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Sint Maartenskliniek

Center for Healthcare Operations Improvement and Research

PDEng Thesis

Decision support for planning and scheduling orthopaedic surgeons

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by

Marelise Hattingh

born on 27 March 1992, in South Africa

Under supervision of:

prof. dr. R.J. Boucherie[1]
ir. R. Vromans[2]

[1] Stochastic Operation Research

Faculty of Electrical Engineering,
Mathematics and Computer Science

University of Twente
Enschede, The Netherlands

[2]Sint Maartenskliniek,
Nijmegen,
The Netherlands

Summary

Sint Maartenskliniek located in Nijmegen, The Netherlands, aims to provide the best care in the fields of orthopaedics, rheumatology and rehabilitation. They continually optimise and integrate processes and planning to improve patients' and medical staff's experience throughout the care-chain. The problems presented in this document are based at the orthopaedic department of Sint Maartenskliniek.

During the first project a decision support prototype was developed that can be used by the planners at the hospital to schedule orthopaedic surgeons on a daypart level for a period of two weeks, twelve weeks in advance. One day consists of a morning- and an afternoon daypart. This planning activity is currently done manually by hospital capacity planners: it is a time intensive task and the effect the schedule has on the downstream resources such as the number of beds required or radiology utilisation, is not fully taken into account.

The methodology used for both projects mainly comprises: i) understanding the problem context; ii) developing a mathematical model that accurately represents the real-world problem and also solves or optimises the case; iii) building the model into software with an user interface; and, iv) conducting verification and validation activities with an outlook on implementation.

For the first project an integer linear programming approach was used. The prototype successfully creates a daypart schedule within a few minutes whilst distributing the resulting utilisation at the downstream departments more evenly and adhering to additional operational requirements. Additionally the maximum number of required beds and x-rays are also reduced, which indicates potential cost benefits.

Given the success of the first project, the second project considered the activity of determining the total number of required surgery and outpatient sessions per surgeon per week. This is referred to as an activity-plan and is actually input for the first prototype. The activity-plan is made twelve weeks in advance and takes into consideration the yearly production targets (the number of surgeries a surgeon aims to complete in one year), whilst managing the waiting list length for surgeries. Naturally there are also a number of operational requirements to include in the model.

The problem was first modelled as a simple Markov Decision Process considering only the planning of one surgeon. From the results of this model, it was concluded that a Markov Decision Process is indeed too complex to provide a practical solution, and most valuable, that the process can be modelled with deterministic elements. Accordingly the problem was modelled and solved with an integer linear programming approach.

This problem has previously been attempted, but none of the solutions were of practical use to the hospital. The prototype developed during this project shows great potential regarding further implementation. It will not immediately be used by planning staff, but rather by the logistical team at the hospital. This is due to the concept being new to the planners and the input data still requiring further review and interpretation.