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THE THREE PILLARS OF SIMULATION: PROCESS, DATA AND EXPERTISE

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ABSTRACT

Using discrete event simulation as a tool in the healthcare industry is becoming more common as budgetary constraints and reduced reimbursement rates force higher quality of care at lower costs. Healthcare providers are implementing quality and process improvement techniques in their practices to help mitigate the aforementioned effects. At Array Architects, we have seen significant growth in the number of healthcare clients interested in using process-led design to build consensus around a new space. Discrete event simulation allows us to experiment with different process flows and determine the appropriate amount of space for the desired process. This tool gives us the confidence to present design options that save our clients precious capital dollars and support processes that focus on improving the value and quality of care. Using two case studies, we will demonstrate how process, data and expertise are the three pillars that support a successful healthcare architecture simulation.

1 THE THREE PILLARS OF SIMULATION

Ten steps compose a sound simulation study (Law 2007). The elements presented by Law align with three broader categories: process, data and expertise. We believe these three pillars support a successful simulation. Process brings together the model definition, experiment design and production runs. Data, including the final analysis results and the initial system data analysis, drives the model. The expertise of those who work in the system every day, as well as that of the modeler, combines for successful problem formulation, model validation and verification, and accurate application of results. By joining process, data and expertise, we are able to develop an accurate simulation study, which can inform design decisions.

2 CASE STUDY: NORTHEAST ACADEMIC CHILDREN'S CLINIC

An urban pediatric hospital on the east coast of the United States serves thousands of patients daily. Aging infrastructure, increasing demand and important adjacencies led the hospital to combine related services. In this situation, facilities sometimes determine their new space needs by aggregating the current number of resources utilized by each individual clinic. The resulting space plan may be oversized, supported by little or no data. Lacking data, we cannot validate space needs, resulting in unnecessary capital expenditure.

2.1 Process

Each of the three clinics operated using the exact same process. Theoretically, merging them should have been simple. The major process steps included check-in, exam and checkout. When these three clinics began operating in the same space, they could all use their existing overall process while sharing staff and room resources.

2.2 Data

To build accurate models of the individual clinics, each group collected data over the same time interval; with additional data extracted from the patient database. After confirming that all three models were running accurately, we combined them into a single model that shared all resources. Consulting clinical experts throughout these processes helped to ensure accurate representation of the process and data in the simulation model.

2.3 Expertise

Because this was a renovation project, there was a limited amount of space available for the new clinic. The clinical experts were concerned about the number of exam rooms and the waiting space, expressing this as the problem they faced. The simulation model helped the experts see that there would be plenty of space if all three clinics began operating as a single unit with shared resources.

2.4 Results

The simulation gave our client the confidence they needed to make critical decisions about the exam rooms, waiting space and support spaces. Moreover, after hearing explanations supported by the simulation model, the experts were confident enough to include two additional service lines in the new space. The results allowed for more flexible planning so that renovations would not be necessary in the near future.

3 CASE STUDY: MID-ATLANTIC ACADEMIC CHILDREN'S EMERGENCY DEPARTMENT

An urban academic medical center focused on pediatrics sees more than 85,000 visits each year in their emergency department. Designed 15 years ago, the segregated pods and small triage area limit flexibility and result in long lines and unsafe conditions. Through process mapping and discrete event simulation, a multi-disciplinary team of experts was able to test alternate patient flow approaches to identify the optimal balance of process time and staffing resources to ensure consistent success.

3.1 Process

The care of emergent pediatric patients is complex. In an effort to gain as much information as possible, a two-step triage and assessment process was in place. The unintended consequence was a bottleneck at assessment. To combat the problem, the providers felt a redesign of the arrival area was necessary in conjunction with process changes to combine some existing care steps and reduce patient moves.

3.2 Data

Using data the internal Lean group already collected, we developed a simulation model to test the implication of process decisions on overall throughput and resource needs. The resulting model was a dynamic tool that allowed the team to change the variables during a future-state process design meeting. This real-time feedback from providers allowed quick consensus and decision making about the ideal future state.

3.3 Expertise

During early design meetings, the experts (in this case healthcare providers) described the problem and the simulation modeler helped formulate the questions the model needed to help answer. When presented with the simulation model, the experts provided valuable feedback regarding throughput and additional time-varying arrival rate data. The experts, who used the results of the simulation model to compare various staffing combinations and waiting times, made the final design decision.

3.4 Results

Through process redesign of security, registration and check-in, and the shifting of the nursing assessment to the bedside, patient throughput could improve by focusing on the key information needed at each step. By analyzing the output of the simulation model for different scenarios, it was determined that adding one additional registrar reduced overall wait times and allowed two nurses to return to bedside care within the current staffing plan.

REFERENCES

Law, A. M. 2007. Simulation Modeling and Analysis. 4th ed. New York: McGraw-Hill, Inc.