Resource Management Simulator for Radiology Departments
Shuntaro YUT¹, Hajime SASAKI², Yoshitaka BITO³, Hideyuki BAN³,
Minoru KITAMURA⁴, Takashi NAKASHIMA⁴ and Takao OBARA⁵

¹ Central Research Laboratory, Hitachi, Ltd., Tokyo, Japan;
² Medical Information Technology Division, Hitachi Medical Corporation, Japan;
³ Hitachi General Hospital, Hitachi, Ltd., Ibaraki, Japan;
⁴ Hitachi, Ltd., Tokyo, Japan;
⁵ Medical Information Technology Division, Hitachi Medical Corporation, Japan;

Abstract
We propose a new system to manage modalities in radiology departments. Our system introduces a novel method to accurately estimate some indexes in order to provide an analysis of resource plans within three broad categories: financial affairs, patient satisfaction, and productivity. The main idea is to simulate the operational status of modalities. Results from a preliminary hospital evaluation show that use of the system results in more efficient resource management.

Background and Purpose
Analyzing the management of radiology departments is important in hospital administration because the income generated by the radiology department is higher than that of other departments. However, the data stored in a radiology information system (RIS), such as the number of examinations per day/month, is not fully leveraged because such analyses require a significant amount of time and highly skilled labor. Accordingly, we propose a new simulator to manage modalities using RIS data. When users set a new resource plan, our simulator gives managers a comprehensive view of the future performance of the radiology department.

Methods
To evaluate the resource plan, the system introduces a novel method to estimate various indexes within three broad categories: financial affairs, patient satisfaction, and productivity.
To estimate the indexes, the system creates a typical occurrence pattern model of patient appointments and emergency examinations. The method has 3 features.
1. Users can set various kinds of resource plans, such as limitations of the modality's schedules (e.g., abdominal exams are scheduled only in the afternoons), number of modalities, and office hours.
2. The system calculates indexes depending on the frequency distribution of occurrence with respect to each pattern from a RIS.
3. The system introduces Monte Carlo simulation to simulate the operational status of modalities. Firstly, all kinds of examinations occur depending on the distribution. Then, it decides the start time of each examination in the order of descending priorities: emergencies, scheduled appointments, and other than those above.

Results
We validated our system using actual RIS data. Figure 1 shows an example of the system display. When users set a new resource plan to increase the number of modalities on the left, the radar chart on the right shows the predicted indexes. In this case, the chart indicates that income and waiting time are improved; on the other hand, operating rate and ratio of income to expense get worse. Users can see that the new resource plan is better if managers consider income and waiting time to be most important.
To validate the accuracy of our method, we compared the indexes calculated by our method with actual results obtained by applying the new plan. The average prediction error was approximately 4.3%. An excerpt from the error results is shown in Table 1. It is clear that our method can accurately estimate indexes.

Conclusion
We have developed a new simulator system to manage modalities. The system can easily analyze resource plans, resulting in effective resource management.

References

Table 1: Experimental Results (excerpt)

<table>
<thead>
<tr>
<th>Index</th>
<th>Error (%)</th>
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<tbody>
<tr>
<td>Income</td>
<td>0.5</td>
</tr>
<tr>
<td>Ratio of Income to Expense (Inpatient)</td>
<td>0.7</td>
</tr>
<tr>
<td>Ratio of High Cost Operation</td>
<td>13.4</td>
</tr>
<tr>
<td>Operating Rate</td>
<td>-8.6</td>
</tr>
<tr>
<td>Waiting Time</td>
<td>-8.4</td>
</tr>
</tbody>
</table>