DOCC (Data-based Operation & Communication Center) Surgery PAN (Data Delivery Tool)

- Samsung Medical Center -

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Executive Summary

In tertiary general hospitals, where many surgical departments are located, the wait time for patients requiring surgery may be extended due to the limited number of operating rooms.

- Solving this issue of wait times for surgery can be addressed not only by physically increasing the number of operating rooms but also by finding ways to use the available rooms more efficiently.

We have made efforts to establish and extend a culture of sharing operating rooms so that rooms assigned to a specific surgeon, but unused—such as when the surgeon is away for an academic conference—can be used by another surgeon.

- When it was recognized that a specific operating room (e.g., one normally used for endocrine surgery) would be empty, computerized scheduling was used to systematically open that operating room to the same medical division (e.g., Endocrine Surgery) four weeks in advance, the same medical department (e.g., General Surgery) two weeks in advance, and other medical departments (e.g., Urology) one week in advance.

Additionally, Surgery PAN*, which provides information on the estimated time of surgeries, helped ensure tighter scheduling, leaving no rooms empty during regular working hours (ex. 08:00–17:00). In particular, knowing the time information for each operating room allowed surgeries expected to start after regular hours to be moved to rooms becoming available two hours before the end of regular working hours.

* The name 'PAN' comes from the Korean word for a bulletin board.

As a result of the increased surgeries during regular hours made possible by sharing and rescheduling surgeries, an average of 3.5 more regular surgeries were performed per day in 2023 compared to 2021, enabling additional 864 regular surgeries per year as of 247 business days. Additionally, the rate of breast cancer patients undergoing surgery within 30 days after visiting the hospital—a government-evaluated indicator—rose from 33.9% in 2021 to 54.7% in 2023, an increase of 61.1%.

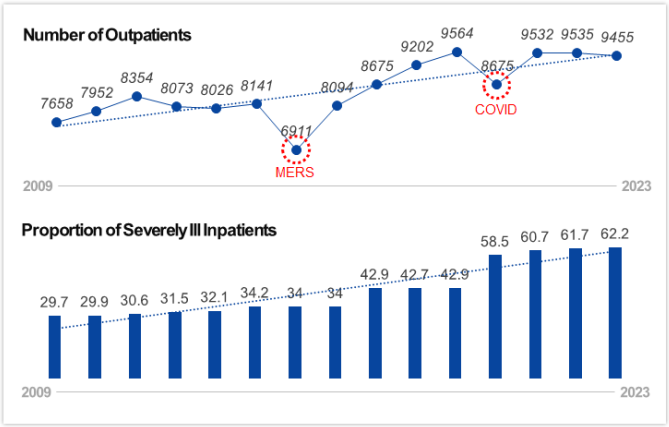
- No patient safety issues were observed due to these schedule adjustments; the intervention using DOCC Surgery PAN did not significantly affect the length of stay or the likelihood of surgical complications, readmissions, or reoperations within 30/60 days (all p-values > 0.1).

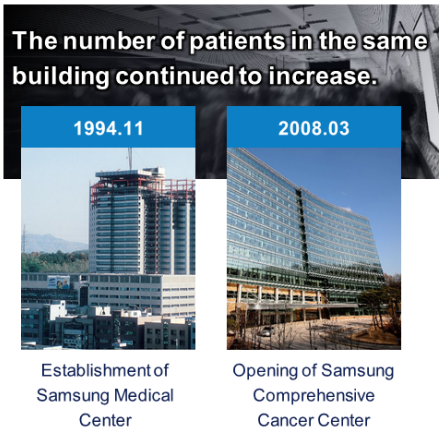
Defining the Clinical Problem and Pre-Implementation Activities

Since 2008, Samsung Medical Center has been treating patients in a complex that includes the main building, an annex, and the cancer center. The number of outpatients, which averaged 7,658 per day in 2009, increased to 9,455 as of 2023. The proportion of severely ill inpatients also increased, from 29.7% in 2009 to 62.2% in 2023.

- As the number of outpatients and the proportion of severely ill inpatients grew, the demand for surgery also increased, but the number of operating rooms remained the same, with a total of 56 (25 in the main building, MOR; 11 in the annex, AOR; and 20 in the cancer center, COR).

Table 1. Demand for surgery increased but surgical resources remained the same





In this situation, we pinpointed the following issues and identified ways to use the operating rooms more efficiently.

- Although there was always a shortage of operating rooms, it was difficult to use an operating room assigned to a surgeon if the surgeon was away due to academic conferences, business trips, vacations, or days off. (Also, there was no system prioritizing emergency or severely ill patients requiring immediate surgery.)
    - In creating a system for sharing operating rooms, we identified which operating rooms were unused due to the absence of the assigned surgeon and were available for other medical departments.
- There was no system to display operating room usage status. To determine which of the hospital's 56 operating rooms were in use, empty, or available for emergency surgery, it was necessary to make numerous phone calls to each operating room manager, a process that took considerable time.
    - We sought to create a system allowing surgical participants (surgeon, anesthesia team, surgical scheduler, etc.) to view room availability for emergency surgeries instantly.
- When inputting the estimated time that a surgery would require, surgeons often underestimate the time needed for surgery to receive confirmation from the anesthesiologist. For the surgery scheduler coordinating necessary surgeries, this led to difficulties when surgeries took longer than estimated.
    - To support the surgery schedulers, we wanted a system displaying the average time for each surgery by analyzing surgical procedure codes and the actual surgical time recorded by each surgeon over the past year

The following considerations were also necessary in planning for efficient use of the operating rooms.

- At the point of system introduction, breast cancer patients had to wait an average of 50 days for surgery. One goal was to reduce the wait times for surgery, thereby preventing patients with severe illness from leaving for other hospitals.
- A competency management system was needed to quickly assign surgical nurses capable of performing specific surgeries in unexpected situations.
- Additionally, it was necessary to increase efficiency during regular working hours and to reduce the variation in operating room utilization rates.

Design and Implementation Model Practices and Governance

The most crucial part of establishing a system for sharing operating rooms is understanding the culture in which these rooms exist and ensuring they function as efficiently as possible within that culture. Taking into account the uniqueness of specific surgeons and medical departments, the following rule was set:

- When a surgeon cannot use the assigned operating room due to a planned absence, other departments that may share the operating room are prioritized based on how far in advance the room is available.
    - To foster a culture of sharing, department priorities were respected as much as possible, while allowing flexibility for others to use the rooms when necessary.

Figure 1. Establishing sharing rules for operating rooms

    - The Chief Medical Officer, Chief of the Clinical Management Office, and other leaders set an example so that each surgeon could understand the benefits of sharing operating rooms. The process can be summarized as follows.
        - Regular meetings played an essential role. The Operating Room Management Committee (with directors from all surgical departments) was held every two months, and the Medical Department Meeting was held monthly to provide continuous updates on the direction, issues, and achievements of operating room sharing.

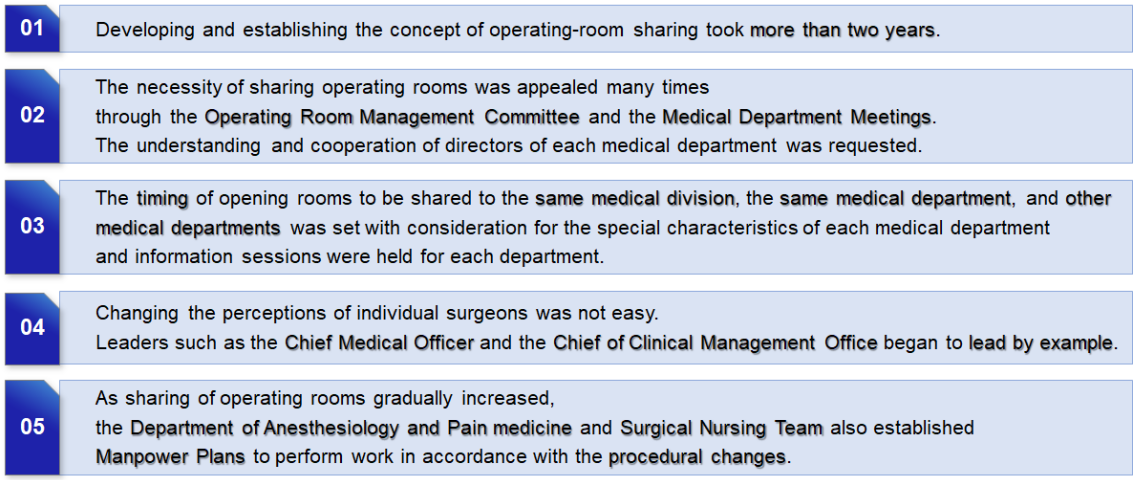


Figure 2. Key points related to the sharing of operating rooms

To better convey real-time information on the use of each operating room at Samsung Medical Center, we classified the usage status of each room.

- For more efficient communication, operating rooms in use are colored blue, while unused rooms are marked in yellow. Additionally, the stages from suturing to surgery completion are indicated in light blue, and empty rooms where the patient has not yet arrived are colored in light yellow.

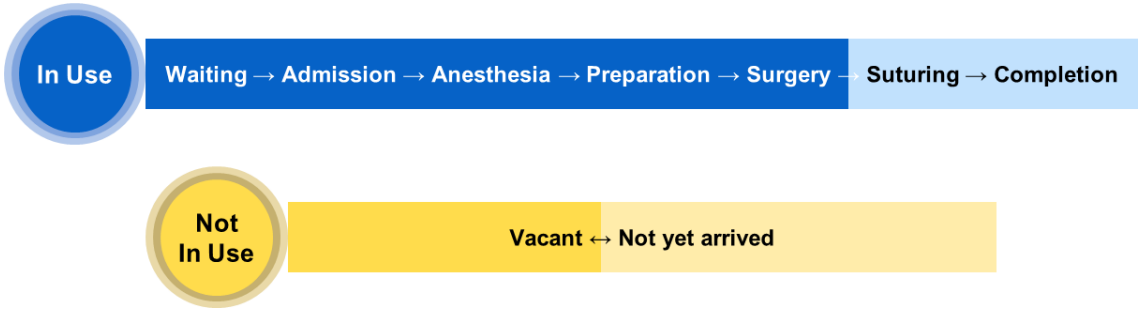


Figure 3. Stages of operating room use and non-use

The goal of operating room efficiency is to accommodate as many surgeries as possible during regular hours. The primary time period to be filled through surgery rescheduling is from two hours before the end of regular working hours (e.g., 15:00) to the end of the day (e.g., 17:00).

- Providing more accurate surgery time estimates has helped to shift surgeries expected to start after regular hours to operating rooms becoming available two hours before the end of the regular workday.

Figure 4. Best practice for surgery scheduling from an operating perspective

- Surgeons tend to input shorter estimates for surgical times to receive confirmation from the Anesthesia Department. To correct these estimates, we implemented a logic that adjusts the inputted times based on the average time required for similar surgeries over the past year, using the following priorities:

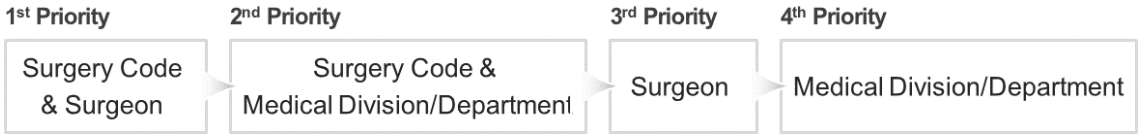


Figure 5. Logic to correct the surgeon's estimated surgical time

Clinical Transformation Enabled through Information and Technology

- Developing the DOCC Surgery PAN to improve operating room efficiency took approximately six months. This included two months of brainstorming with surgical schedulers, idea sketching, and data verification, one month of working with UI/UX designers to develop the design, and three months to convert the design into a working program.

- To streamline operations, we developed a DOCC Surgery PAN to monitor each operating room and to provide the necessary support at the right time and place, according to the following concept.

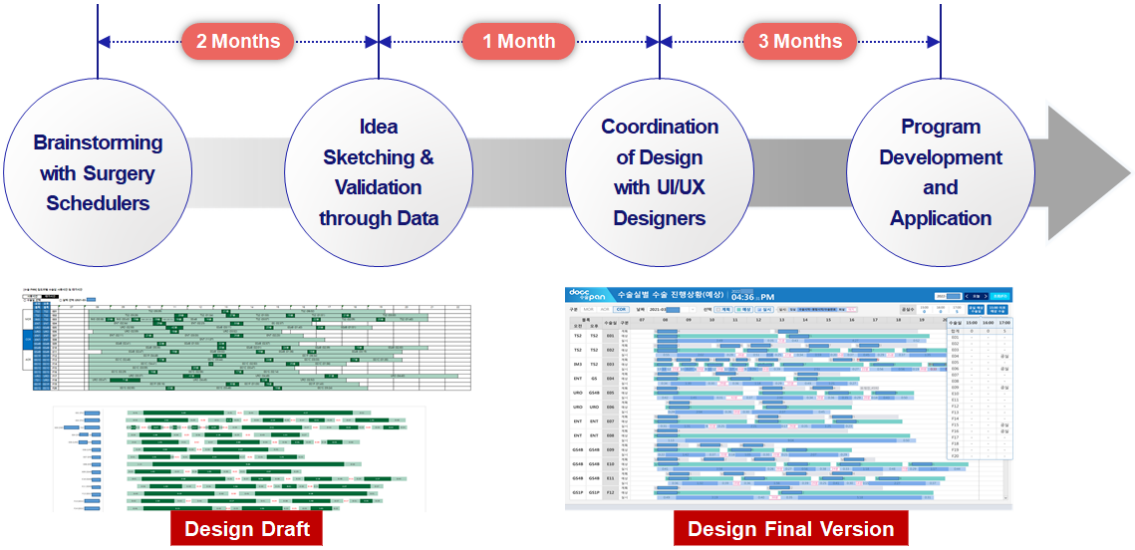


Figure 6. Approximate timeline from design to implementation

- Real-time monitoring

    - The 1st Surgery PAN was developed for hospital staff involved in the surgeries (medical departments, surgical nursing teams, the Department of Anesthesiology and Pain Medicine, peri-anesthesia care teams, the clinical management team) to view the status of operating rooms. This allowed for immediate confirmation of the available operating rooms when arranging emergency surgeries.

        - To increase visibility, operating rooms currently in use were colored blue, and those not in use were colored yellow. Other stages were indicated as follows: light blue for surgeries nearing completion; light yellow for empty operating rooms where the next patient has not yet arrived.

Figure 7. [DOCC Surgery PAN] Operating usage status

- Review of progress and issues from past to present
    - The 2nd Surgery PAN was developed to monitor the utilization rate of each operating room by time period. The utilization rate was tracked based on the location, day of the week, and time period at 30-minute or one-hour intervals, depending on the presence or absence of downtime.
        - This process identified the causes of persistently low rates of utilization during specific times, which were addressed by increasing manpower, changing shift times, or rescheduling surgeries.

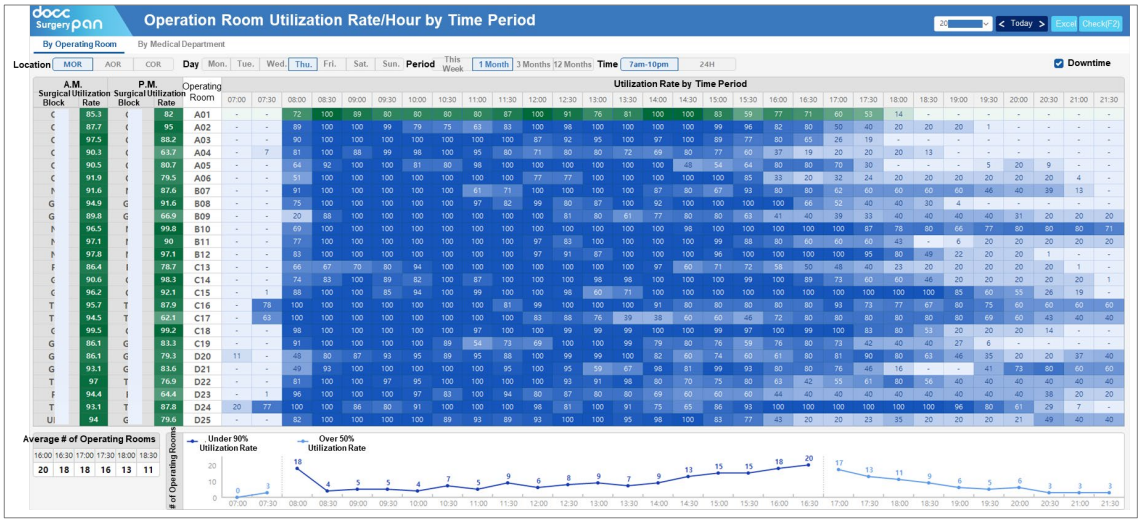


Figure 8. [DOCC Surgery PAN] Operating room utilization rate/hour by time period

- Adjustment of same-day and next-day surgery schedules
    - The 3rd Surgery PAN allowed active coordination of surgery schedules for the current and following day. First, the estimated surgery time was calculated using data from past surgeries, which was closer to the actual time required. This was compared with the surgeon's estimate, which tended to be shorter, allowing surgeries to be rescheduled based on the corrected time.
        - Using this corrected time, surgeries expected to start after 17:00 could be moved to operating rooms likely to become available after 15:00. Additionally, to prepare for potential delays, information was provided regarding surgeons using two or more operating rooms at the same time.

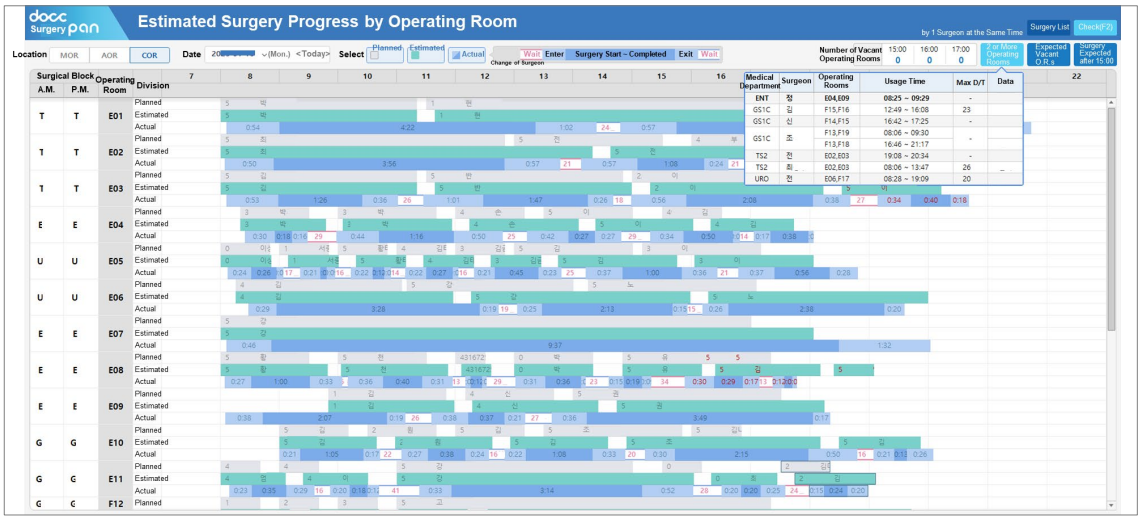


Figure 9. [DOCC Surgery PAN] Estimated surgery progress by operating room

- Rescheduling surgeries to improve efficiency was limited to regular working hours. Data showed an average daily increase of 3.5 regular surgeries, from 184.9 in 2021 to 188.4 in 2023. However, non-regular surgeries decreased by 0.9 from 21.2 to 20.3.

Table 2. Average number of surgeries per day from 2021 to 2023

	Average Number of Surgeries per day		
	During Regular Working Hours	Outside of Regular Working Hours	Total
2021	184.9	**21.2**	206.1
2022	185.5	21.7	207.2
2023	188.4 (▲3.5)	**20.3 (▼0.9)**	208.7 (▲2.6)

- Therefore, while overall operating room efficiency during regular hours improved, overtime of surgical staff was reduced.

- Allocating personnel based on the surgical nursing skills required for each surgery.
    - The 4th Surgery PAN allowed more efficient scheduling and communication with surgical nurses. Team leaders and part leaders in charge of each surgical area could easily assign personnel using the drag-and-drop function and monitor surgical skills based on each nurse's surgical history. This information was also stored on the server for future reference.

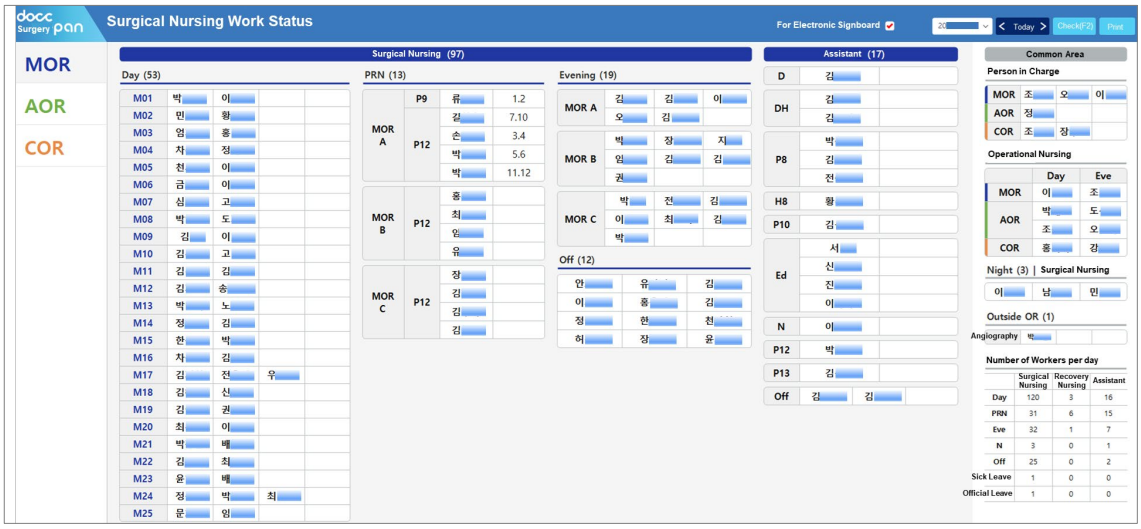


Figure 10. [DOCC Surgery PAN] Surgical nursing work status

- The 5th Surgery PAN provided information on nurses' surgical techniques based on their past work history. This allowed nurses with the required skills to be quickly assigned in emergency situations. The data also served as a roadmap for skill development.
    - Basically, a surgical nurse's skills were mapped according to the daily schedule, which also included the medical department assigned to each operating room on each morning/afternoon of the week. However, while the nursing schedule was updated daily, department-to-operating room assignments were updated monthly, unless special circumstances arose.

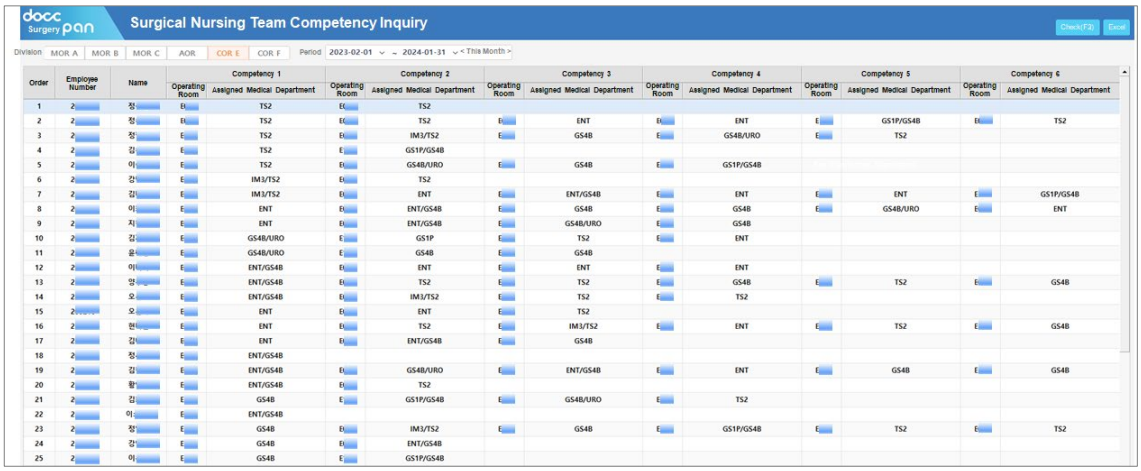


Figure 11. [DOCC Surgery PAN] Surgical nursing team competency inquiry

- Optimize surgery scheduling for the upcoming week
    - The 6th Surgery PAN provided an overview of the expected number of surgeries and the anticipated utilization rate for each operating room. This was based on information on surgeries scheduled for the upcoming week. When scheduling additional surgeries, information was available to prioritize operating rooms with lower utilization rates, marked in red or yellow.
        - The primary goal of this PAN was to reduce variation in room utilization across different days of the week by adjusting surgery schedules up to one week in advance.

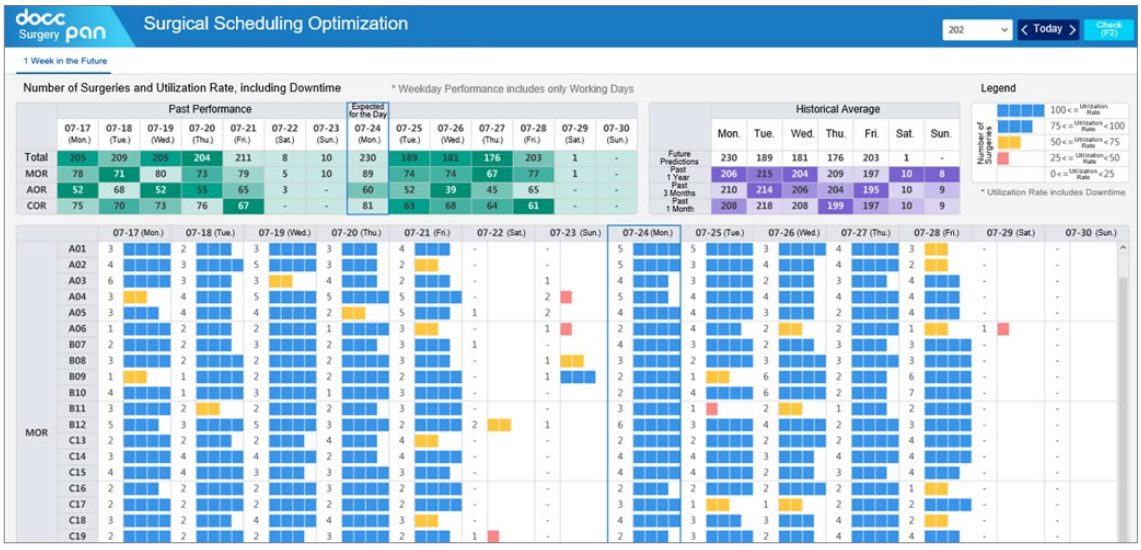


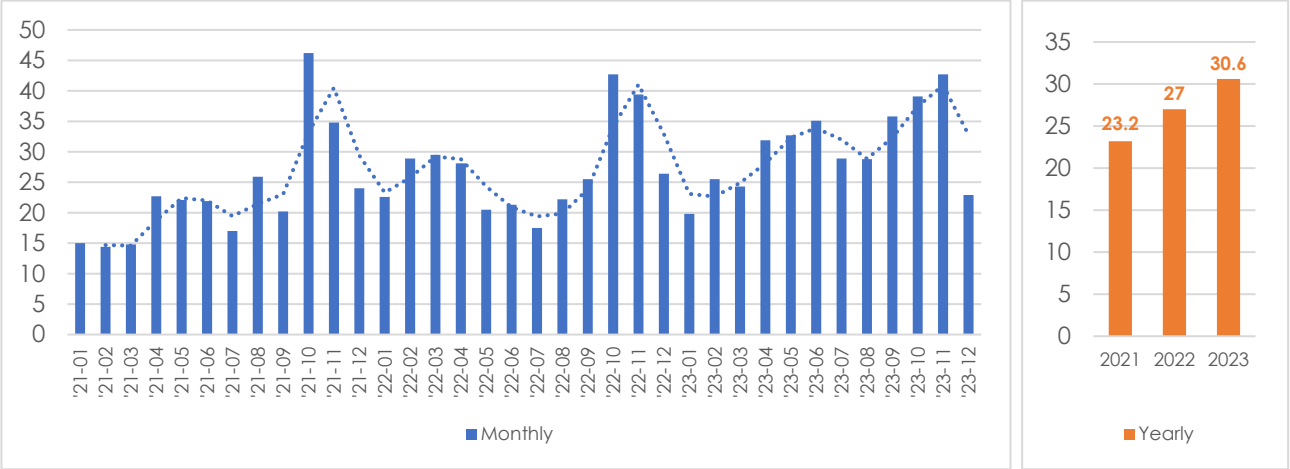
Figure 12. [DOCC Surgery PAN] Surgical scheduling optimization

Improving Adherence to the Standard of Care

In attempt to address the issues related to room utilization mentioned above, several supplemental systems were implemented; the results are summarized as follows.

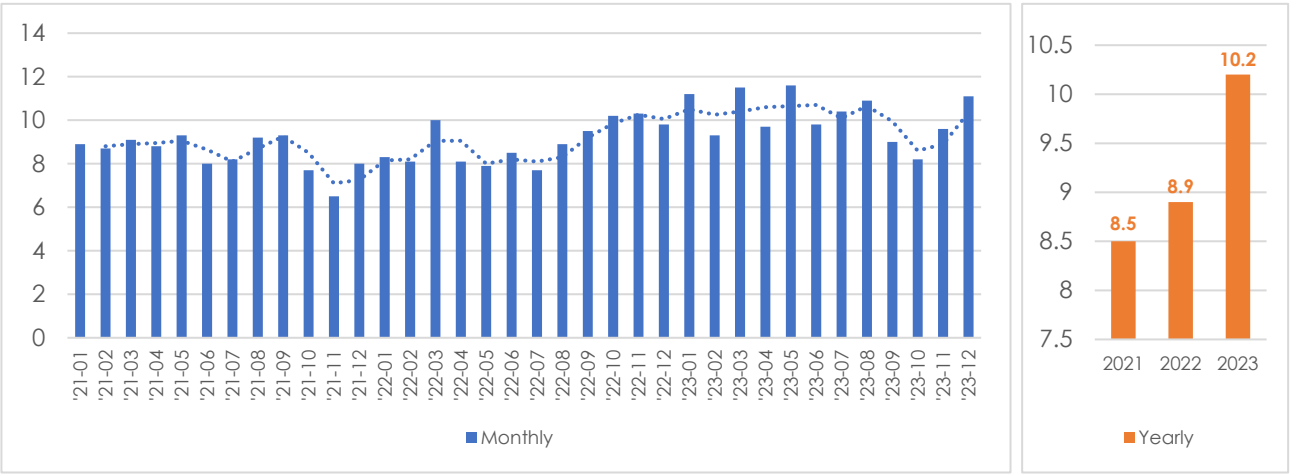
- Efforts to improve operational efficiency during regular hours resulted in a 31.7% increase in daily operating room sharing time, from 23.2 hours in 2021 to 30.6 hours in 2023.

Table 3 Average daily operating room sharing time (in hours)



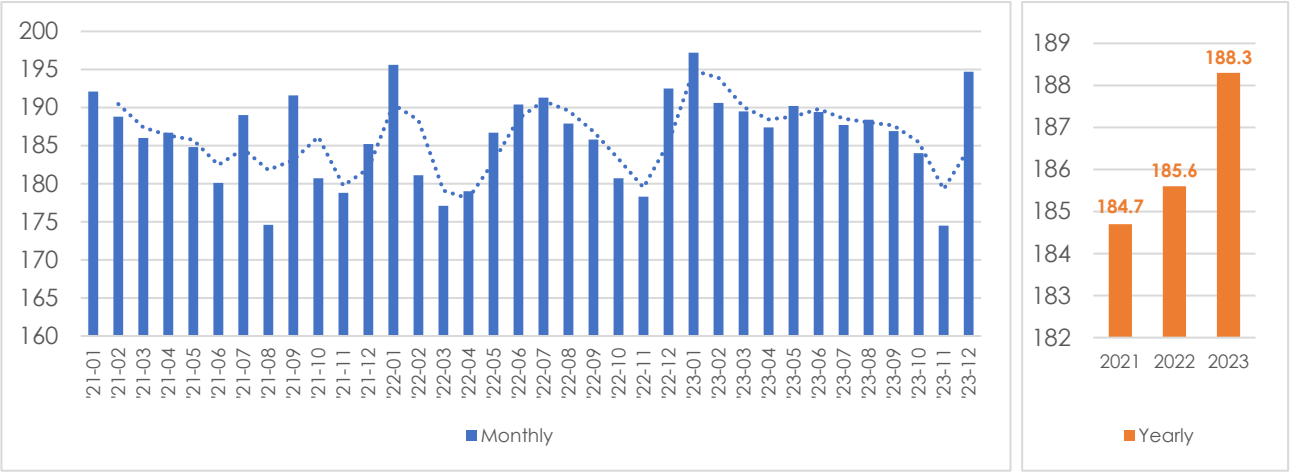
- Additionally, the number of rescheduled surgeries during regular hours rose by approximately 20.2% from an average of 8.5 per day in 2021 to 10.2 in 2023.

Table 4. Average daily surgical rescheduling cases during regular working hours



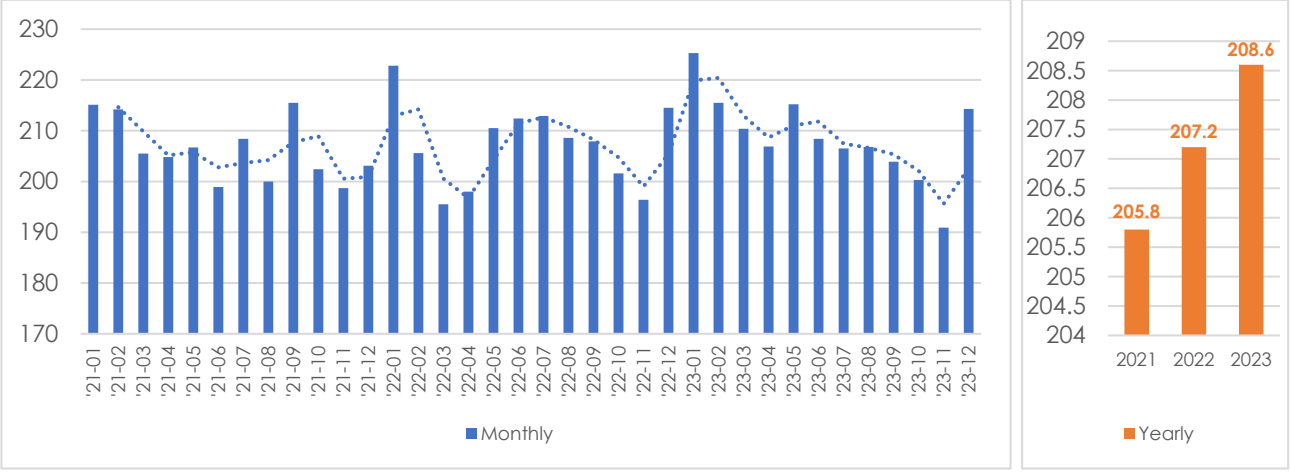
- The number of regular surgeries increased by approximately 1.9% from 184.7 per day in 2021 to 188.3 in 2023.

Table 5. Average number of surgeries performed per day during regular working hours



- Although the number of non-regular surgeries slightly decreased, the total number of surgeries increased by approximately 1.3% from 205.8 per day in 2021 to 208.6 in 2023, due to the rise in regular surgeries.

Table 6. Average total number of surgeries per day

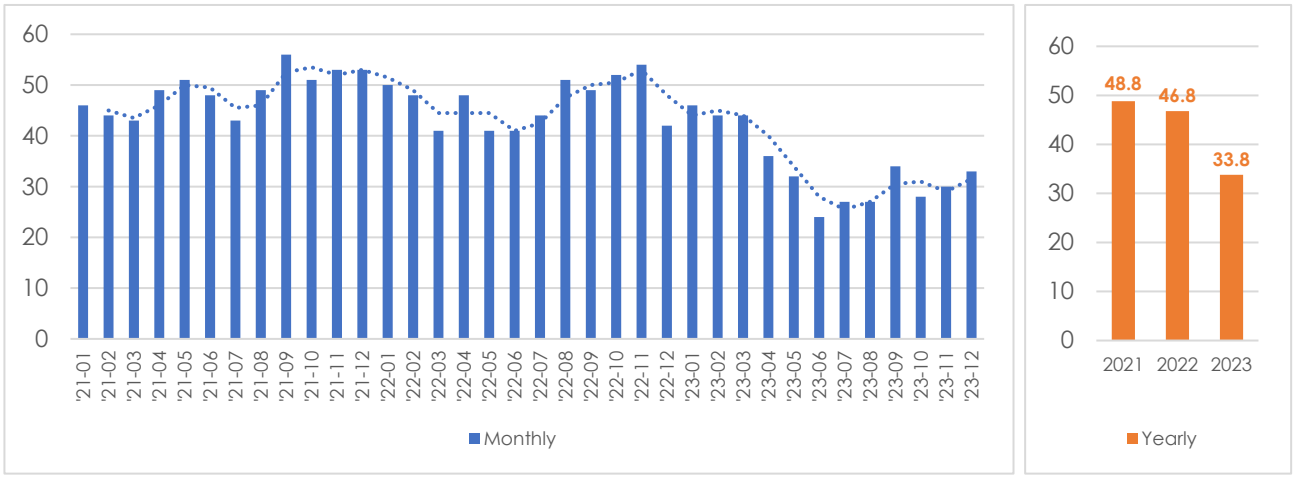


Improving Patient Outcomes

As a tertiary hospital, Samsung Medical Center specializes in complex surgeries, and we have worked to improve operational efficiency to meet the growing demand.

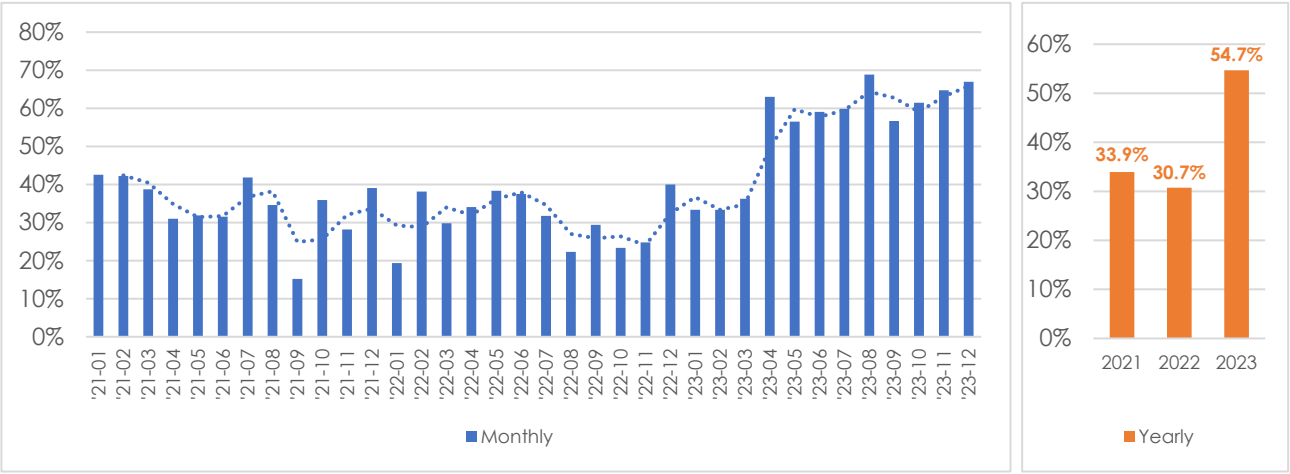
- As a result of the changes made with DOCC Surgery PAN, approximately 864 more patient received necessary surgeries per year—an average of 3.5 more per day in 2023 (assuming 247 business days), compared to that of 2021.
    - The Korean Health Insurance Review & Assessment Service tracks the rate of breast cancer surgery within 30 days of diagnosis. Thanks to increased efficiency, the average waiting time for breast cancer surgery decreased by approximately 30.9% from 48.8 days in 2021 to 33.8 days in 2023.
    - In addition, waiting times for surgeries for liver cancer, colorectal cancer, and stomach cancer—which are also tracked by the Korean Health Insurance Review & Assessment Service—improved somewhat after the introduction of the DOCC Surgery PAN. However, as the average waiting times for these surgeries were already less than 30 days before the introduction of DOCC Surgery PAN, no further data analysis was performed.

Table 7. Average daily waiting time (in days) of surgery for breast cancer patients



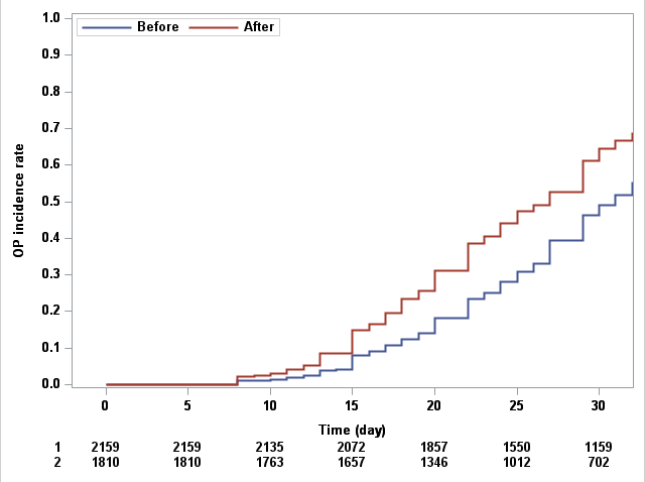
- To further analyze the impact of the DOCC Surgery PAN on breast cancer surgery, we focused on the non-neoajuvant group. We found that the proportion of new breast cancer patients who received surgery within 30 days of visiting Samsung Medical Center increased by approximately 61.1%, from 33.9% in 2021 to 54.7% in 2023.

Table 8. Rate of surgery within 30 days after new breast cancer patients visited the hospital



- We further limited the analysis to the non-neoadjuvant patients and examined the cumulative surgery rate before and after the introduction of DOCC Surgery PAN. The cumulative surgery rate was consistently higher after the introduction of DOCC Surgery PAN across all time periods (p-value < 0.0001). Additionally, we confirmed that the median time until surgery for 50% of the non-neoajuvant patients was reduced by four days-from 31 days before to 27 days after the introduction, bringing the waiting time below 30 days.

Table 9. Comparison of surgical incidence rates by days for non-neoadjuvant patients



▣ **Median Survival Time & 95% CI (in days)**

Intervention	Estimate	95% CI
Before PAN	31.0	(30.0, 32.0)
After PAN	27.0	(26.0, 27.0)

- Since the introduction of DOCC Surgery PAN, breast cancer patients have been able to receive surgery more quickly. A statistical analysis of side effects in the non-neoajuvant group was conducted to ensure patient safety. After adjusting for cancer stage, we found no statistically significant differences in 30- and 60-day readmission rates, reoperation rates, or surgical complications

before and after the introduction of the system. The length of stay was also statistically insignificant before and after the introduction of Surgery PAN. All p-values were greater than 0.1, confirming that there were no patient safety concerns resulting from the PAN.

Table 10. Introduction of PAN effect after AJCC 8th Stage 1–3 correction

■ **Logistic Regression Analysis for Non-Neoadjuvant Patients**
(Group Variable : Before / After, Correction Variable : Stage)

Intervention After PAN vs. Before PAN		Odds Ratio	95% CI	p-value
Readmission Rate	within 30 Days after Surgery	0.877	(0.468, 1.641)	**0.6811**
	within 60 Days after Surgery	0.774	(0.434, 1.383)	**0.3875**
Reoperation Rate	within 30 Days after Surgery	0.902	(0.471, 1.727)	**0.7563**
	within 60 Days after Surgery	0.744	(0.405, 1.365)	**0.3395**
Surgical Complications		0.495	(0.174, 1.409)	**0.1878**

■ **Linear Regression Analysis for Non-Neoadjuvant Patients**
(Group Variable : Before / After, Correction Variable : Stage)

	Parameter	Regression Coefficient		
		Estimate	Standard Error	p-value
Length of Stay	Intervention After PAN	0.086543319	0.070004474	**0.2167**

- Furthermore, the fact that the increase in the number of regular surgeries is higher than the total number of surgeries holds significant meaning in relation to both patient safety and operational efficiency.
    - This is particularly important because, from the patient's perspective, surgeries performed during regular working hours are believed to offer more stable care compared to surgeries conducted during overtime, taking into account the patient's condition and potential staff fatigue.

Accountability and Driving Resilient Care Redesign

The measures taken to improve the efficiency of operating room utilization with DOCC Surgery PAN can be summarized as follows:

- First, priority for additional surgeries scheduled for the following week is given to operating rooms with lower expected utilization rates.
  Second, rescheduled surgeries for today and tomorrow that are expected to begin after regular hours to within regular working hours, whenever possible.
  Third, emergency surgeries are arranged efficiently based on the real-time status of operating rooms.
  Fourth, approaches are considered to increase the use of operating rooms that have been underutilized during certain periods in the past.

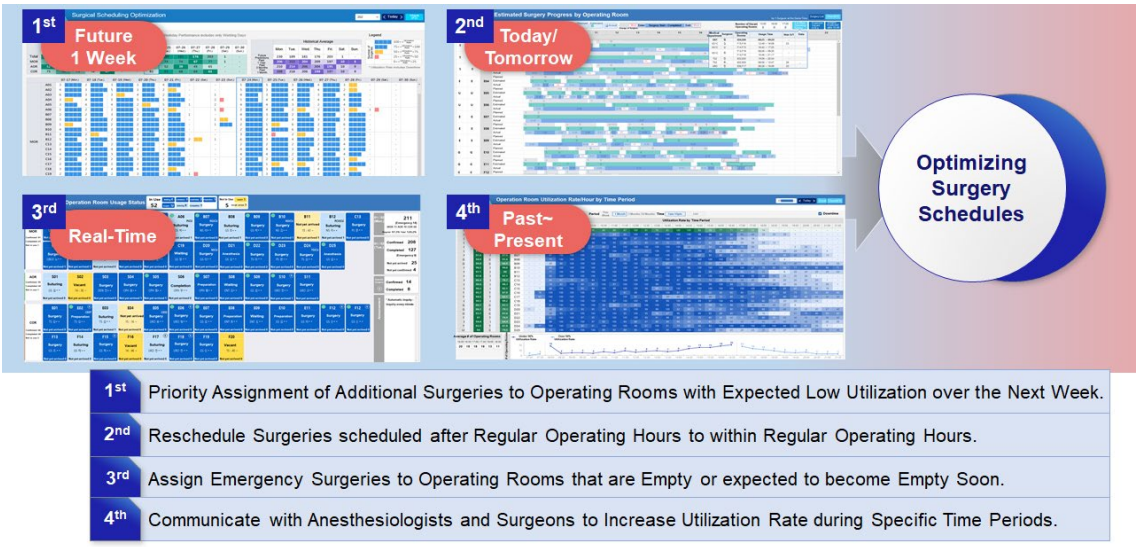


Figure 13. Optimizing surgery schedules using Surgery PAN

Lessons learned from implementing the DOCC Surgery PAN:

- First, it is important to create an environment where stakeholders experiencing issues related to operating room usage can view and understand the same data about the current situation.
  Second, presenting data with clear evidence helps facilitate communication.
  Third, achieving efficiency in operating room utilization requires applying different strategies tailored to the past, present, and future.
  Fourth, leaders must take the initiative, leading by example to gain support and encourage behavioral change among others.
    - Hospital leaders successfully implemented the operating-room sharing rule by preserving each department's priority for its assigned operating rooms as much as possible. This encouraged surgeons to recognize the benefits of being able to use another operating room when necessary.

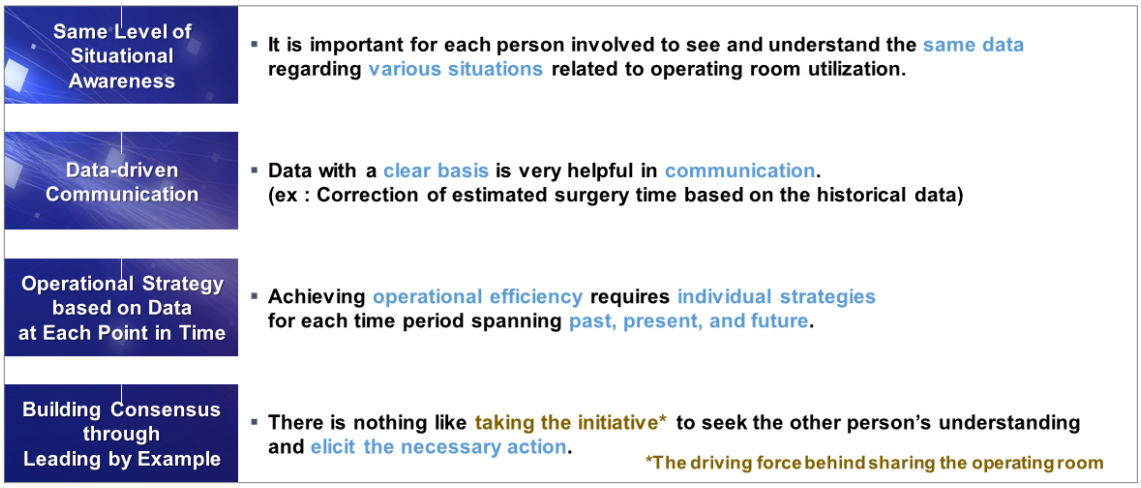


Figure 14. Lessons learned: Key success factors

Additionally, patent applications were filed for certain logic systems developed within the DOCC Surgery PANs to increase operating room efficiency, for the following cases where it was deemed necessary to secure intellectual property rights.

- For the 2nd Surgery PAN, the patent application (US 18/515,839) under the title 'APPARATUS, METHOD AND COMPUTER-READABLE STORAGE MEDIUM FOR ALLOCATING OPERATING ROOMS BASED ON UTILIZATION RATE BY TIME PERIOD' was filed, and its main contents are listed below.
    - Based on the utilization rate by time period for each operating room, operating rooms can be assigned to increase the utilization rate during regular working hours for rooms with lower usage rates. The basic workflow for implementing this is as follows:

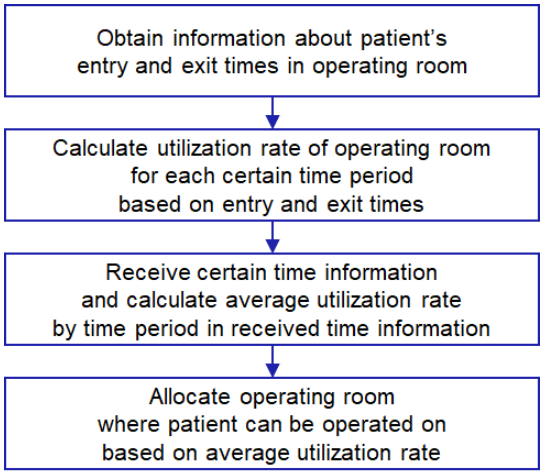


Figure 15. A flow assigning surgeries to specific time periods based on utilization rate

- For the 5th Surgery PAN, the patent application (US 18/396,950) was filed based on a title such as "METHOD OF AND APPARATUS FOR PROVIDING INFORMATION ON MEDICAL PERSONNEL," which details the method for utilizing competency information about surgical nurses.
    - As shown in the table below, a surgical nurse's competency score is calculated based on the number of participations and the time spent on specific surgeries. This includes information on the medical department, surgeon, surgery category, and surgery code.
    - Based on this competency information, nursing personnel can be assigned to surgeries according to their skills, even in the absence of the administrator.

Table 11. Competency calculation logic for surgical nurses

	Medical Department (Weight a%)	Surgeon (Weight b%)	Surgery Category (Weight c%)	Surgery Code (Weight d%)	Competency Score
Number of Participation (Weight α%)	$X_1 = x_1 \times a\% \times \alpha\%$	$X_2 = x_2 \times b\% \times \alpha\%$	$X_3 = x_3 \times c\% \times \alpha\%$	$X_4 = x_4 \times d\% \times \alpha\%$	$X = X_1 + X_2 + X_3 + X_4$
Participation Time (Weight β%)	$Y_1 = y_1 \times a\% \times \beta\%$	$Y_2 = y_2 \times b\% \times \beta\%$	$Y_2 = y_2 \times b\% \times \beta\%$	$Y_2 = y_2 \times b\% \times \beta\%$	$Y = Y_1 + Y_2 + Y_3 + Y_4$
Total					X + Y

HIMSS Global Conference Audience Guidance (This will not be published)

Topic Guidance: Check three which apply to this case study

Culture of Care and Care Coordination

Data Science/Analytics/Clinical and Business Intelligence

Process Improvement, Workflow, and Change Management