THE INTERDEPENDENCIES OF DESIGN AND MEDICAL TECHNOLOGY

Integrated Planning from a Single Room and Project-wide Perspectives
LEARNING OBJECTIVES

• Develop the best practice design process on Hybrid OR solutions

• Identify the various design challenges related to Hybrid OR environment

• Assess the impact of medical technology on health facility design

• Understand the Integrated Technology Planning - the best practice for the design and delivery process
WHAT IS A HYBRID OR?

BROAD DEFINITION:
A hybrid operating room is a surgical theatre that is equipped with advanced medical imaging devices such as fixed C-Arms, CT scanners or MRI scanners.

NARROW DEFINITION:
Cath Lab meets Surgery.
DEFINITION

Cath Lab Suite

Hybrid OR

Operating Theater
TRANSCATHETER AORTIC VALVE REPLACEMENT - TAVR
DRIVERS OF HYBRID OR - *BENEFITS*

**SURGEONS:**
- Improved patient care: Crisis management, improved communications, integrated technologies
- Room Flexibility: Interventional use to MIS to open procedures all in one room
- Improved workflow collaboratively designed for improved safety and productivity

**NURSING:**
- Improved staff productivity through improved ergonomics and workflow
- Improved patient care
- Improved room utilization, reducing scheduling challenges

**ADMINISTRATION:**
- Optimize capital monies
- Optimize room utilization – full range of procedures allowing 24/7 use
- Surgeon retention and recruitment
## TYPES OF PROCEDURES

<table>
<thead>
<tr>
<th>Common Procedures</th>
<th>Vascular Surgeon</th>
<th>Cardiac Surgeon</th>
<th>Interventional Cardiologist (Adult)</th>
<th>Interventional Cardiologist (Peds)</th>
<th>Neurosurgeon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Abdominal aortic aneurysm (AAA)</td>
<td>Coronary artery bypass graft (CABG)</td>
<td>Diagnostic caths</td>
<td>Hypoplastic left heart syndrome</td>
<td>Aneurysm coiling</td>
</tr>
<tr>
<td></td>
<td>Thoracic aortic aneurysm (TAA)</td>
<td>Aortic valve replacement</td>
<td>Coronary stenting</td>
<td>Heart biopsy</td>
<td>Intracranial stenting</td>
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<tr>
<td></td>
<td>Carotid stenting</td>
<td>Mitral valve repair/replacement</td>
<td>PTCA</td>
<td>Diagnostic cath</td>
<td>Carotid stenting</td>
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<tr>
<td></td>
<td>Peripheral PTA</td>
<td>Peripheral stenting</td>
<td>Peripheral PTA</td>
<td>ASD</td>
<td>Intra-arterial TPA</td>
</tr>
<tr>
<td></td>
<td>Peripheral stenting</td>
<td>Peripheral artery bypass</td>
<td>Peripheral stenting</td>
<td>VSD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peripheral artery bypass</td>
<td></td>
<td>Heart transplant</td>
<td>PFO</td>
<td></td>
</tr>
<tr>
<td>Procedure well suited for Hybrid Room</td>
<td>AAA</td>
<td>MIDCAB/stent Valve/stent</td>
<td>Peripheral stenting</td>
<td>Structural heart Hybrid Stage I</td>
<td>Aneurysm coiling</td>
</tr>
<tr>
<td></td>
<td>TAA</td>
<td>Percutaneous valves</td>
<td>Stent/MIDCAB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peripheral stenting</td>
<td></td>
<td>Stent/valve</td>
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</table>

*Source: Hospital of the Future, The Advisory Board Company*
TECHNOLOGY OPTIONS - CONVENTIONAL

Source: HKS Architects
SAMPLE ROOM LAYOUT - CONVENTIONAL
Exceptional positioning flexibility for unrestricted patient access
TECHNOLOGY OPTIONS - FLEXIBLE
TECHNOLOGY OPTIONS – FIRST LASER GUIDED C-ARM

LASER-GUIDED MOVEMENT

- The AGV rotating laser continuously scans its environment
- Position calculated based on the signal sent back by reflectors

VEHICLE-MOUNTED GANTRY

The C-arm is mounted on a motorized laser-guided L-arm, the Advanced Guided Vehicle (AGV)
TECHNOLOGY OPTIONS – FIRST LASER GUIDED C-ARM

Flexible system positioning for imaging

The Satellite has been put through the equivalent of 10 years of everyday clinical usage including up to 35,000 exams and over 120,000 movements.
Parking positions that adapt to your room

- 35 m² (377 ft²)
- 45 m² (484 ft²)
- 100 m² (1076 ft²)
<table>
<thead>
<tr>
<th>Technology</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>• Lower equipment cost</td>
<td>• Less flexibility to park the C-arm when not in use</td>
</tr>
<tr>
<td>Robotics</td>
<td>• Flexibility in parking positions</td>
<td>• Higher equipment cost</td>
</tr>
<tr>
<td></td>
<td>• Less ceiling support required</td>
<td>• Require floor structural reinforcement</td>
</tr>
<tr>
<td>Flexible</td>
<td>• Complete flexibility in room coverage</td>
<td>• Higher equipment cost</td>
</tr>
</tbody>
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## Design Approach

<table>
<thead>
<tr>
<th>Critical Tasks</th>
<th>Key Personnel</th>
<th>Deliverable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify technology platform(s)</td>
<td>• Hospital Administration</td>
<td>A business plan with specific technologies &amp; procedures targeted</td>
</tr>
<tr>
<td></td>
<td>• Surgeons</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Nursing</td>
<td></td>
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<tr>
<td></td>
<td>• MEQ Planner</td>
<td></td>
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<tr>
<td>2. Determine room sizing &amp; orientation</td>
<td>• Architect</td>
<td>Schematic departmental and room Layouts</td>
</tr>
<tr>
<td></td>
<td>• MEQ Planner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Surgeons &amp; Nursing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Imaging Vendor/OEM</td>
<td></td>
</tr>
<tr>
<td>3. Layout X-Ray equipment</td>
<td>• Architect</td>
<td>Preliminary site specific drawing for X-Ray system</td>
</tr>
<tr>
<td></td>
<td>• MEQ Planner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Imaging Vendor/OEM</td>
<td></td>
</tr>
<tr>
<td>4. Develop ceiling mounted equipment</td>
<td>• Architect</td>
<td>Preliminary site specific drawing incorporating X-Ray equipment, lights &amp; booms</td>
</tr>
<tr>
<td>configuration</td>
<td>• MEQ Planner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Surgeons &amp; Nursing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lights &amp; Booms Vendor</td>
<td></td>
</tr>
<tr>
<td>5. Incorporate OR integration technology</td>
<td>• Architect</td>
<td>Conduit schedule based on the site specific equipment configuration</td>
</tr>
<tr>
<td></td>
<td>• MEQ Planner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Surgeons &amp; Nursing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• OR Integration Vendor</td>
<td></td>
</tr>
</tbody>
</table>
DESIGN APPROACH – TECHNOLOGY PLATFORM
Operating Room (Exam Room)  
800 – 900 sq. ft. Recommended

- OR Workstation
- Equipment Room: 144 sq. ft. Recommended
- Control Room: 120 sq. ft. Recommended
- Scrub/Stretcher Alcove: 140 sq. ft. Recommended
- OR Storage

DESIGN APPROACH – **ROOM SIZING**
New Pre-Op

New OR’s

Existing OR’s

Overflow for PACU

Existing PACU
CASE STUDY– DEPARTMENTAL LAYOUT

Hybrid Suite
CASE STUDY– **ROOM SIZING**

CONTROL ROOM
129 SF

ENDO-VASCULAR OR (HYBRID)
786 SF

EQUIPMENT ELECTRONICS
128 SF

STRETCHER
CASE STUDY – X-RAY POSITIONING
CASE STUDY – CEILING MOUNTED EQUIPMENT POSITIONING

CONTROL ROOM
129 SF

ENDO-VASCULAR OR (HYBRID)
786 SF

EQUIPMENT ELECTRONICS
128 SF

STRETCHER

A  B  C  D  E  F
CASE STUDY – VIDEO INTEGRATION

- Wall Plate/C-Arm
- Wall Plate/Ultrasound
- Endo Camera 1
- Endo Camera 2
- Vital Signs
- Microscope
- In-light Camera
- 3rd-arm Camera
- Room Camera
- PACS

19” Touch panel with Video Preview
PREPARED TO DESIGN YOUR HYBRID SUITE?

Process & Approach

✓ Define your Hybrid Suite (Procedures & Technologies).
✓ Assemble a design team.
✓ Don’t be afraid to engage vendors/OEMs.
✓ Implement the best practice approach.
✓ Hire a medical equipment planner!
PROJECT-WIDE PERSPECTIVE
The alignment of Medical Technology with Architectural and Engineering Design is critical to the construction process; creating best-of-class facilities; and ultimately improved patient outcomes.
IMPACT OF MEDICAL TECHNOLOGY

CONSIDERATION OF MEQ AS A KEY ELEMENT OF PLANNING IS CENTERED AROUND 6 MAJOR CLIENT DRIVEN DIMENSIONS:

• MEQ capital represents over 25% of total project costs
• MEQ has a direct impact on facility design and operational work flows
• MEQ is a major critical path in a construction and delivery program
• MEQ coordination represents a high risk to all project stakeholders
• MEQ directly supports improved patient safety and clinical outcomes
• MEQ impacts an organization’s bottom line
IMPACT OF MEDICAL TECHNOLOGY - **COST**

TODAY’S HEALTHCARE PROJECTS ARE INCREASINGLY EXPENSIVE

Medical Technology Costs

- Are Second only to Construction
- Can Equal 30% of total Construction Costs
- Have Additional Cost Impacts:
  - *Patient Care*
  - *Ongoing Maintenance*
  - *Ongoing Operations and Staffing*
  - *Reimbursement*

*These are ‘Forever Costs’*
TODAY’S HEALTHCARE PROJECTS ARE INCREASINGLY COMPLEX

- Universal Operating Rooms
- Robotics
- Point of Use / Mobile Devices
- Hybrid Surgical / Interventional Rooms
- Acuity Adaptable Patient Rooms
- Campus-centric Telemedicine
- e-ICU Rooms

- Facility-wide Monitoring & RFID
- Flexible Imaging Suites
- Central UPS Systems
- OR Integration
- Sterilization Automation
- Lab & Pharmacy Automation
- Bariatric Care
Examples of current Integration Points and Technologies:
- Imaging Systems
- Cardiac output monitors
- Defibrillators
- Fetal monitors
- Electrocardiographs
- Infant incubators
- Infusion pumps
- Intelligent medical device hubs
- Interactive infusion pumps
- Physiologic monitors
- Ventilators
- Vital signs monitors

Examples of future Integration Points and Technologies:
- Active RFID
- Patient Health Cards
- Biometric devices (palm vein readers)
- Thermometers
- Patient Scales
- Kiosks
- Alerts to communications systems
- Smart beds
- Lighting and environmental controls
- Vital Sign devices to EMR
- Nurse call systems
- Patient phone systems
- TV/entertainment system
- Refrigerators
IMPACT OF MEDICAL TECHNOLOGY – SYSTEMS & WORKFLOWS

THE EVER-EXPANDING LIST OF ROOMS AND SYSTEMS

INTELLIGENT PATIENT ROOMS

- 2-way video conferencing
  - Family
  - Physician

EMR PAC’s Lab Results

Tracking Systems

TELEPRESENCE

VIRTUAL ENVIRONMENTS

- Virtual Surgery
- 3D Electronic Medical Record
- Molecular Based Surgery
- Patient Therapy

CONTEXT AWARE SURGICAL SUITES
NEED FOR FLEXIBLE FACILITY SOLUTIONS

Preventing facility obsolescence: building a hospital with a future

Technology Trends Impact:

- Flexibility and Adaptability
- Physical Expansion
- Building System Infrastructure
- Information Technology Scalability
IMPACT OF MEDICAL TECHNOLOGY

RESULTS OF EARLY MEDICAL EQUIPMENT INTEGRATION WITH DESIGN

• ALIGNMENT OF TECHNOLOGY WITH TRUE CLINICAL REQUIREMENTS
• ALIGNMENT OF TECHNOLOGY WITH DESIGN CONCEPTS
• SUPPORT OF FLEXIBLE FACILITY DESIGN
• ELIMINATION OF WRONG TECHNOLOGY SELECTIONS
• TRUE BUDGET ESTIMATES EARLIER IN PLANNING
• REDUCTION OF DESIGN REWORK
• MINIMIZATION OF CONSTRUCTION CHANGE ORDERS
• IMPROVED SCHEDULE COMPLIANCE
• OPTIMAL PROCUREMENT AND TECHNOLOGY ADOPTION STRATEGIES
• DEVELOPMENT OF BEST VALUE TECHNOLOGY PACKAGE
### Breakdown of a Typical Medical Equipment Package

<table>
<thead>
<tr>
<th>Equipment Category</th>
<th>% of Equipment Budget</th>
<th>% of Equipment Items</th>
<th>Arch. Significant</th>
<th>IT Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>45%</td>
<td>13%</td>
<td>100%</td>
<td>90%</td>
</tr>
<tr>
<td>Group 2</td>
<td>37%</td>
<td>35%</td>
<td>20%</td>
<td>40%</td>
</tr>
<tr>
<td>Group 3</td>
<td>18%</td>
<td>52%</td>
<td>20%</td>
<td>&lt; 2%</td>
</tr>
</tbody>
</table>

*Note – Group 1 has lowest % of Qty, and highest impact on Design and IT*

*Group 1 = Major Fixed (Imaging, Sterilization, Lights & Booms)*

*Group 2 = Major Movable (Monitoring, Beds, Defibs)*

*Group 3 = Minor Moveable (Shelving, Carts, Waste Recept.)*
IMPACT OF MEDICAL TECHNOLOGY

MANAGING THE IMPACT (TECHNOLOGY TRIANGLE)

Introduction of New Technologies

The Technology Triangle

Budget Impact

Construction & Schedule Impact
IMPACT OF MEDICAL TECHNOLOGY

MANAGING THE IMPACT (TECHNOLOGY TRIANGLE)

- Involve Medical Technology Planning Early in the Design Process
- Develop and Manage ‘Strike Lists’ of High Impact Technologies
- Utilize a MEQ Design Matrix for all Major Equipment
  - Allows the completion of CD prior to actual technology selection
- Establish a Comprehensive Change Management Process
  - Evaluation and Approval of Technology Changes
- Establish a Strategic Technology Advisory Committee (for the duration of the project)
  - Monitor Clinical Requests and Technology Trends
- Early Engagement of Major Technology Vendors (During the Design Phase)
  - Imaging Systems, Sterilization, etc.
- Early Confirmation of Installation and Commissioning Schedules
- Early Confirmation of Training Requirements and Schedules