Using Advanced Process Simulation Methodology to Plan for a Major Facility Renovation of the Surgical Suite at The Children's Hospital of Wisconsin (CHW)

Submitted by Alexander Kolker, PhD,
Outcomes Operations Project Manager,
Children's Hospital of Wisconsin

ASQ

A case study presentation from the ASQ Healthcare Division: www.asq.org/health.

Submit your own case study
to be considered for publication.

What other content would you like to see on the Healthcare Division site? **Let us know!**

About Children's Hospital of Wisconsin (CHW)

- Member of Children's Hospital and Health System (CHHS)
- Private, independent, not-for-profit, 296-bed, Magnet designated teaching hospital
- Surgical services consist of 12 operating rooms, 2 special procedure rooms, and a full complement of support services
- Performed a total of 14,628 surgical procedures in 2008
- Mission is our children (and it spells "care"):
  - **C**aregiving - offering some of the nation's best medical care
  - **A**dvocacy - speaking up and protecting children
  - **R**esearch - finding cures to the illnesses that affect children
  - **E**ducation - sharing what we learn and teaching others to care for kids

ASQ

The Project Team

- Alexander Kolker, PhD, outcomes operations project manager (leader)
- Mary O'Connor, RN, MSN, MBA, director, surgical services
- Brett Norell, MHA/MPH, FACHE, business manager, surgical services
- Keith Oldham, MD, surgeon in chief
- George Hoffman, MD, chief of anesthesia

The Problem

- Children's Hospital of Wisconsin (CHW) has maximized the capacity of its current operating rooms and special procedure rooms.
- In addition, surgical services is spread geographically in the facility, requiring a majority of patients to arrive to one floor for preoperative preparation and then transport to another floor for their surgical procedures.
- As a result, the organization is in the planning stages for a major facility renovation of its surgical suite to increase capacity; patient, physician, and staff satisfaction; and efficiency of surgical services.
- The expansion will also allow for the streamlining of patient flow both in preoperative services and within the operating room areas.

ASQ

The Problem

The practically important issues that arise with a renovation for capacity expansion are:

- Is the designed number of general and specialized operating rooms and prep/post-operative beds adequate to meet the projected patient flow and volume increases through 2013?
- If the design does not meet the need, how many operating rooms and/or prep/post-operative beds would be needed?
- Ensure that the renovation cost is under control and maintain a high level of quality and satisfaction standards for surgical services, using answers from management science to determine that the number of operating rooms and prep/post-operative beds is not excessive.

ASQ

Project Goal

Performance criteria established for the management science model:

- Delay for patient to be admitted to a preoperative surgical bed should not exceed 15 minutes.
- Delay to enter operating room from a preoperative surgical bed should not exceed the following:
  - ✓ General OR – 2 hours
  - ✓ Urgent OR – 3 hours
  - ✓ Cardiovascular OR – 5 hours
  - ✓Neurosurgery OR – 3 hours
  - ✓Orthopedic OR – 2 hours
  - ✓Cardiac Cath Lab – 2 hours
- Percent of patients waiting longer than acceptable delay to enter operating room from a preoperative surgical bed should not exceed 5%.
- Delay to enter post anesthesia care beds from an operating room should not exceed 5 minutes.

Average annual utilization of operating rooms should be in the range of 60% to 90%.

ASQ

Root Cause Analysis

- Principles of management science and operations research helped address the issue of capacity analysis and patient flow in the complex surgical facility.
- Discrete events simulation methodology is the most powerful scientific and engineering methodology for analyzing and managing a proper balance of patient flow.
- The proper balance includes:
  - Number of patients entering the system at the given point of time
  - Number of patients leaving the system after spending the appropriate time in it
  - Capacity constraint of the system that limits its ability to handle the required number of patients in a safe way that meets the high quality standards of our hospital

ASQ

Root Cause Analysis

- Discrete events computer simulation methodology helped predict if the current number of beds and operating rooms and their allocation for the various surgical services would be enough to meet the projected patient flow demand from 2009 to 2013.
- Using computer simulation of a number of feasible scenarios, we determined the best possible allocation of available resources (operating rooms and beds) to meet the accepted criteria and estimated the implementation cost of different options.

ASQ

Addressing Root Causes

The following computer simulation models (tools) were developed and analyzed:

- **Model 1:** Baseline operations - all surgical services function as currently specified between two floors. Construct two general operating rooms onto upper-level floor to serve otolaryngology, gastroenterology, and pulmonary patient volume from lower-level floor.
- **Model 2:** Move gastroenterology and pulmonary patient volume from upper level to a separate service area.
- **Model 3:** Separate service area for gastroenterology and pulmonary patient volume that includes 2 to 3 special procedure rooms and 8 to 11 prep/post beds and PACU (post-anesthesia care unit) beds.

Total annual patient volume included in the simulation models is in the range from 15,000 to 17,000.

ASQ

Addressing Root Causes

Decision variables were:

- The number of pre-operative beds and PACU beds
- The number of operating rooms and special procedure rooms (SPR)
- Their allocation for surgical services

Project personnel included:

- Healthcare management science expert-computer simulation specialist and project manager-leader
- Data analyst
- Director of surgical services
- Upper hospital management and physicians who participated in review of simulation results and conclusions

Time requirement for project: approximately one month

ASQ

Addressing Root Causes

Obstacles encountered included:

- Building complex computer models of real-world patient flow surgical operations
- Extracting and combining needed data from several different databases
- Meeting the tight project timeframe and modification of input data and model after review of previous simulation runs

These obstacles were overcome because of the understanding by upper management that multi-million dollar management decisions require quantitative analysis based on management science/engineering.

ASQ

Return on Investment

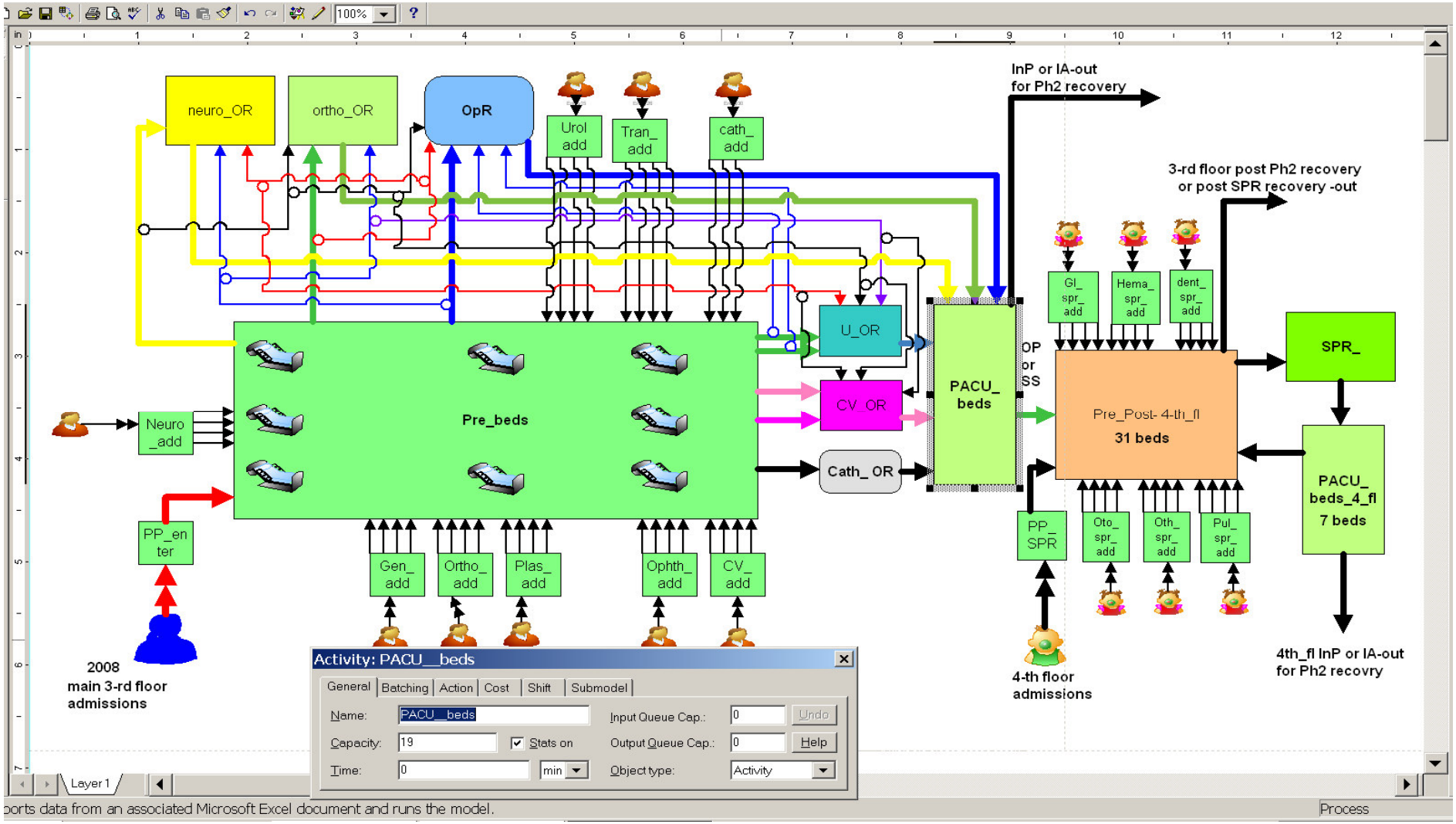
- Projected investment for OR renovation is approximately $10.75 M.
- **Projected return on investment is 7% over a 15-year period, and positive cash flow in year one.**
- Patient/family satisfaction survey results projection for rating of care as “excellent” (based on the scale of *poor, fair, good, very good and excellent*) is greater than 65%.

Monitoring and Evaluating Over Time

- The director of facilities development oversees renovation progress, budget, construction time, quality, etc.
- Surgical services and medical leadership are engaged in the final design and occupation planning of new surgical space.
- A simulation model similar to the one developed to determine the appropriate number of pre- and post-operative beds and operating rooms will be used to evaluate the progress of the new process over time.

ASQ

Simulation Model Layout



For More Information

- Learn more about Children's Hospital of Wisconsin: www.chw.org.
- More case study presentations are available from the ASQ Healthcare Division: www.asq.org/health/quality-information/library.
- Read healthcare case study articles from ASQ: www.asq.org/healthcare-use/why-quality/case-studies.html.
- To find articles, books, courses, and other resources on healthcare quality, search the ASQ Knowledge Center:

  www.asq.org/knowledge-center/search.

ASQ