

PLANNING FOR TOMORROW

It takes teamwork to build the modern OR

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One of the greatest challenges faced by operating room managers, hospital administrators and facility design teams is determining which technologies should be deployed on the first day of a facility's opening, which technologies should be prepared for the future and how they should all fit together. The key to successfully working through these crucial issues is early planning by the entire design team.

OR Technology Planning

From the medical equipment perspective, knowing which ORs will be configured for which type of procedure will determine the equipment and configuration. But, as it relates to the audiovisual and information technology systems, it is a little more difficult to nail down.

Granted, almost all the medical equipment today requires connectivity to the data network, and that is primarily an infrastructure-related issue that is accomplished through coordination with the medical equipment planner, architect and the technology consultant. However, as it relates to what type of communication systems, displays and applications to use, consideration must be given to how procedures are performed, organizational and operational efficiencies, flexibility, and due diligence to determine the return on investment for various systems.

First steps in this process begin at the OR stakeholders meeting with the facility's information technology department, the technology consultant and the architect to plot the strategic plan for OR opera-

tion and organization in regard to technology systems. From this visioning process, clear guidelines, systems selection and cost models should be determined. The results of this process become a roadmap for technology deployment for the project.

The resulting roadmap is not a static document. Due to the nature of the design and construction process, combined with the fast-paced, changing world of communication technologies, it must be a flexible plan that allows for adaptation throughout the life of the project. One key to success for any OR technology deployment, or any health care technology deployment for that

matter, is future-thinking for infrastructure flexibility, adaptability and growth.

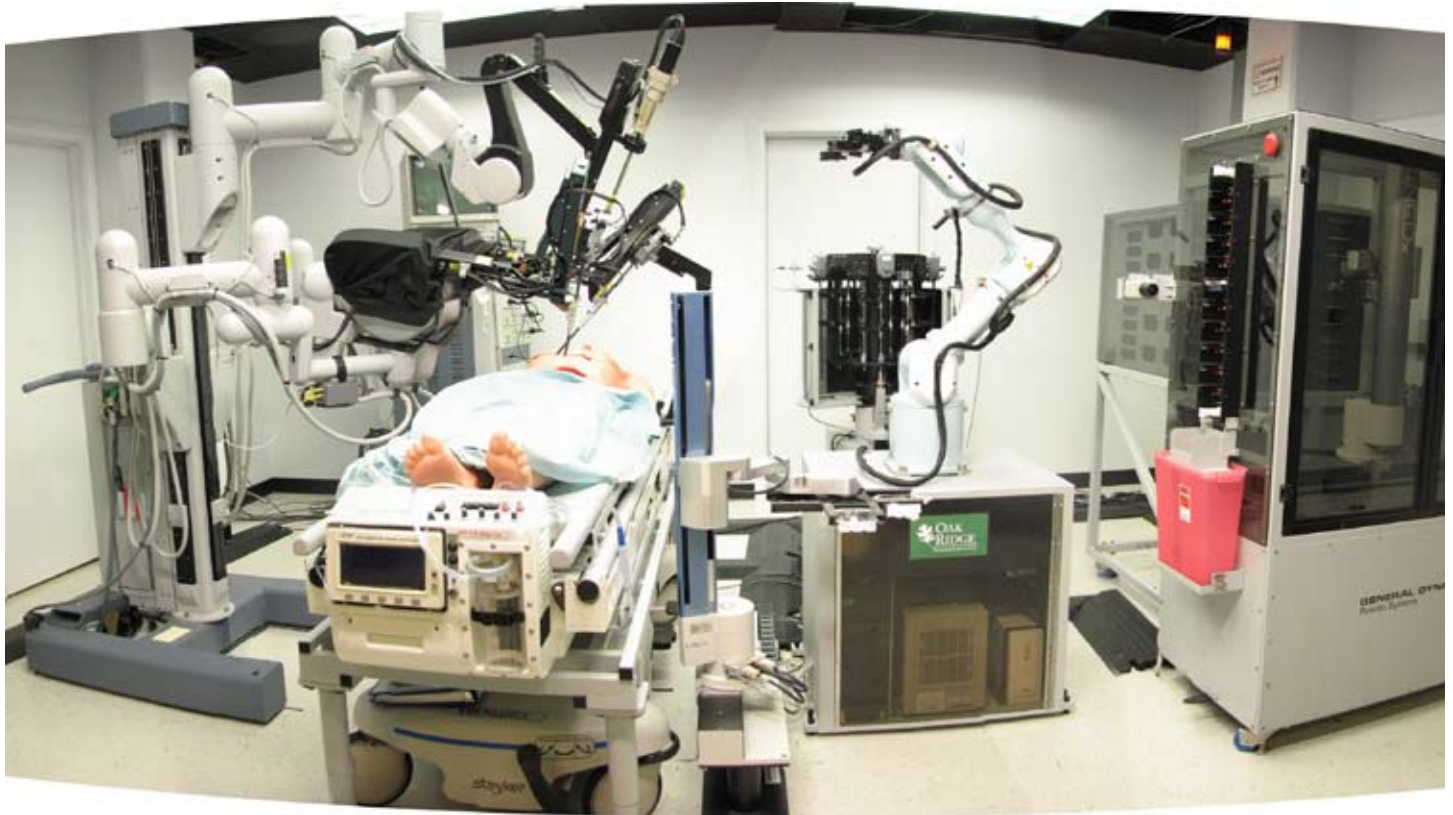
Perhaps various systems are desired that will not be deployed when the OR opens but may be installed several years down the road. The better the team can anticipate future needs and provide for a more plug-and-play infrastructure to accommodate future deployments, the lower the cost, time and inconvenience associated with new systems integration.

The Integrated OR

One emerging technological trend is the integrated or "context aware" OR, an envi-



The da Vinci® Surgical System is a sophisticated robotic platform for ORs, designed to enable complex surgery procedures using a minimally invasive approach.



In 2005, the Defense Advanced Research Projects Agency Defense Sciences Office awarded a multiorganization team led by Menlo Park, Calif.-based SRI International a contract to develop a “trauma pod” to stabilize injured soldiers within minutes.

environment that links changes in the OR environment with the computer systems in use, which are otherwise static. This environment is achieved with systems that take advantage of technologies such as radio-frequency identification (RFID) and integrates them with other systems such as telemetry, medical vitals, electronic medical records (EMR), picture archiving communication systems (PACS), and other software applications to provide a real-time, interactive monitoring platform.

When using RFID on staff, surgical tools, medications and more, movement of these items can be monitored and OR staff can be notified that a given item that was scheduled as part of the procedure has not been used, like an early warning system. RFID can provide essential, location-based information throughout the entire procedure, including who entered and exited the OR, or what surgical tools were used, for historical record keeping and procedure review for educational purposes.

All this information can be displayed on the patient dashboard for the surgeon and the OR staff. Systems such as the Live-

Data OR Dashboard™ from LiveData Inc. (livedata.com), Cambridge, Mass., captures, synthesizes, and automatically displays essential patient information in real-time throughout the patient procedure.

Robotics in the OR

Futuristic technologies that are becoming more and more of a reality in the operating room, although in limited numbers, are robotic surgical tools.

These medical curiosities range from surgical tools and medication dispensers, to state-of-the-art remote surgical procedure robots, such as the da Vinci® Surgical System by Intuitive Surgical Inc. (www.intuitivesurgical.com), Sunnyvale, Calif., which allows a surgeon to perform surgery from outside the OR, or even in another city or country. As of 2000, the da Vinci system has been cleared by the Food and Drug Administration for general laparoscopic surgery and, since then, the FDA cleared the da Vinci surgical system for thoracoscopic (chest) surgery for cardiac procedures performed with adjunctive in-

decisions and urologic and gynecologic procedures.

Many medical futurists believe that one way to improve efficiency in the OR and help combat the nurse shortages will be to utilize more and more robotic surgical devices. Imagine freeing available staff for other vital patient-related tasks and replacing the scrub nurse or the circulating nurse with a robotic system that never tires and is always available, such as Penelope™ Surgical Instrument Server (SIS) from Robotic Systems & Technologies Inc. (www.roboticsystech.com), Bronx, N.Y.

Combine robotics with a truly context aware OR, and the possibilities for unmanned surgical procedures are possible. An example of this is the unmanned OR lab at the Scientific Research Institute (SRI) (www.sri.com) in Menlo Park, Calif. Presently focusing on surgical procedures for soldiers in the battlefield to conduct unmanned medical treatment, this technology and the use of the “trauma pod” can stabilize injured soldiers within minutes after a trauma, and administer life-saving medical and surgical care prior to evacua-

IMPACTS OF OR TECHNOLOGY To Healthcare Facility Design

With the excitement of deploying breakthrough technology in the OR comes the realization that there are new building design challenges that first must be worked out. These challenges include creating spaces, pathways and support infrastructure.

Planning for the delivery of medical technologies in the OR can be a daunting task. It is important to think about the configuration of the OR as it supports the technology systems. What is not seen in the OR is the connectivity required for booms, gas systems, power and lighting and how it gets routed to the control points. Without careful planning and coordination, the OR will end up with a rat's nest of cables in its ceiling spaces, which impacts operation, maintenance and flexibility. Important issues that need to be addressed early in the design process include the following:

- **Head-end equipment.** A trend in OR technology design is to get away from the traditional placement of the technology support/control (head-end) systems inside the OR itself. Unlike older proprietary systems, the newer audiovisual and information technology systems can be controlled over converged Internet protocol (IP) networks, so the need for these systems to be housed inside the operating room is gone. This allows for a centralized control room to be located outside the sterile core and prevents the technicians from having to gown up to operate or configure the OR technology systems. Moving away from proprietary systems will lower the costs of ownership and increase the ability to integrate systems, resulting in greater flexibility to implement future technologies.

- **Power requirements.** As new technologies are added in the OR, the number of power devices and circuit capacity requirements increases significantly. Add in the need for redundancy for life safety systems, and the need to provide robust emergency power becomes even more critical. To provide a higher level of redundancy and reliability, networks are built to be increasingly resilient, which requires more power and more cooling. One of the primary contributors to this change in power and cooling is the deployment of Power over Ethernet (PoE) systems. These systems can increase the power requirements of network equipment by as much as five or six times over their predecessors. Many communication equipment rooms now have power requirements of 20 to 540 watts per square foot, the heat loads of 15,000 to 25,000 British thermal units per hour or more.

- **Pathway and spaces.** On day one, some facility directors or administrators may walk into a technology equipment room and say, "Wow! Why all the space?" But within a year or two, as new technologies are brought in, the room may be near capacity. Planning for future growth is essential in OR design. In addition, pathways must be designed to have adequate separation and clearances. Electromagnetic and radio-frequency interference, fire stopping and maintenance must all be taken into consideration.

- **Flexibility.** Keep it as simple as possible as it relates to the flexibility of the OR and health facility design. Take advantage of converged systems design with regard to cable infrastructure, network transport and common medical equipment communication protocols. Converging technologies onto a single platform in both the wired and wireless environments is the process of distributing many different low-voltage systems over the same structured cabling and logical data network systems. The more that can run on a common systems infrastructure, the more the OR suite can be considered plug-and-play.—T.M.

tion and during transport. This innovative technology also has the potential to be used in civilian hospitals when trauma centers are too far away to save a patient's life.

Remote Monitoring

In addition to remote surgical procedures is remote monitoring. With tremendous advances in telemedicine, the ability to accurately view and remotely interact real-time with a surgical team is here today. High definition video combined with new camera technology has created the telepresence environment, allowing for accurate remote consultative surgical procedures, as well as detailed medical educational tools.

Telepresence solutions such as the MedPresence conference room being used at St. Joseph's Hospital and Medical Center's Barrow Neurological Institute in Phoenix allows physicians and students to remotely observe surgeries being performed in real-time from the physician's office or the classroom. Participants feel as if they are in the operating room with the ability to view all aspects of a given operation. The benefits of the solutions like the MedPresence Surgical Training Theatre by Human Productivity Lab (www.humanproductivitylab.com), Ashburn, Va., are significant in all aspects of the medical/surgical field through increased productivity, reduced travel and improved distance learning. This leads to dramatic return on investment (ROI) for medical organizations. For instance, a physician who is required to be in the OR with his or her patient throughout a surgical procedure, although not physically performing the procedure, can now be face-to-face in surgery from a few doors down in his or her own office space. This



The MedPresence telepresence solution at Barrow Neurological Institute in Phoenix.

allows the physician to be productive on other tasks while still being involved in the surgery. By the same token, high dollar procedures that are performed at only three or four institutions throughout the world can be observed by a wide network of medical colleagues, surgical residents and medical students. These real-time participants can take advantage of the knowledge to be gained from renowned experts using emerging surgical techniques without traveling long distances.

Practice Makes Perfect

In another trend, pre-operative planning and surgical rehearsal of complex procedures in an interactive visualization environment can be created to allow the production of 3D surgical planning data sets. Image review and analysis tools allow the surgical review of computed tomography, magnetic resonance imaging and angiographic examinations in an interactive 2D and 3D environment.

Surgery simulators can be classified into three categories. The first-generation simulators display only the anatomy, in particular the geometry of the structures involved in a surgical procedure. With this, the user can essentially navigate within a virtual representation of the patient, with limited detail.

A number of these simulators have been

developed in recent years and are available today. These systems are generally used as diagnostic tools, and also to assist with surgery planning, but are limited in their complexity.

Second-generation simulators not only include the geometric modeling of the body anatomy, but also the modeling of the physical properties of the living tissues. This provides for realistic interactions between surgical instruments and the actual tissues. A few of these systems are available today, including such surgical simulators as LAP Mentor™ by Symbionix™ USA, (www.symbionix.com), Cleveland, or the ProMIST™ by Haptica Inc., (www.haptica.com), Boston.

Third-generation simulators combine anatomical, physical and physiological modeling. There is a greater degree of complexity with these models, because they are combining the physiological and physical properties of the patient. Some third generation models exist, but no commercially available product is currently on the market.

Breakthroughs in Lighting

Finally, there have been different ways of focusing light in the OR, different ways of directing the light or creating a spot, but for over 70 years the light source itself has been the halogen bulb. This light source is

known for its high quality bright light, but not for its efficiency in terms of lamp life or heat.

Advanced surgical lighting uses light-emitting diode (LED) technology that utilizes both white and color LEDs to create a very high level of almost shadow-free illumination.

The most important features in surgical lighting—intensity, color temperature, heat control, shadow control, maneuverability and flexibility—are inherent in this technology. Surgeons can even use voice commands to adjust the intensity or the color of the light.

Detailed Due Diligence

Determining which systems to consider and deploying them in the OR is a daunting process that requires due diligence by the design team as it relates to process, culture, services and cost.

Gathering the appropriate stakeholders and necessary technical experts to look at strategic plans, ROI, future trends and facility impacts are crucial to a successful OR suite design and implementation.



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Systems such as the LiveData OR Dashboard™ shows a summary of the patient and surgical case, enhancing team communication, patient safety and workflow efficiency.