Operating Room Planning

An agent based system analysis and design

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**Summary**

Für Interessierte, die sich innerhalb kurzer Zeit einen Überblick über den Inhalt eines Berichts verschaffen wollen, ist das Summary (eine halbe bis anderthalb A4-Seiten das geeignete Mittel. Die Zusammenfassung soll die folgenden fünf Aspekte beleuchten: Problemstellung, Problemlösungen, allenfalls mit Varianten, Hauptergebnisse, Schlussfolgerungen und Vorschläge für das weitere Vorgehen. Die Zusammenfassung entscheidet – zusammen mit dem Inhaltsverzeichnis – ob die Leserin, der Leser den Text eingehend studiert oder gleich beiseitelegt.

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# Introduction

The aim of this report is to present an analysis and design of an agent based system which is capable of handling the “Operating room planning” problem.

# Purpose of Agent System

# Agent Architecture

## Patient Agent

The Agent has to handle the general patient cases, referred as long term planning, where an optimal schedule is the resulting artifact. Emergency cases, referred as short term planning, must also be handled, and are always in a higher priority than the general patient cases.

Due to the dynamic nature of patient cases (e.g. a general case can always become an emergency case), the Agent needs a reactive part for handling emergency cases yet the overall problem solving must be handled by a pro-active part for long term planning.

Therefore, the approach is to design the Agent as a Hybrid Agent [1; *Wooldridge, An Introduction to Multi Agent Systems* ].

This leads to layered architecture for the Agent, where the layers are organized hierarchically; the most basic reactive behaviors are in the top layers, the long term planning in the bottom ones.

The primary layers are identified as a Reactive Layer for handling environment changes and a Planning Layer for the long term planning. The reactive Layer may affect the planning layer, as the emergency case handling may result in a reprioritization of the overall situation.

# Methodologies

# Agent Interaction

# Agent Communication

Consider the following diagram, showing the defined subsystems and Agents, and the interaction paths between them:

Resource Managers

OP-Room-Provider

Team-Provider

Post-OP-Provider

Emergency Department

Some Department

Some Department

Patient Departments

## Inter Patient-Department Communication

The Patient departments can communicate with each other, using a CPL dialect. The main purpose of the communication is to organizing the joining of resources, when a single Department Agent is not able to solve a specific problem. (The Agent probably requires an additional expert team from another department)

Additionally, the Emergency Department has a communication line with the other departments. As soon as a patient becomes an emergency case, the Emergency Department is informed. Additionally, the Emergency Department can request any allocated resources from another department, as long as those resources are not yet are running an operation.

The task oriented situation fits well in the CPL communication pattern. A task is mainly to cure a patient – and this might require cooperation between departments.

## Resource Auctions

We have identified three resource types. The resources are identified as a time slot in an operating room, a surgery team and a post-OP care place. All resources are time depended and must match for a feasible care package. The resource providers keep track of the current bookings and allocations. The do not allow overlapping bookings.

All department agents can join the resource auctions.

The trading goods in the auctions are of course not money but “DIP”s (department importance points). Each patient department gets a given amount of such DIPs each day, which can be spent, in the auctions. The only exception to the rule is the Emergency Department.

### Just-In-Time-Auctions initiated by Client request

Although auctions are always created and managed by the resource providers, the dynamic matter of the bookings is a problem. The duration of an operation is always different, so the resource providers cannot just offer an Operating room for 2 hours – probably it is required longer or shorter. We assume that for a given operation, we can estimate the overall duration.

For this reason, we have invented a new auction system, based upon two phases. First, auction clients can place a request on a resource provider. Then, the resource provider creates appropriate auctions based upon the requests.

The department Agents (referred as clients in auctions) can therefore place requests on the resource providers, of what resources they need and for how long they need them. Based upon this information, the resource providers can create auctions.

### Emergency Department priority

As soon as the Emergency Department places a resource request, all affected auctions are immediately closed. An auction is “affected”, when the resource and the time slot overlaps with the request of the Emergency Department. All required resources are allocated to the Emergency Department instantly.