

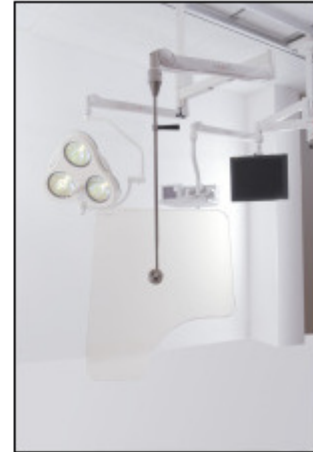
## Special report: In the OR, the ceiling's getting crowded

April 22, 2011

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*This report originally appeared in the April 2011 issue of DOTmed Business News*

With the advent of the hybrid operating room and other multifunctional surgical, interventional and imaging spaces in today's health care facilities, focus has turned to maximizing patient and caregiver safety while saving space and improving efficiency and utilization. To fit all the new equipment, designers and engineers looked to the sky, or more precisely, to the ceiling as the final frontier in space utilization.



**MAVIG GmbH's  
Portegra2 System**

No matter how advanced the OR, the ultimate purpose remains the same — patient care. The interaction between patient and equipment is also relatively simple . . . either the patient is brought to the equipment or the equipment is brought to the patient. Surgical lights, C-Arms and X-ray units to MRI scanners and robotics can all be brought within easy reach. However, when this equipment is all provided on the floor, it can limit accessibility and even create fall and infection hazards.



Some ceiling mount solutions prove more challenging than others. For example, tandem mounting different types of equipment on high-tech equipment booms and suspension systems requires a great deal of planning and vendor collaboration, but OEMs are stepping up to the challenge.

**MAVIG GmbH's widescreen  
monitor suspension system**

"A lot of things that have been on the floor historically are now mounted up on the ceiling," says Patrick Down, director of STERIS' project design group. "STERIS collaborates extensively with other OEMs, architects and hospital engineers to create hybrid ORs from concept all the way through construction and installation. By integrating not only equipment but all the cords and accessories into ceiling-mounted delivery systems, we can position everything to not only be safer, but more ergonomic for the staff."

### **Vertical integration goes up**

Just about anything designed for a floor cart can be mounted on the ceiling, including endoscopy equipment, electrosurgical units, Harmonic scalpels and even IV poles and the patient tables themselves. Even equipment that may have already been mounted off the floor has experienced upgrades. One hot item, the flat-panel monitor, can be tandem-mounted onto surgical light systems now.

"They're smaller and can be mounted on a light system instead of an equipment boom, bringing them closer to the surgeon and support staff," says Down.

In the case of hybrid ORs, where surgery, interventional procedures and imaging are brought together in close quarters, there are a few more structural considerations in the planning phase than for a standard OR or imaging suite.

"The amount of space to plan most hybrid rooms is going to be significantly larger than a traditional cath lab or even open heart room, because you've got to accommodate all of the equipment from these multiple modalities and the placement of that equipment is going to be based on each vendor that is chosen," says Down.

Hybrid rooms really only started surfacing in 2004 and 2005, but today's cutting-edge, multi-OEM contracted rooms began emerging around 2008. It has taken years to establish relationships, but now just about all major OEMs are working together.

"It made the planning process more streamlined for the owners, the architects and the equipment-planning community to have the vendors working in unison rather than independently," says Down.

### **Lights and monitors come and go**

It's not only important to bring instruments and imaging to the patient, it's sometimes just as important to be able to move them away. Susan Sherman is in charge of U.S. sales and business development for MAVIG, German makers of ceiling support and radiation protection systems.

In addition to widescreen suspension systems, which can accommodate today's mammoth 56-inch medical grade widescreen monitors, MAVIG also provides dual and multi-monitor systems that can support up to eight different monitors. One thing that makes the Portgera2 system, another MAVIG product, unique is its combined functionality as lighting system and radiation protection. With built-in shielding, the Portgera2 protects the physician's upper body from ionizing radiation.

"Its easy configurability can meet every facility's clinical needs while accommodating individual physician preferences," says Sherman. "The component choices include lighting, radiation shielding and single/dual monitor supports. There are nine different lighting options that range from a halogen exam lamp to the new multi-color LED lamps with video camera capabilities. The radiation shields offer eight different shield designs and styles."

### **MRI on the ceiling**

Suspending lights and monitors from the ceiling is only natural, but how about MRI systems? Catching on in the hybrid OR are interventional MRI procedures. IMRIS is the Manitoba, Canada-based maker of the IMRIS Neuro for tumor resection, the IMRIS NV for stroke management and the IMRIS Cardio for cardiovascular and angiography procedures. One of the most innovative features of these scanners is that they all hang and can move about on ceiling rails through one or more rooms.

IMRIS vice president and chief scientist John Saunders and director of business development Brad Woods say the design of IMRIS products have always been patient-centric.

"We decided very early on that we were going to bring the magnet to the patient," says Saunders. "That was always our objective."

Hospitals can choose one-, two- or three-room configurations depending on the function of the room. The scanner is brought out from an equipment bay to the patient when needed.

“Those overhead rails are attached to the pillars of the building where the suite is located in order to be able to carry the load of the magnet, which ranges from 5 to 6 tons,” says Woods.

### **Ceiling mounting for infection control**

IMRIS’ design specifically addresses the necessity to maintain the sterile field.

“From a safety point of view, you can’t have rails in the floor,” says Saunders. “We had ideas of having rails under the floor, but when you have any indentation in the floor, it has the potential to lead to infection problems. There is a sterility issue, which is very important.”

IMRIS keeps an in-house customer engineering group who works with the architect and hospital engineers. On average, it takes about 12 to 18 months from design configuration to installation to create a comprehensive suite.

### **From planning to install**

With so many equipment choices and interactivity to account for, how do health care design teams design and plan what goes where in a hybrid OR? The use of 3-D and CAD drawings helps a great deal.

“These tools enable the architects and equipment planners to view the equipment positions, rotation capabilities and predict the interactions of all of the equipment in today’s health care environments,” says MAVIG’s Sherman.

All of these heavy loads being pendant from the ceiling require very specific structural engineering. Here’s where the American Society of Healthcare Engineers’ Mike Viviano steps in. Viviano, a senior project manager for St. Louis-based Northstar Management Company, is an expert in fitting all the pieces together in these very tight spaces.

“One thing that needs to be considered in the design phase is the amount of power and utilities required and the heat that each of these pieces generates, and the requirements for the actual surgery or operation from the surgeon’s perspective and the care team’s perspective.”

Many times, engineering teams receive very generic information from vendors when the equipment has not yet been selected. Engineers have to design with a lot of questions and what-ifs in mind in terms of ceiling space and utilities required.

“There are some big challenges,” says Viviano. “In order to do the design work we need to know what vendor it’s going to be and this could be any piece of equipment in a cath lab, a CT or an X-ray room. Sizing the room and making sure we are addressing all of the utility requirements is probably the biggest challenge.”

### **Ceiling infrastructure**

Once the vendors and equipment have been chosen for a suite, the engineering really begins. There is very limited space inside the ceiling for all of the wire, hose and ducts required, let alone the heavy-duty infrastructure onto which the heaviest equipment is bolted.

“Above the finished ceiling, there is a lot of structure required to hold everything depending on the weight of the booms, or ceiling rails, or robots, and lighting and such,” says Viviano. “Each one of those has requirements from vendors, including the physical weight and moment loads they carry. This means those elements that the equipment bolts to needs to be designed by a structural engineer.”

Specific materials are not necessary for bolting equipment such as C-arms or equipment booms, he says. As long as the loads are met, any material from structural steel to Unistrut framing and tubing can be used. What Viviano means by “moment loads” is the increased weight of a piece of equipment as it is articulated toward its most expanded point. For instance, an equipment boom that is hanging down and stretched to capacity holding surgical equipment and whatever else is mounted there.

“When an equipment boom hangs off the ceiling and there’s an arm, it creates a moment function on that support,” says Viviano. “It’s pretty heavy when you support something from a distance laterally. Some of them I see reaching up to the thousands of pounds.”

If that sounds like a challenge, consider installing something like a hybrid OR in an existing, renovated space. Viviano says this is often the case, and it’s an obstacle course to make everything fit as it should.

“In a renovation you really don’t have a lot to work with and you pretty much know what your barriers are,” he says. “The other factor to consider is that almost all pieces of medical equipment in the room, whether they are on the floor or mounted in the ceiling, have a very specific floor-to-ceiling height, especially for C-Arms.”

### **Building automation takes it one step further**

The final frontier for the hybrid OR seems to be going in the direction of near-complete building automation, or essentially, being able to control an entire rooms’ worth of equipment, whether mounted on the ceiling or the floor, from a single control panel. Viviano says this requires an entirely new set of equipment to make this run smoothly.

This trend is already taking over the latest and greatest hybrid suites, and it is just a snapshot of the future for the hybrid OR from floor to ceiling.