consists mainly of quantitative data from SUH's data registration system QlickView.
Literature used to conduct the research is mainly course literature from Lund University and scientific articles takes from the University's library database Summon. The articles have been reviewed to ensure that only the most relevant is used in the research. Aside from the literature the research is also based on interviews with the supervisors from the clinic and Lund University. These interviews are conducted in an informal manner in order to fill gaps and avoid not getting important information due to too much structure. Also, there have been observations from various visits at the clinic that might have affected the author's objective view.
Armistad & Clark (1994) suggests three problems when capacity planning in a service organization:

- The organizations limited ability to alternate capacity in order to handle fluctuations in demand
- The need to deliver a consistent high service standard
- The varying degree of uncertainty in demand

When an organization fails in handling the demand the article suggests that an organization can choose to let quality fall uncontrollably or they can try to control the fall. This phenomenon is referred to as entering the Coping Zone. The Coping Strategy to handle this issue consists of:

- Improved capacity planning through forecasting
- Measure the service quality and the use of critical resources
- Implement a measurement system that is warning when the organization is close to the Coping Zone
- Decide whether to let service quality fall or not
- Decide how extra resources should be obtained

In this research the focus has been on point one above; to improve the capacity planning through forecasting. The forecasting will also contribute to point number three; warning when the coping zone is soon entered.
De Vries, Bertrand & Vissers (1999) suggests that Health Care is facing challenges today that large parts of the industry has already faced. Amongst these are:

- Need for efficient use of resources and reduced costs
- Increased pressure to achieve higher service quality and shorten the waiting times in their processes

It's further suggested that the hospital should be reviewed as a virtual organization with each part operates as a focused factory. However this leads to the following dilemmas:

- The hospital directors limited availability to control the production process against the key role of the highly educated doctors
- The unclear ownership of patients through the process
- The need to control all parts of the organization against the impossibility to control all parts

The data has been gathered and analyzed with the knowledge obtained from these articles in mind. After analyzing the data patterns from the data available from 2011, an approach to create a forecasting model based on this data was made.

RESULT

This report results in a forecasting model that has the primary objective to enable improved capacity planning for the clinic of orthopedics. In the figure at the bottom of this page the layout is presented. It is based on historical data from 2011, due to the fact that previous data was ill documented. The wish to create an easy maintainable and understandable model with pretty good forecasting capabilities lead to a model based purely on arriving work orders or remittances. The model then uses historical data distribution patterns to create work load profiles. These profiles are used to split up the remittances to future work load amongst the departments. The work load profiles contain information about:

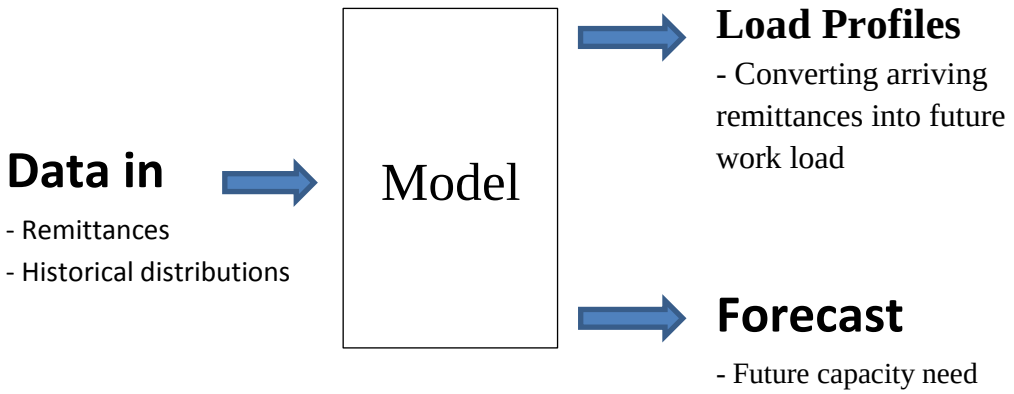
- The time from order to first visit
- The number of visits a patient realizes
- The times between a first visit and the patient's next visit
- Visits that takes place at another department than where the remittance arrived

In addition to these distributions it has been discussed to incorporate other factors into the model as well. The three most important are listed below.

- What month the work order arrives
- The current queue length
- The number of orders being returned

The first two were excluded because of the increased complexity this would bring to the model and the follow up of the same. The ladder was excluded due to lack of data registration. This however was discussed with the supervisors at the clinic and was estimated to be small enough to be disregarded.

The model was built in Excel through VBA programming. In order to evaluate it, real data from the first three months of 2012 was retrieved. Primarily the changes of queue lengths were the target of the evaluation. The errors were measured in absolute numbers. To put these in context they were compared with the average number of work orders per month and department. The result was that an error of between 0-30 percent per department occurred. One or two departments have a result higher than 30 percent. For one of the departments it was the effect of very small flows. For the other it was the effect of faulty evaluation data. In order to create a wider evaluation, all errors were summarized except from the department with faulty data. This sum came to -3 or a 0 percent error. The previous action also decreases the influence of standard deviation built into the model. Apparently the errors go both ways which results in a good overall model.



DISCUSSION & CONCLUSIONS

As has been revealed in this report the main reason to the queue increase is the heavily reduced staffing during the summers. This creates the queues that then have to be handled during the rest of the year. The forecasting model was created in order to enable better capacity planning to avoid this increase. The result of the model has been satisfactory though there are still issues to be handled further down the road. The model only specifies the number of visits that have to occur. It doesn't specify the specific type of visit. There is a difference between new visits and return visits in the sense that if a new visit is handled this is automatically removed from the queue, whereas return visits has no effect on the queue what so ever. This makes it difficult to evaluate the model based purely on the queue affect spotted. The reason for the evaluation that was made was to confirm that the new visits part was in order. This doesn't validate the entire model but makes it much more trustworthy since they are both based on the same data gathering.
Another is the fact that queues that exist today might have an effect on the capacity planning. The model only describes what has to be done in order to avoid a queue increase. If a queue decrease is desired, it can be done by increasing the capacity more than the model suggests. The paste of this decrease is hard to predict without an evaluation of the actual result. The author of this article recommends the clinic to follow up this research in a number of ways. Most importantly, the order data has to be updated monthly to avoid the model being outdated. Also, a follow up needs to be conducted on the orders being distributed to the department called MACIH because the number is not likely to be consistent over time. Finally, the model should be tried and tested for a whole year to make sure it predicts as good as the test run made in the first three months of 2012.

REFERENCES

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