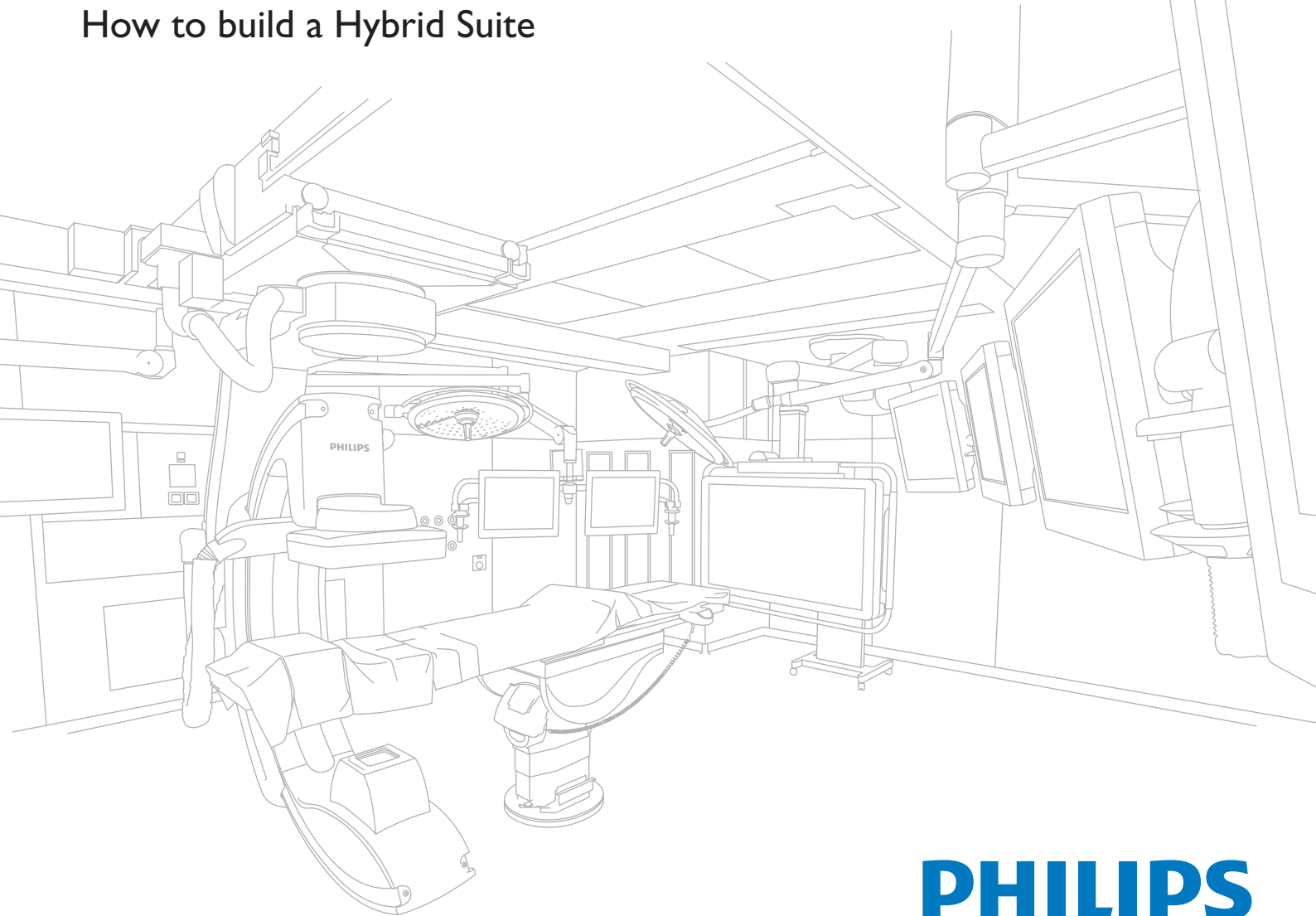


# Making the difference where it really matters

How to build a Hybrid Suite



**PHILIPS**

# Introduction

Together we make the difference in minimally invasive treatment to improve patient outcomes and save lives. With our Live Image Guidance we aim to remove barriers to safer, effective and reproducible treatments, delivering relevant clinical value where it's needed most – at the point of patient treatment.

One of the most important innovations in the treatment environment in the last few years has been Hybrid Suites (ORs). These universal operating rooms offer many clinical and financial advantages, but they are challenging and complex projects.

This book has been written to help inform and guide all of the stakeholders involved in the process of establishing a Hybrid Suite. Based on Philips experience from designing a large number of Hybrid Suites around the globe, it provides an overview of the process, tips, and best practices (over 500 projects by early 2013), that can help ensure successful results. Our comprehensive design and project teams can simplify the entire process from initial idea to realization, including the management of all third-party vendors.

If you are starting such a project, we hope that this book will shed light on the key aspects involved and facilitate a discussion with the stakeholders. As you proceed, we hope you will consider using the expertise of Philips to your advantage. Please contact your local Philips representative if you have any questions or would like further information.

## Making the difference where it really matters

**How to build a Hybrid Suite**





# 5 steps to realizing a Hybrid Suite

## Discover the Hybrid Suite

1

Gather information and develop a common understanding of what a Hybrid Suite means for all stakeholders

## Define the business case

2

Analyze the investments required and expected returns to make a "Go" or "No-Go" decision

## Define the requirements

3

Make a list of the key user and equipment requirements

## Design the room layout

4

Design the layout of the room around the users' needs

## Optimize usage of the Hybrid Suite

5

Prepare and train for the Hybrid Suite to make optimal use of the room

Where  
can we  
find help

How should we organize ourselves

Who  
should be involved

How can I explain to  
my colleagues what  
a Hybrid Suite is

Where can we find  
more information

## Discover the Hybrid Suite

1

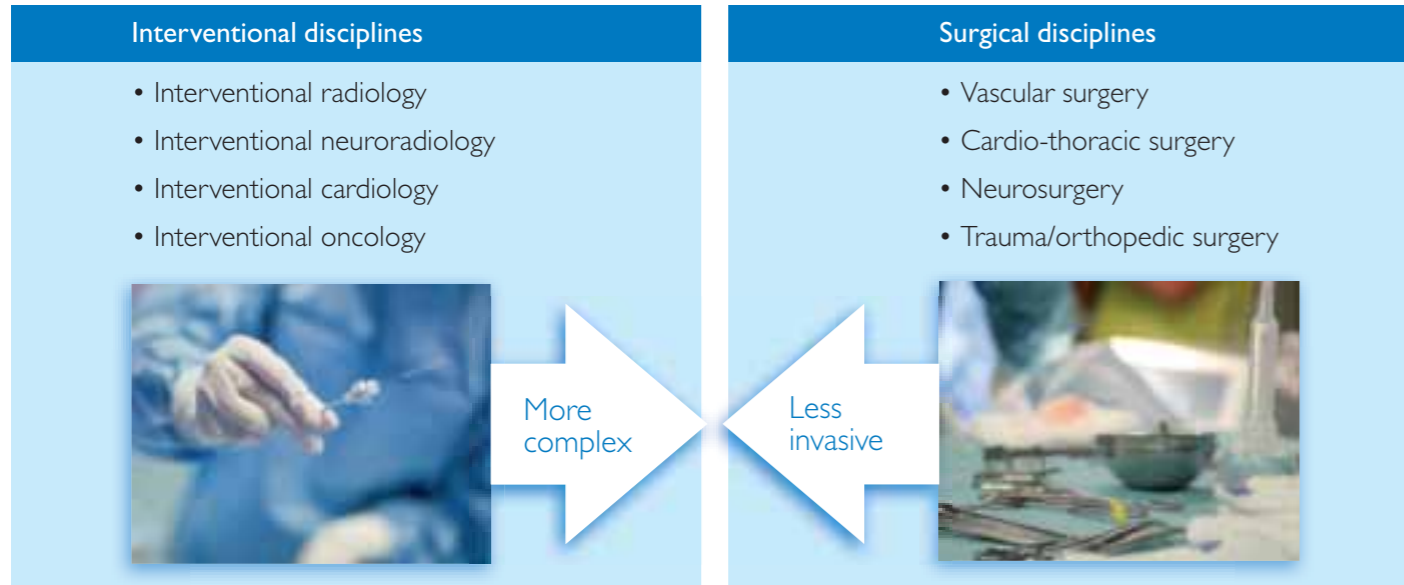
- 1 Create a common understanding of the Hybrid Suite
- 2 Define the clinical use of the Hybrid Suite
- 3 Create a project plan
- 4 Appoint an effective steering team
- 5 Create clear lines of communication and responsibility
- 6 Use this book as a tool to facilitate discussion in the hospital



“I think with the Hybrid Suite you are opening the window to the future. I think there is only very little doubt that in the future there will be less open surgery and more catheter based or remote accessed surgery. We have new borders but they are very far away and we have to discover where they are.”

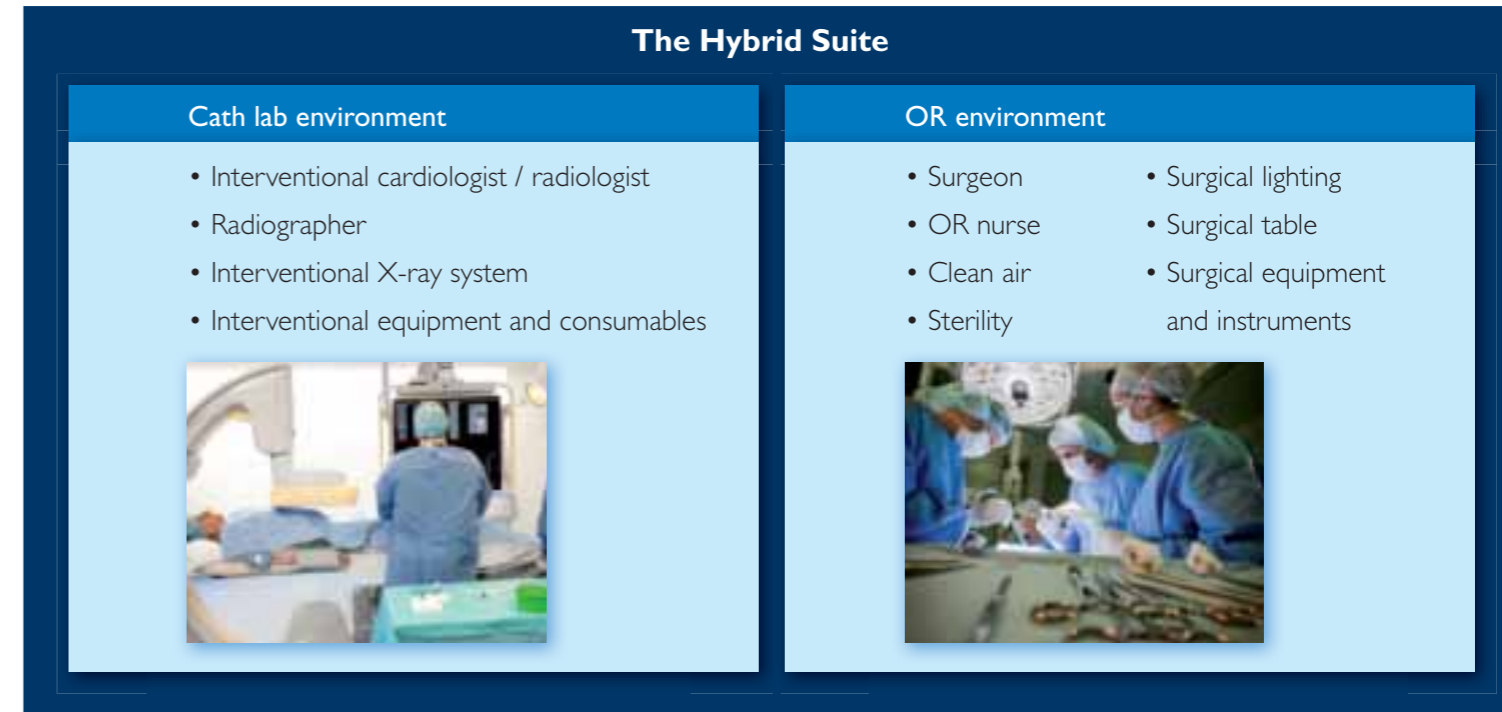
Professor M. Lachat MD, vascular surgeon,  
Zürich University Hospital, Switzerland

# 1 Create a common understanding of the Hybrid Suite



There is a lot of talk about the Hybrid Suite, but what is it exactly? It is a new treatment environment that is the result of clinical trends in the past decades. Interventional medicine and surgery are growing towards each other. Interventionalists are broadening the scope of their procedures to treat increasingly complex diseases, while surgeons are performing less invasive surgical procedures. Endovascular and open surgery are being combined in hybrid procedures.

Interventionalists need to be able to manage the risks associated with more complex procedures, while surgeons need advanced imaging technology to support their less invasive procedures. This creates a need for hybrid suites that can easily adapt to endovascular, minimally invasive, open surgery, and hybrid procedures.



## The Hybrid Suite is born

The cath lab environment, with its high end X-ray system, trained interventional staff, and specialized consumables provides the infrastructure for endovascular treatment. The OR, with its high sterility, trained surgical staff, anesthesia and surgical equipment provides an excellent infrastructure for surgical treatment. When you combine both in a single room, the Hybrid Suite is born.

A Hybrid Suite allows your facility to perform a full range of procedures – from endovascular to hybrid to minimally invasive

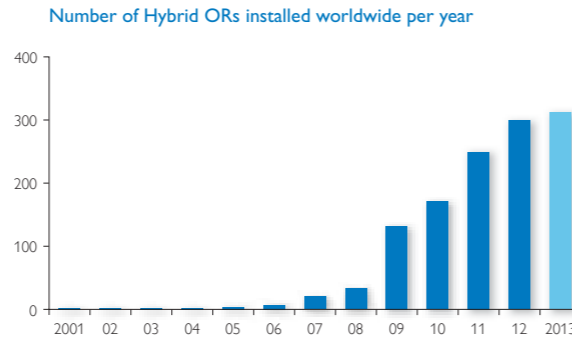
or open surgery – in a single room, virtually without compromise. In the changing healthcare landscape, the Hybrid Suite allows you to explore new procedures in an environment designed for the broadest clinical needs. This helps your facility stay at the forefront of clinical excellence. Medical teams can work smoothly together and quickly adapt the room to different set-ups required for diverse procedures. This allows your hospital to use this room to its fullest extent and enhance patient care in the community.

## Becoming a well-recognized hospital infrastructure

In the past few years, the number of Hybrid Suites has risen dramatically, and it is becoming a well-recognized hospital infrastructure. Within the next five years, it is expected that most hospitals with comprehensive cardiovascular and neurosurgery services will be planning or will have implemented at least one Hybrid Suite.

To justify this investment, a solid business case is needed. Many healthcare facilities do not currently use the full capacity of their operating theater, even though this is their largest revenue and cost center.

Because the Hybrid Suite can be used for a diverse range of procedures, it allows efficient use of people and technical resources. It also has the potential to improve care for patients, by allowing multiple procedures that would otherwise be performed in separate rooms, to be performed in the same room in one treatment session.



### Hybrid Suite, Hybrid OR, or Hybrid cath lab?

It's all in the name. But whether you say "Hybrid Suite," "Hybrid OR," or "Hybrid cath lab," it all comes down to a multi-purpose room. Based on their frame of reference, interventionalists typically talk about a Hybrid cath lab or Hybrid angio lab, and surgeons are more likely to talk about a Hybrid OR. Either way, the idea is the same: a room where you can perform both endovascular and surgical procedures.

The interventionalist might place more emphasis on endovascular procedures rather than surgical procedures, and a surgeon might envisage the opposite. We have chosen the term Hybrid Suite to encompass both visions.



## 2 Define the clinical use of the Hybrid Suite

There are many types of complex minimally invasive and surgical procedures that can benefit from being carried out in a Hybrid Suite. Common surgical specialties include cardiac, vascular, neurological, and many more. Because each specialty has its own workflow, set of equipment, and team, it is important to first define the case mix that makes sense for your facility. Hybrid Suites that focus on cardiac or vascular procedures or both are seen most frequently, while other applicational areas, such as neuro and oncology, etc. are rapidly developing.

The following pages describe the main applicational areas that can be considered for the Hybrid Suite.

“The choice of a Hybrid Suite was intended to combine the imaging capabilities of a cath lab with the facilities of an operating room, in order to provide an optimal environment for both the cardiologist and the cardiac surgeon.”

Professor V. Falk MD, cardiac surgeon,  
Zürich University Hospital, Switzerland



### Typical disciplines and procedures in the Hybrid Suite

#### Vascular procedures

- EVAR (TEVAR, FEVAR and F-TEVAR)
- Below the knee, carotid stenting, visceral, and other peripheral vascular

#### Cardiac procedures

- TAVR
- Transcatheter Mitral Valve
- Other structural heart procedures
- PCI procedures
- Hybrid EP procedures
- Combined procedures

#### Neuro and spine procedures

- Minimally invasive surgical spinal fixation
- Kyphoplasty/vertebroplasty
- 3D navigated spinal instrumentation
- AVM treatment, stroke treatments, aneurysm clipping/coiling

#### Other applications

- Trauma surgery
- Thoracic surgery
- Orthopedic surgery
- Oncology procedures
- Urology procedures

#### New concepts

- Robotic Hybrid Suite
- MR OR
- CT OR

Mature

Developing

Pioneering





“The location [for EVAR] should have access to the full range of high quality imaging equipment, theater specification room and full anaesthetic facilities and support.”

Joint Medicines and Healthcare Products Regulatory Agency Working Group

## Vascular surgery and interventions

### **EVAR is key driver for continuing growth**

One of the key drivers for the growth of Hybrid Suites in vascular surgery and interventional radiology is the growth of Endovascular Aneurysm Repair (EVAR) procedures. Endovascular techniques are being increasingly used.

Most vascular surgeons are now trained to perform these interventional procedures. As technology evolves, EVAR procedures are also being applied to treat more complex diseases. Fenestrated grafts, hybrid thoracic procedures, and others are being performed.

### **Key challenges**

Critical aspects of procedures include the accurate placement of devices. Physicians require 3D imaging guidance to support the placement of devices and live imaging to check results in real-time. Working in an efficient and sterile working environment is also very important.

### **Advantages for complex vascular procedures**

The superiority of EVAR compared to surgical treatment of Aortic Abdominal Aneurysms (AAA) has been established. Joint Medicines and Healthcare products Regulatory Agency (MHRA) Working Group, UK, to produce guidance on delivering an Endovascular Aneurysm Repair (EVAR) Service, December 2010. Less invasive procedures result in better

clinical outcomes and in a better patient experience. They reduce the patient stay and use of expensive hospital services, such as the ICU, which also reduces overall healthcare costs.

### **Clinical guidelines for EVAR are moving to the Hybrid Suite**

The most recent publication of the Joint Medicines and Healthcare products Regulatory Agency (MHRA) Working Group in the UK, to produce guidance on delivering an Endovascular Aneurysm Repair service recommended, “the location [for EVAR] should have access to the full range of high quality imaging equipment, theater specification room and full anaesthetic facilities and support...” These clinical guidelines support the usage of the Hybrid Suite for performing EVAR procedures.

## Cardiac surgery and interventional cardiology

### **TAVR is key driver for continuing growth**

Transcatheter aortic valve replacement (TAVR) procedures are leading the growth in Hybrid Suites for cardiac surgery and interventional cardiology. TAVR procedures have risen dramatically over the past five years and are being performed in more and more facilities worldwide. The first devices were accepted for usage in the US in 2011, and the procedure is gaining acceptance in many other countries.

As this technology advances, new complex procedures are being performed, including mitral valve repair, LAA closure, septal defect closure, combined procedures (e.g. PCI/CABG), hybrid EP procedures, pediatric cardiac procedures, and others.

### **Key challenges**

Critical aspects of procedures include the accurate placement of devices. Physicians require 3D imaging guidance to support the placement of devices and live imaging to check results in real-time. Working in an efficient and sterile working environment is also very important.

### **Advantages for complex cardiac procedures**

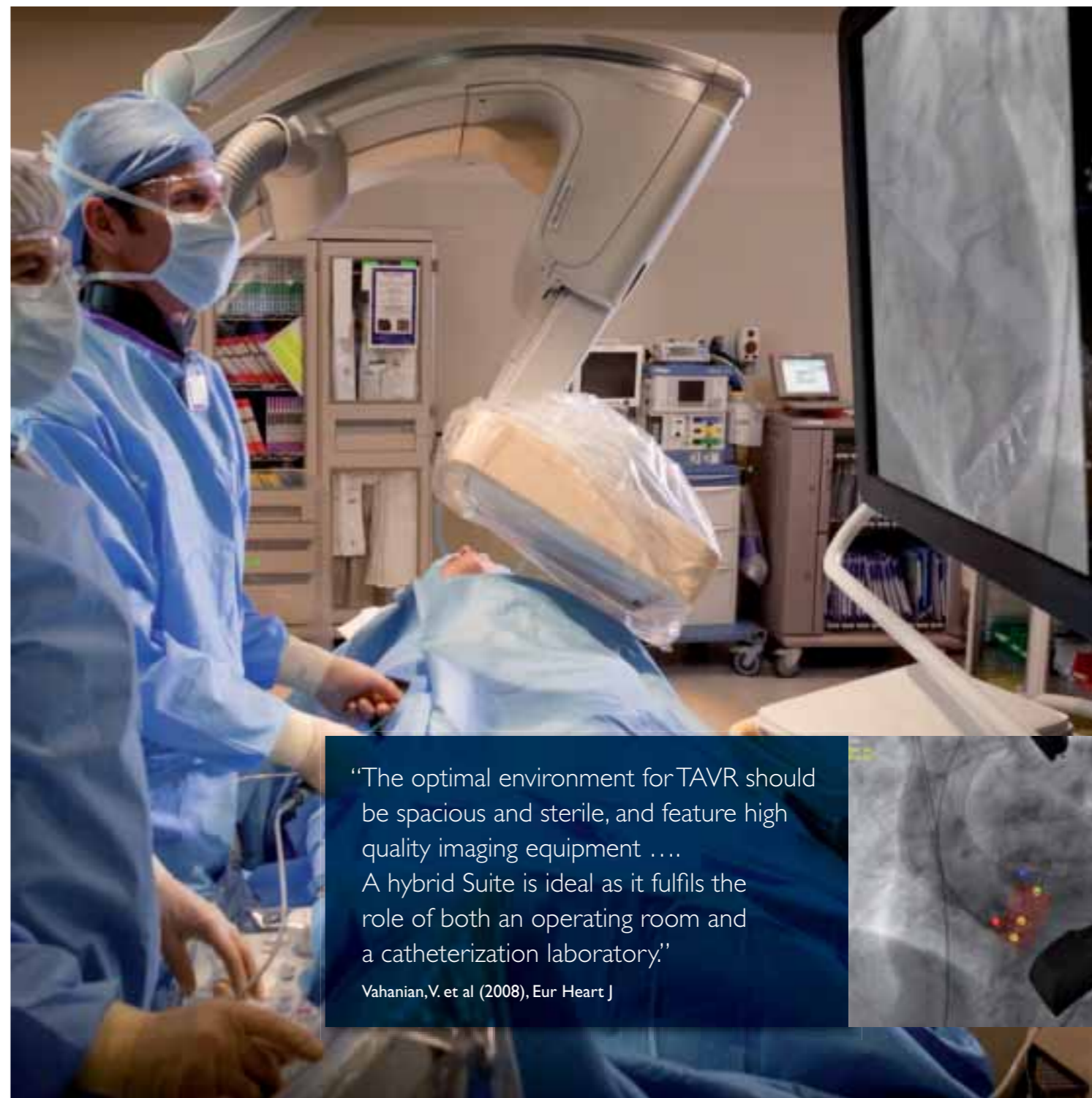
TAVR has been proven to lead to better clinical outcomes for specific patient groups as documented, for instance, in the PARTNER trials. (Leon, M.B. et al (2010), N Engl J

Med, 363: 1597-1607.) The PARTNER trials established the effectiveness of TAVR in reducing patient mortality and this led to the fast growth of this procedure.

### **Clinical guidelines for TAVR are moving to the Hybrid Suite**

Leading clinical bodies in the medical world, including EACTS, ESC, and EAPCI have reached a consensus that a Hybrid Suite is the optimal treatment infrastructure for TAVR procedures. According to a position statement from the ESC, EACTS, and EAPCI, published in the European Heart Journals, "...The optimal environment for TAVR should be spacious and sterile, and feature high quality imaging equipment... A Hybrid Suite is ideal as it fulfils the role of both an operating room and a catheterization laboratory." (Vahanian, V. et al (2008), Eur Heart J, 19: 1463-1470.)

Comparable statements have been made by the American College of Cardiology (ACC) and the Society of Thoracic Surgeons (STS).



"The optimal environment for TAVR should be spacious and sterile, and feature high quality imaging equipment ... A hybrid Suite is ideal as it fulfils the role of both an operating room and a catheterization laboratory."

Vahanian, V. et al (2008), Eur Heart J

## Neuro and spine surgery

### Three dimensional peri-operative imaging is key driver

Several procedures are driving the move towards performing neuro and spine procedures in the Hybrid Suite. Three dimensional peri-operative imaging is the key driver for performing neuro and spine surgery in the Hybrid Suite. Hybrid neuro procedures that combine open surgery with an angiography to check the results are being performed more often. Minimally invasive spine surgery is being performed using 2D and 3D imaging, and these procedures are growing as well. Tracking and navigation systems are typically used to support both neuro and spine surgery.

### Key challenges

Critical aspects of procedures include the accurate placement of devices. Physicians require 3D imaging guidance to support the placement of devices and live imaging to check results in real-time. Working in an efficient and sterile working environment is also very important.

### Advantages for complex neuro and spine procedures

Using live fluoroscopy imaging to obtain immediate feedback on the success of the procedure has the potential to reduce follow-up procedures and complications. If an unsatisfactory result is seen, clinicians can immediately take corrective action while the patient is still in the room.



“3D acquisition of data really changed the work for our neurosurgeons because they are people that work in a 3D world”

Prof. Dr. med. D.A. Rufenacht,  
Klinik Hirslanden, Zürich, Switzerland

# New horizons for the Hybrid Suite

## New applications

### New hybrid procedures benefit from being performed in the Hybrid Suite

A number of other types of procedures are benefiting from the combination of a sterile surgical environment with high quality intra-operative X-ray imaging.

#### Thoracic surgery

During thoracic surgery, it can be useful to perform X-ray guided biopsies to obtain critical information about malignancies.

#### Orthopedic surgery

2D and 3D imaging of joints and fractures can support orthopedic surgeons in placing devices with more precision.

#### Oncology interventions

Surgical and interventional techniques are being combined to perform oncology interventions, such as renal and prostate procedures with greater precision.

#### Trauma surgery

Combined surgical and endovascular treatments are being used for patients with complex multi-trauma. CT-like imaging is used to detect slow bleeding and to verify treatment. This extends the options for surgical and/or endovascular repair and optimizes workflow between the emergency department, OR, and radiology.



## New concepts

### Robotic Hybrid Suite

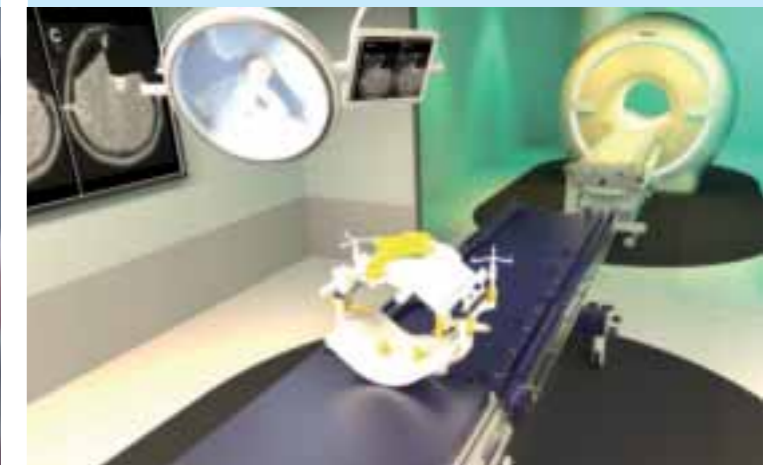
Endovascular and minimally invasive robotic technology offers the future promise of allowing doctors to perform procedures from outside of the room. This has the potential to reduce staff X-ray dose, while increasing speed, efficiency, and precision. There are several different robotic concepts being applied in the Hybrid Suite, from companies such as Hansen, Corindus, and DaVinci. They are being used for robotic vascular surgery, cardiac surgery, neurosurgery, and other fields such as urology.

### MR OR

An MR OR combines an OR with an integrated MR system to enable MR guided interventions and neurosurgical procedures. Electrophysiology and pediatrics are other possible applications.

### CT OR

A CT OR combines OR with an integrated CT system to enable CT guided interventions and surgery, for example to perform neurosurgical applications.





## 3 Create a project plan

A project plan needs to be created before starting a Hybrid Suite project to establish the entire timeline for the project. As more information becomes available, the plan can be further defined and finalized.

### A Hybrid Suite project usually has five stages:

1

#### Discover the Hybrid Suite

A hospital becomes interested in the concept of a Hybrid Suite and identifies the procedure mix that might be suitable for their Hybrid Suite. An active search for knowledge and experiences from other facilities begins. Stakeholders are identified and develop a common understanding about what a Hybrid Suite is. This phase usually takes a long time, from six months to several years and starts with the first person who has an idea and a vision. This phase ends when the following milestones have been reached:

- Steering group formed
- Project manager appointed
- First timeline and project plan created

2

#### Define the business case

Hospital management investigates the rationale for establishing the Hybrid Suite. The amount of investment required is calculated and is compared against the expected returns to evaluate the feasibility of the project. This phase can take several months for analysis and discussion, and ends when the following milestones have been reached:

- Procedure mix defined
- Business case approved
- Financing secured
- Go / No-go decision

3

#### Define the requirements

All stakeholders provide their requirements for the Hybrid Suite. Based on the requirements, key decisions about the equipment required should be made. This phase typically takes three to six months, depending on when all of the stakeholders can meet together and discuss their requirements.

4

#### Design the room layout

The layout of the room is designed around the needs of the users to ensure smooth procedures. This phase can take a few months, mainly depending on when all of the stakeholders can meet and discuss workflow and room design. The process can be accelerated through the use of 3D simulation tools. This phase ends when the following milestones have been reached:

- Room is designed according to stakeholder requirements
- Equipment has been ordered from suppliers

5

#### Organize for the Hybrid Suite

To make sure that the Hybrid Suite can be used to its full extent, the organization should prepare and train for the Hybrid Suite and set-up a process for acquiring patients and referrals to the new facility. The actual installation and certification process will take several months, depending on how much construction effort is needed. This phase ends when the following milestones have been reached:

- Equipment is installed and room is certified
- Staff are trained
- Protocols and processes are established
- Hybrid Suite is installed and certified
- Room is ready for the first patient

## 4 Appoint an effective steering team

### Involvement of all stakeholders as early as possible

Establishing a Hybrid Suite in a hospital usually involves a large group of stakeholders from diverse disciplines. It is important to involve all stakeholders as early as possible in the process to ensure that all clinical, operational, financial, and safety considerations are taken into account. This helps facilities avoid costly errors and achieve a successful result.

Stakeholders generally fall into four different groups.

#### Clinical disciplines

They provide input on the clinical guidelines that must be met to perform their respective applications.

#### Other clinical

They provide input on the placement of equipment and workflow for different applications.

#### Organization and investment specialists

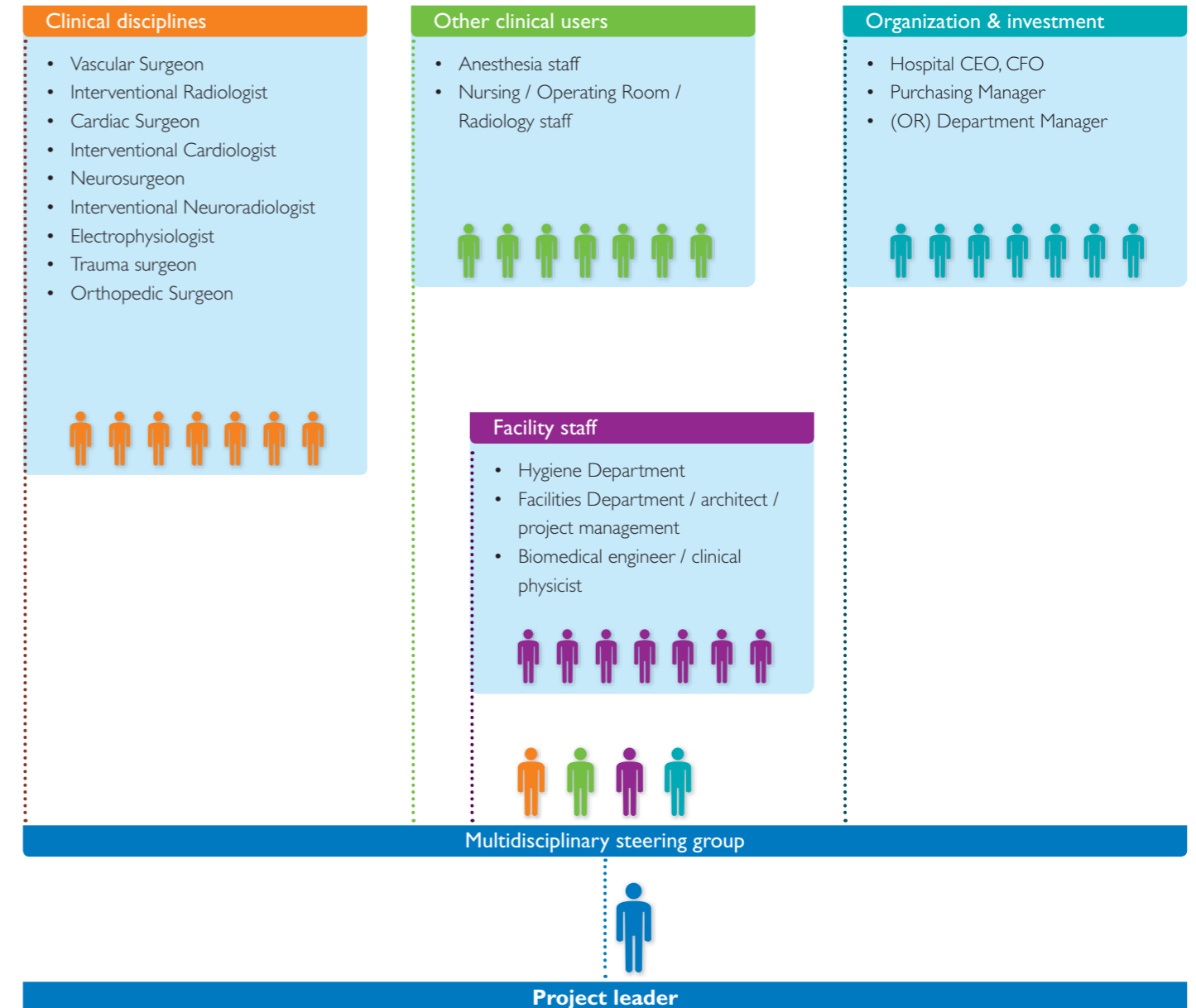
This group usually leads the investment decision and includes hospital managers and the purchasing department.

#### Facility staff

This group is key in the realization phase and includes people from the hygiene, biomedical, medical physics, and other building specialists.

To ensure a smooth process for establishing the Hybrid Suite, it is very important to create clear lines of communication and responsibility. On the hospital side, a multidisciplinary steering group should be set up that represents all of the stakeholders. This group can then make all of the decisions related to the Hybrid Suite. The steering group should appoint a single project leader in the hospital, to manage the entire process and coordinate the communication with the internal and external stakeholders.

## Overview of hospital stakeholders in the Hybrid Suite



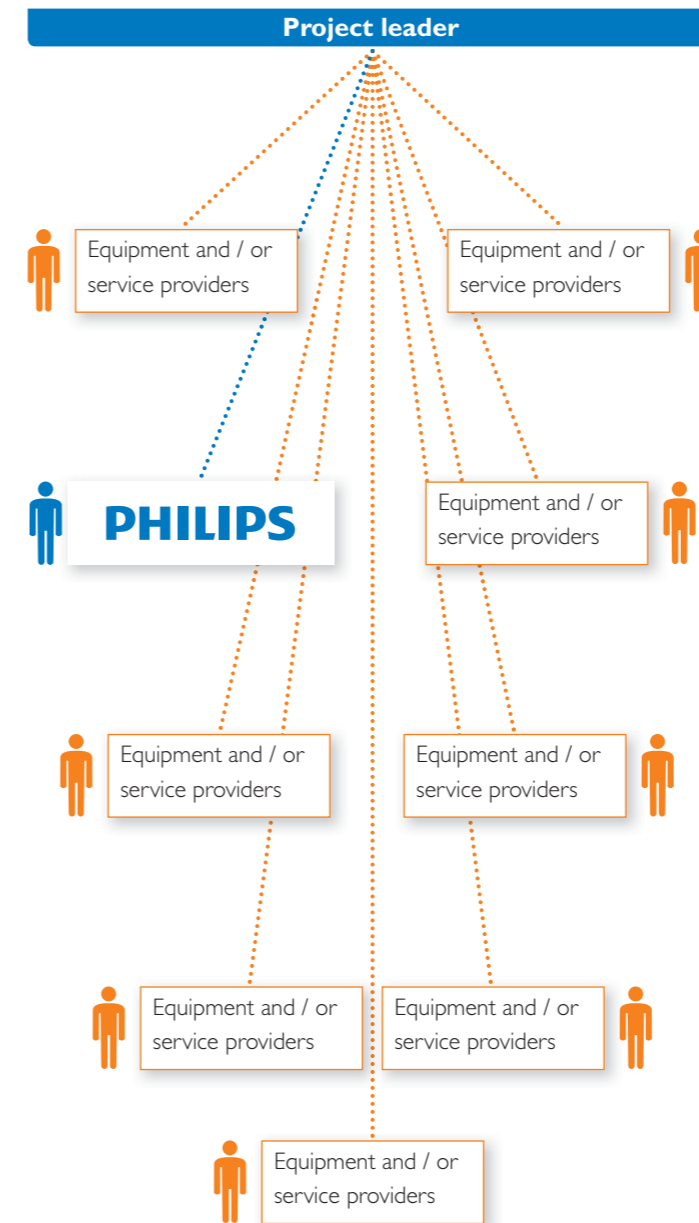
# 5 Create clear lines of communication and responsibility

On the external side, there can be 20 or more equipment and service providers involved. To make things simpler and more manageable, it can be useful to work with a turnkey provider.

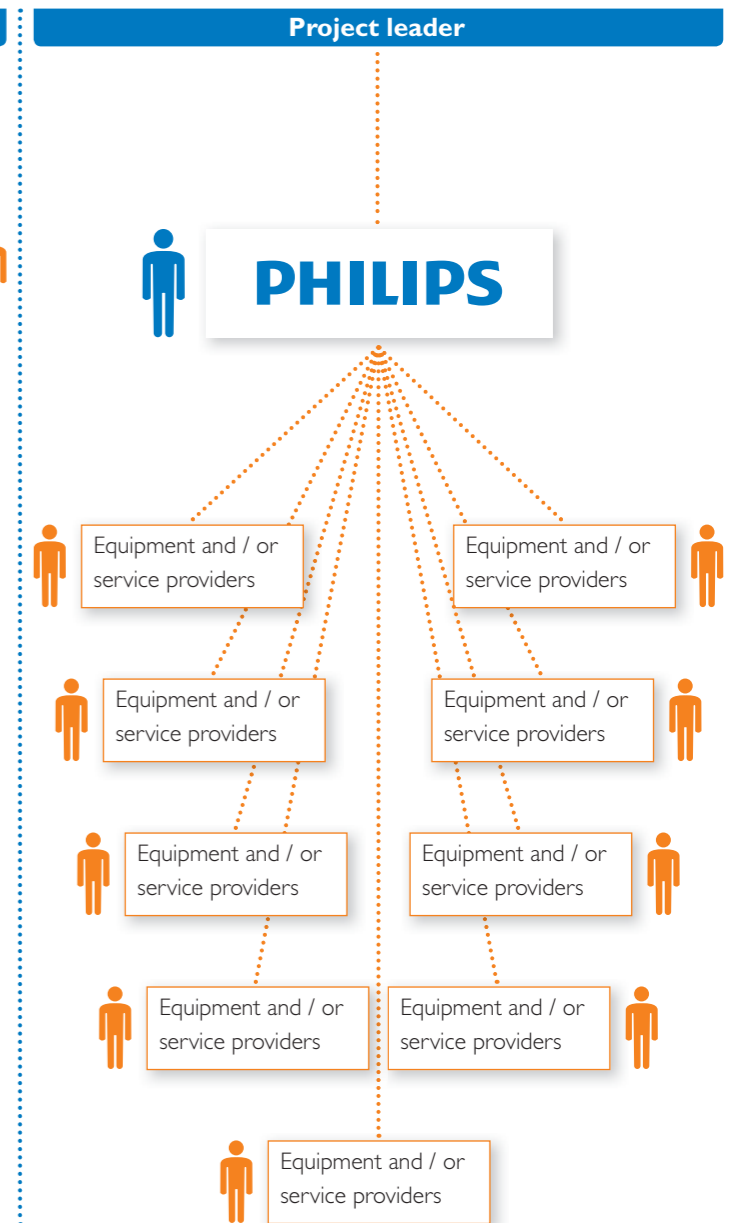
The hospital project leader then works with one single external supplier who in turn manages all of the other equipment and service suppliers. This saves a great deal of time and can result in cost savings as well because many misunderstandings are avoided.



## Regular supplier solution



## Turn-key solution



A photograph of a man in a white lab coat over blue scrubs, looking intently at another man whose back is to the camera. The man in the lab coat has a focused expression. The background is a blurred clinical setting.

## We can help you discover the Hybrid Suite

While you are investigating how to realize a Hybrid Suite, Philips can provide information and share experiences from different Hybrid Suite projects to help give your stakeholders a realistic understanding of a Hybrid Suite. Our project managers have carried out over 500 projects across the world to date (early 2013), and can give you a clear overview of what such a project entails. All based on our collaborative relationships with our alliance partners, including MAQUET, Steris, Skytron, and other third-party suppliers.

We can also support your facility's internal process by facilitating the discussion between different stakeholders.

What is the return  
on a Hybrid Suite

**HOW**  
can we justify the investment  
**What**  
will it cost

What caseload and procedure  
mix should we choose

## Define the business case

2

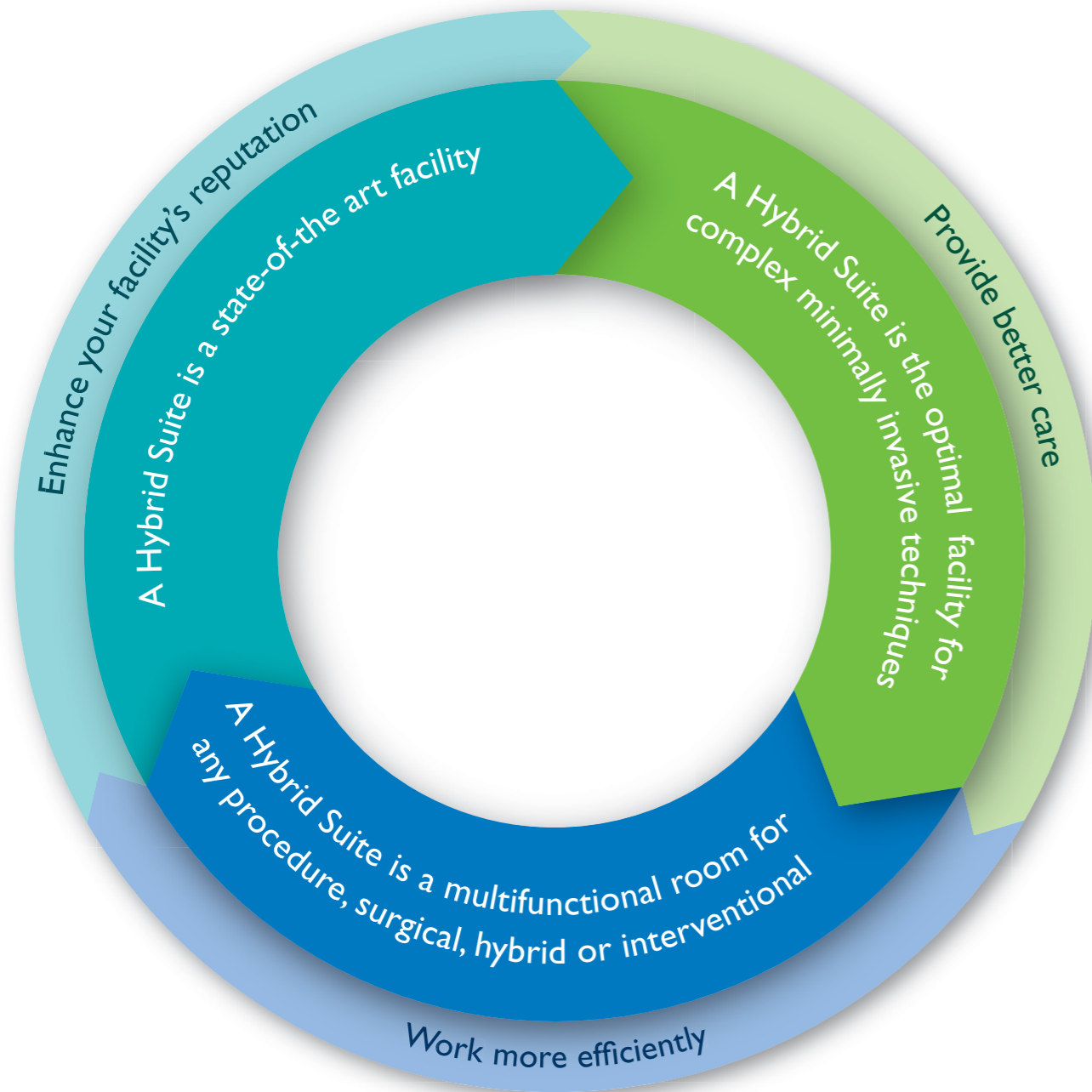
- 1 Develop a rationale based on your hospital's strategy
- 2 Make sure you have the right caseload to justify the Hybrid Suite
- 3 Create a financial overview of investments and running costs
- 4 Assess the Return on Investment





“The fact that the use of a Hybrid Suite is recommended by the professional societies makes it almost mandatory. In particular, the growing number of transcatheter valve implantations really needs a Hybrid Suite environment for these patients. This makes it relatively easy to present a business case.”

Professor V. Falk MD, cardiac surgeon,  
Zürich University Hospital, Switzerland



# 1 Develop a rationale based on your hospital's strategy

There are three basic reasons to invest in a Hybrid OR: to provide better care, work more efficiently, and enhance your facility's reputation.

Taking all three reasons into consideration when preparing the business case for your Hybrid Suite ensures that you will leverage both the tangible and non-tangible factors involved. For instance, the advantages of EVAR and TAVR procedures for patients have to be weighed against the investment required and potential caseload to earn a return on the investment. Being able to perform a range of different procedures in the same room has to be accompanied by an investment in training staff on how to work in new multi-disciplinary teams. Besides tangible returns like revenues received for procedures, the role that a Hybrid Suite can play in attracting new staff and patients should also be added to the balance.

### Provide better care

The Hybrid Suite is the appropriate environment for performing EVAR, TAVR and other hybrid procedures. You can switch from an open to a minimally invasive procedure and vice versa without moving the patient from the interventional suite to the OR for emergencies. This saves time and can reduce risk for the patient.

### Work more efficiently

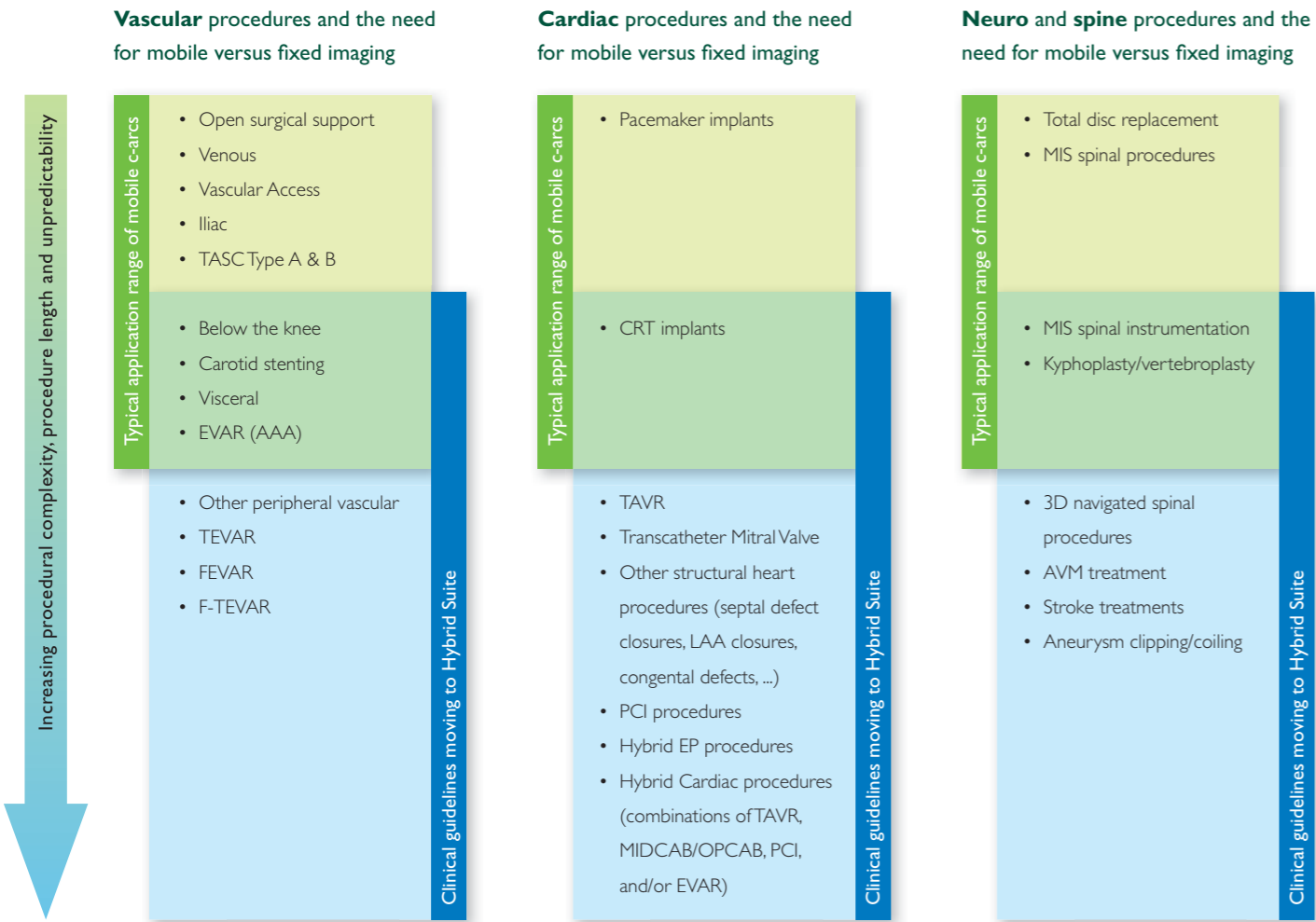
A Hybrid Suite is the optimal facility for performing complex, minimally invasive, surgical, and hybrid procedures. Minimally invasive techniques have been shown to lead to better patient outcomes and lower costs, due mainly to shorter hospital stays. By performing new procedures, such as EVAR and TAVR, your facility can expand the care it offers to patients and increase your case mix.

Because you can perform any kind of procedure, you can maximize the utilization of the room. You can plan any kind of procedure for the Hybrid Suite, which makes it future proof. You can also adapt the room to future changes in your procedure mix.

### Enhance your facility's reputation

A Hybrid Suite is a state-of-the-art facility that represents best practice for a number of complex procedures. That means that a Hybrid Suite can enhance the reputation of your facility in the community as a state-of-the-art provider of care. This can differentiate your facility from other providers. Being known as a state-of-the-art facility can help you attract and retain scarce medical staff. It can also enhance your reputation among medical professionals to help you attract more patients and referrals.

## 2 Make sure you have the right caseload to justify the Hybrid Suite



A mobile X-ray system provides adequate imaging support for simple vascular procedures, ranging from Iliac to EVAR (AAA) interventions. At the same time, clinical guidelines for TAVR, TEVAR, FEVAR, and selected endovascular procedures prefer these to be performed in a Hybrid Suite. It is important to look at your caseload and decide if your facility performs enough complex procedures to justify the expense of a high end angiography X-ray system or if a mobile X-ray system is sufficient for your purposes.

The diagrams shown on this spread indicates the typical range of applications for different clinical areas that can be performed with a mobile X-ray system. It also indicates areas where clinical guidelines are shifting towards the Hybrid Suite with a fixed high end X-ray system.

Advantages of a high end X-ray system are superb image quality, the availability of (3D) imaging tools, and a larger field of view. For your hospital's imaging infrastructure, you should have an adequate mix between fixed X-ray systems for complex procedures and mobile systems as back-ups and stand-ins.



Mobile X-ray



Mobile X-ray with flat detector



Fixed X-ray

### 3 Create a financial overview of investments

Investments in a Hybrid Suite vary widely depending on the types of procedures you perform and technologies required. As a general rule of thumb you can plan to invest between 2 to 3 million Euros to establish an operational Hybrid Suite.

The table shows the average range of costs for the most significant items involved.

There are a number of factors that determine whether these items come out at the low end or high end of the scale. These are summarized in the chart.



|                                      | Determining factors   | Average costs  |
|--------------------------------------|---|--|
| <b>Imaging equipment</b>             | <ul style="list-style-type: none"> <li>• What type of X-ray imaging system is required? (monoplane, biplane, different configurations)</li> <li>• What other imaging modalities are required? (ultrasound, etc.)</li> </ul>   | <ul style="list-style-type: none"> <li>• Between half a million and two million Euros</li> </ul> |
| <b>Room equipment</b>                | <ul style="list-style-type: none"> <li>• Is the equipment already available or can it be shared with other rooms?</li> <li>• Is costly, application specific equipment needed? (For instance, a surgical microscope for neurosurgery, cardiopulmonary bypass equipment for cardiac surgery etc.)</li> </ul> | <ul style="list-style-type: none"> <li>• Between 200,000 and 1 million Euros</li> </ul>          |
| <b>Room utilities and facilities</b> | <ul style="list-style-type: none"> <li>• Is the room a new build or remodel of an existing room? For remodeled rooms, utilities and facilities can often be reused.</li> <li>• What are the air flow requirements?</li> <li>• Is a laminar airflow system needed?</li> </ul>                                | <ul style="list-style-type: none"> <li>• Between 200,000 and 500,000 Euros</li> </ul>            |
| <b>Construction costs</b>            | <ul style="list-style-type: none"> <li>• Is the room a new build or remodel of an existing room?</li> </ul>   | <ul style="list-style-type: none"> <li>• Between 200,000 and 1 million Euros</li> </ul>          |
| <b>Services</b>                      | <ul style="list-style-type: none"> <li>• How much support does your organization need in the design, project management, and training process?</li> </ul>   | <ul style="list-style-type: none"> <li>• Between 100,000 and 300,000 Euros</li> </ul>            |

## 4 Assess the Return on Investment

| Costs         |  |
|---------------|--|
| Investment    | <ul style="list-style-type: none"> <li>• Imaging</li> <li>• Room equipment</li> <li>• Room utilities and facilities</li> <li>• Construction</li> <li>• Services</li> </ul> |
| Running costs | <ul style="list-style-type: none"> <li>• Staffing</li> <li>• Consumables &amp; devices</li> <li>• Infrastructure costs</li> <li>• Service costs</li> </ul>                 |

| Revenue             |   |  |
|---------------------|---|--|
| Provide better care | <ul style="list-style-type: none"> <li>• Reimbursement caseload and expanded service</li> <li>• Shift from open to minimal invasive surgery</li> </ul>    | <ul style="list-style-type: none"> <li>- Number of new procedures x reimbursement</li> <li>- Reduced costs hospitalization</li> <li>- Reduced anesthesia expenses</li> <li>- Reduced ICU stay</li> <li>- Improved quality of life</li> </ul> |
| Efficiency          | <ul style="list-style-type: none"> <li>• Increased capacity and efficiency for advanced procedures</li> </ul>   | <ul style="list-style-type: none"> <li>- Number of additional procedures x reimbursement</li> </ul>  |
| Reputation          | <ul style="list-style-type: none"> <li>• Value for attracting new staff/retaining staff</li> <li>• Value for attracting new patients/referrals</li> </ul> |  |

When you are assessing the feasibility of investing in a Hybrid Suite, it is important to create a financial overview of both the costs that will be expended and the revenues that will be generated. Your facility can use this overview to calculate the Return on Investment for the Hybrid Suite. It can also give you an overview of the costs per procedure, which can be useful for decision making.

### Costs

The costs of the initial investment can be written off over the lifetime of the facility. The operational costs for staff and consumables recur each year, and can be calculated separately. However, it can be more useful to calculate all of the costs that are expended for a type of procedure.

### Revenues

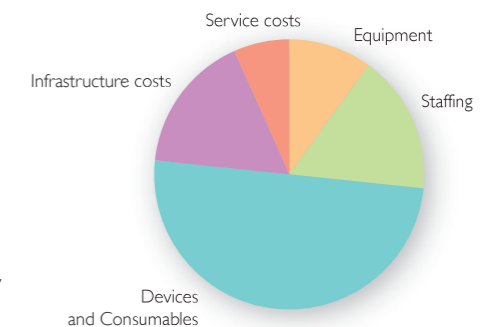
The revenue side is of course driven by the additional service the hospital provides. This can be calculated in financial terms by multiplying the number of procedures by their reimbursement. A shift from open surgical to minimally invasive treatment delivers other financial returns as well. Patients treated with minimally invasive techniques (TAVR, EVAR) spend less time in the hospital and require a lower level of care in terms of ICU stay and anesthesia support. Improving a patient's quality of life after the procedure can also be factored in.

Another aspect to consider is that a multifunctional room can improve efficiency. This can be calculated by the number of additional cases that can be performed by your facility. Finally, the Hybrid Suite represents a certain value for the reputation of your facility, although it is more difficult to make this tangible and measurable.

### Return on Investment

Although the initial investment in a Hybrid Suite might be significant, in the end, the expenditure on devices, consumables and staffing for each procedure is usually much higher than the initial capital costs. Therefore, to make the business case financially feasible, it is very important to create a Hybrid Suite infrastructure that supports a broad variety of different procedures. That allows the room to be used to its maximum capacity.

### Average costs for a Hybrid Suite





## We can help you define the business case

Philips has designed a large number of Hybrid Suites around the world (around 500 by the beginning of 2013). We have helped leading healthcare facilities calculate caseloads, room utilization, and other operational factors to make well founded investment decisions that support their strategic goals. Our financial professionals can help you efficiently gather the information you need to make the best decisions for your future. They can also compare your scenario to similar projects that have been done in your region to help you further judge the feasibility of your plan.

How can we align  
with all stakeholders  
and requirements

Where do we put the Hybrid Suite

What  
are our imaging requirements

Angio table

or OR table

What level of  
hygiene is needed

## Define the requirements

3

- 1 Create a single document of user requirements
- 2 Choose the location
- 3 Define the workflow and space requirements
- 4 Define hygienic requirements
- 5 Define your equipment requirements
- 6 Define your imaging requirements
- 7 Choose the X-ray imaging system
- 8 Determine the type of table
- 9 Define required video solutions



“In our case we were fortunate enough to be able to create an entirely new room for the Hybrid Suite. This room has an area of 70 m<sup>2</sup>. Together with the technical room, washroom and control room the whole Suite has an area of 110 m<sup>2</sup>. ”

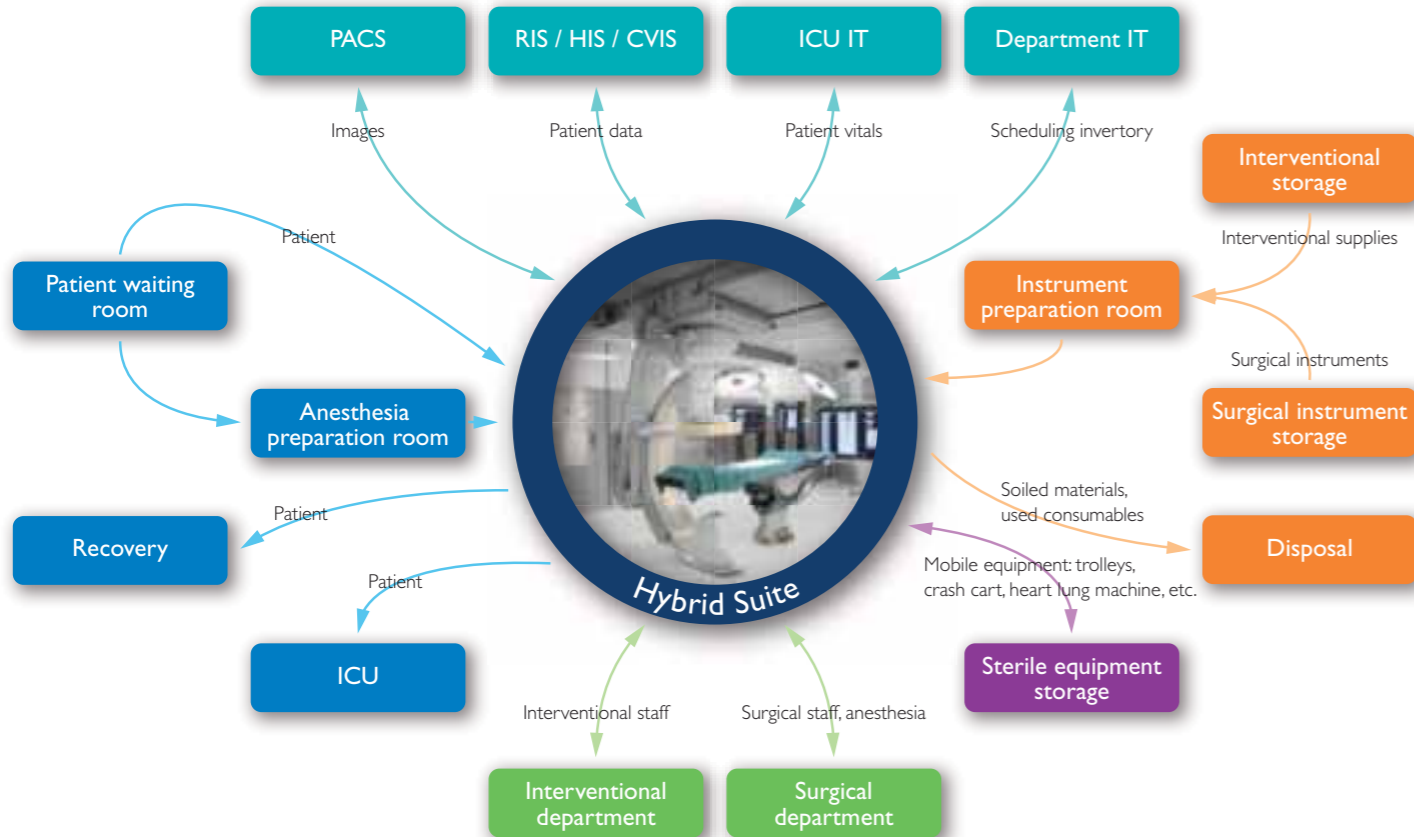
Dr. H. Schröfel, senior cardiac surgeon,  
Karlsruhe Heart Surgery Clinic, Germany



# 1 Create a single document of user requirements

Different people, goods, and information flow in and out of the Hybrid Suite. By mapping these flows, you can determine the critical requirements for this room.

The diagram below shows some examples of these different flows.



## Requirement specification for a Hybrid Suite

Each stakeholder should provide a list of what they need to carry out the procedures that have been defined for the Hybrid Suite. The following items can be included in the scope of the document.

### Project planning

There are many parties involved and the project plan should outline how and by whom the entire project will be managed to ensure that the project is completed on time and on budget. The project timeline and delivery dates should be specified, as well as the acceptance criteria and documentation required for each step of the process.

### Equipment

All general equipment should be agreed upon by the project team and specified through appropriate professionals within the healthcare facility. In addition, all dedicated equipment for particular surgical, interventional and hybrid procedures should be specified as well.

### Room planning

Based on the procedures being carried out, the team should define their physical requirements for the room, including the functional areas, amount of floor space required, sterility requirements and other structural components. Using a software program to map out workflows for different kinds of procedures can assist the

team in organizing the room efficiently to accommodate all personnel and equipment.

### Installation

The requirement document should also look at the IT systems and other hospital systems that will need to be integrated in the new Hybrid Suite. This can include hospital information systems, electronic patient records, inventory systems and billing systems. Setting requirements for how the equipment within the room works together is also a key issue.

### Preparation for procedures

A list of requirements for all of the regulations that must be met to perform the defined case mix in the Hybrid Suite should be drawn up. This will prevent having to turn patients away because a certain requirement has not been met. The project team should also define a list of training courses to prepare the personnel working in the Hybrid Suite for their new roles. This can include training on new technologies and on multidisciplinary teamwork.

### Maintenance and service

The project team should define their requirements for maintenance and service. The required performance levels should be considered for each type of equipment.

### Financing

The project team should also define their financing requirements depending on the resources available to them.

## 2 Choose the location

Deciding on the location of the Hybrid Suite is important. Consider what other areas you will need to access, such as CT/MR scanners, intensive care, emergency rooms, etc. Support facilities such as the blood bank, pharmacy, clinical laboratory, etc. should also be accessible even after normal working hours.

There are usually two obvious choices for where to place the Hybrid Suite: in the radiology or cardiology department or in the interventional or OR facilities. Each location has its own pros and cons as shown in the overview.



### OR facilities

- + Sterile conditions are available
- + Surgical team is available
- + Surgical infrastructure (equipment, anesthesia, lighting) is available, also for emergency conversions
- + Patients flow in and out of ICU and/or recovery
- Interventional team needs to move to surgical department
- Interventional infrastructure needs to be created or supplies need to be moved



### Interventional facilities

- Sterile conditions need to be created
- Surgical team needs to move to another department
- Surgical infrastructure needs to be created or the patient needs to be moved to the surgical department if there is an emergency
- Patients need to be transported to ICU
- + Interventional team is available
- + Interventional infrastructure (equipment, supplies) is available



“The Hybrid Suite combines the imaging capabilities of a cath lab with the facilities of an operating room.”

Professor V. Falk MD, cardiac surgeon,  
Zürich University Hospital, Switzerland

### 3 Define the workflow and space requirements

For the total hybrid suite environment, an area of at least 120 square meters is needed. Within that overall area, there are several separate sections within the Hybrid Suite:

- **Treatment area**

A Hybrid Suite should be larger than a standard operating room and usually the larger the better when it comes to planning. Staff calculations have shown that from 8 to up to 20 people in extreme cases are needed in the team for hybrid procedures, including surgeons, interventionalists, anesthesiologists, nurses, technicians, perfusionists, experts from device companies, etc. To accommodate all of these people and the ancillary areas in a Hybrid Suite, at least 50 square meters of space is needed but over 60 is recommended. Depending on the exact workflow and equipment included, an area of 70 square meters provides ample space for the treatment area of the Hybrid Suite.

- **Control room**

This is used for viewing and remotely manipulating equipment. It should be large enough to accommodate all required staff and equipment, as well as visitors or observers.

- **Technical room**

This is used to store X-ray system and lab-related power supplies and generators, and should be within 30 meters of the Hybrid Suite.

- **Prep room**

This is used to prepare the patient for procedures and for staff to set up their trolleys of instruments, and should be located adjacent to the Hybrid Suite.

- **Scrub room**

The scrub facility is located immediately outside the room and can be shared among several ORs to save space. It can also be used to house all supplies for procedures.

- **Storage room**

Storage is an important consideration as it needs to contain both surgical supplies and interventional supplies.

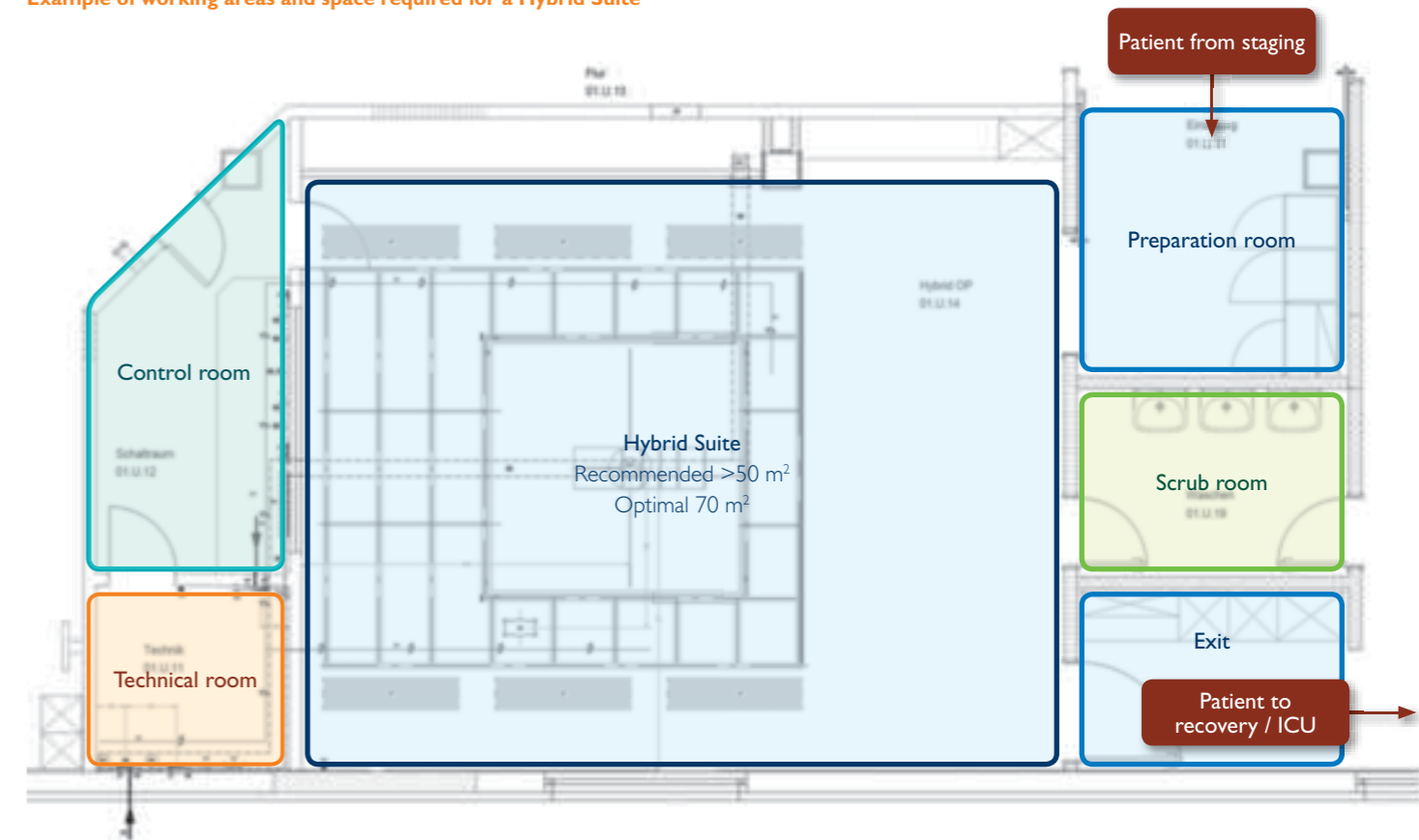
- **Post-op room**

The patient goes here after the procedure before being moved to another location. It should be within 30 meters of the Hybrid Suite.

“An added benefit is that all technologies for treating patients either surgically or interventionally are available in the same room. If any complications arise, they can be treated immediately and successfully without needing transport of the patient to a different department.”

Professor M. Lachat MD, vascular surgeon,  
Zürich University Hospital, Switzerland

Example of working areas and space required for a Hybrid Suite



## 4 Define hygienic requirements

Hygienic requirements differ from healthcare facility to healthcare facility and country to country. To ensure that the Hybrid Suite can be used for the broadest range of procedures, hospitals have a tendency to equip all operating rooms according to the highest standards of sterility. There are three main aspects to consider when defining the hygienic requirements for your Hybrid Suite.

### Staff behavior

Many different surgical and non-surgical people work in the Hybrid Suite, some of whom may not be used to working in a sterile environment. It is important to establish clear sterility protocols for the Hybrid Suite. All Hybrid Suite staff should then be fully trained on the sterility protocols that should be followed when working in the Hybrid Suite.

### Cleanability

It is important to keep the floor clean because this is where most contagions and particles collect. The best way to achieve this is by creating a room layout that keeps the floor totally free from obstructions, the “empty floor” philosophy.

The area where anesthesia equipment is used is considered less clean than the rest of the room. That makes it especially important to avoid moving X-ray equipment in and out of

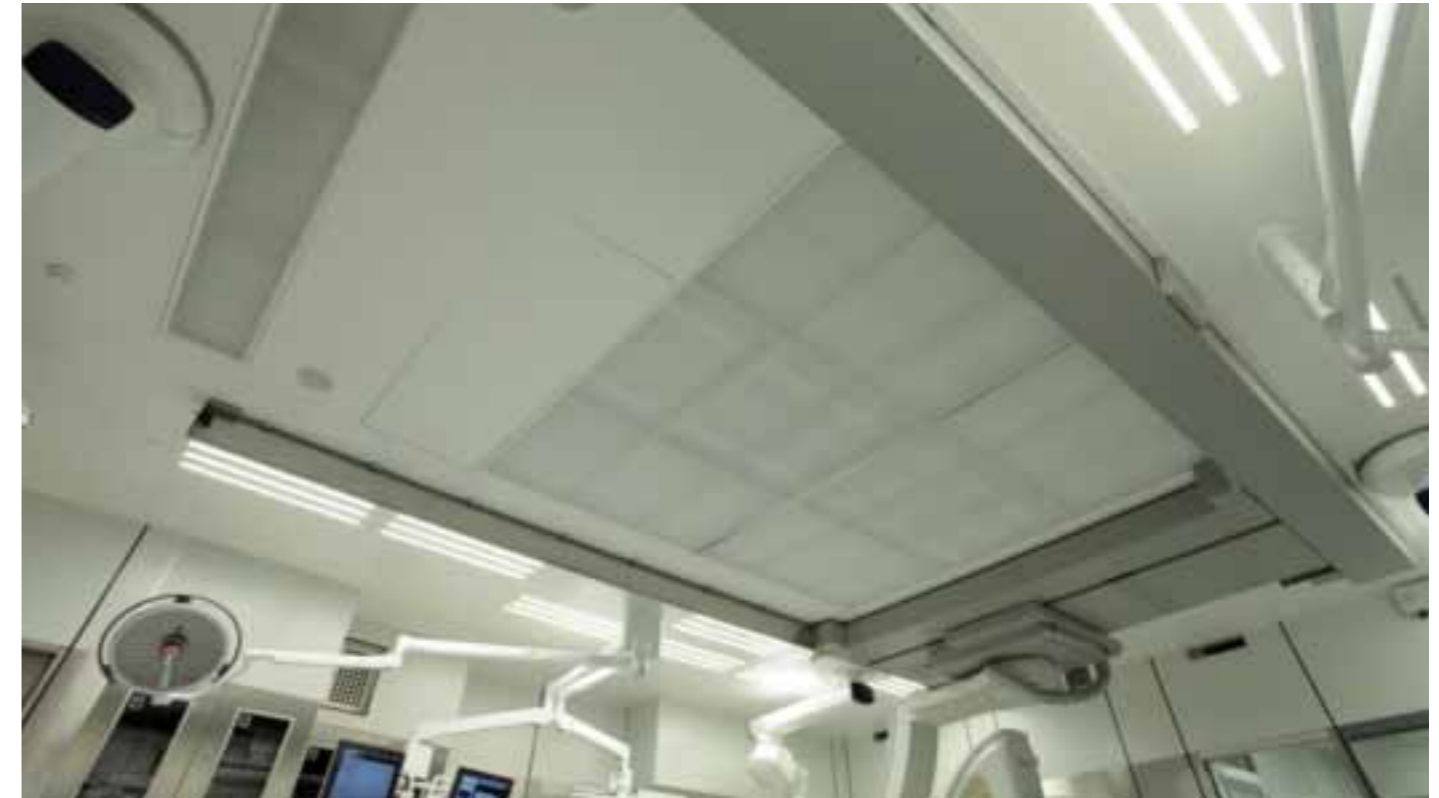
this area, since that can carry contagions into the sterile zone.

It is also vital to keep the main equipment in the Hybrid Suite, including the X-ray system, clean and free of infectious contagions. Covering the system with disposable plastic covers helps prevent infection and preserve sterility and also makes it easier to clean the system after the procedure.

### Clean air technologies

The use of clean air, air conditioning and ventilation technologies are key for achieving high hygienic standards in the Hybrid Suite. There are different types of airflow systems. The most common system used supplies High Efficiency Particulate Air (HEPA) filtered overpressure to the room. The HEPA filter is widely regarded as the ultimate filter, because it traps particles as tiny as 0.3 microns with an efficiency rating of 99.97%.

Over the last decades, the laminar airflow system has become more standard in some regions of the world. These systems create a defined protection zone around the surgical table. These systems are mounted on the ceiling and their placement needs to be carefully chosen.



### Laminar air flow and X-ray systems

Different countries have different regulations and standards for the sterile air conditions in the Hybrid Suite. The hospital hygiene department should be involved to ensure that local standards are adhered to. It is very important to maintain the appropriate level of sterility to reduce the risk of infection.

In a Hybrid Suite, ceiling mounted X-ray systems are the most common imaging solution. The laminar air flow field is also mounted on the ceiling, so ceiling mounted X-ray systems need to be specifically

integrated with the laminar airflow field.

The majority of Hybrid Suites have been installed with ceiling mounted X-ray systems worldwide so most major Hybrid Suite suppliers have experience with these aspects.

Philips dedicated FlexMove system has very wide rails, allowing a complete laminar airflow system to be placed between them. When the room is being used for open surgery which requires the highest levels of sterility, the X-ray system can be parked in the corner, leaving the laminar air flow system totally free of obstructions.

# 5 Define equipment requirements

In order to translate procedure and workflow requirements and workflow requirements into a “shopping list”, it is important to make an elaborate list of all equipment that needs to be purchased for the Hybrid OR. You should also include any services that are needed to realize and operate the Hybrid Suite. Please see the long list of items below.

Checklist of equipment and services:

|                                    |   |
|------------------------------------|---|
| Imaging equipment                  | X-ray, injector pump, Echo, IVUS, FFR ...                             |
| OR equipment                       | OR table, OR lights, booms, videoswitching ...                        |
| Patient care equipment             | Anesthesia, monitoring, bear huggers, crash cart, cell saver, AED ... |
| Surgical equipment                 | Surgical microscope, electro-surgical knife, surgical navigation ...  |
| Accessories                        | Trolley, tray tables, lead shielding ...                              |
| OR room facilities                 | OR furniture, storage, scrub facilities ...                           |
| OR room utilities                  | Lighting, laminar airflow, HVAC ...                                   |
| IT systems                         | Scheduling, inventory, patient monitoring, PACS, EMR ...              |
| Building & construction            |   |
| Integral project management        |   |
| Organizational advice, consultancy |   |
| Comprehensive service              |   |
| Education & training               |   |
| Financing                          |   |



For specific clinical applications, dedicated equipment might be needed.

Please see here for some examples:

|                  |   |
|------------------|---|
| Cardiac surgery  | <ul style="list-style-type: none"> <li>• Cardiopulmonary bypass equipment</li> <li>• ECMO</li> <li>• Cardiac ultrasound</li> <li>• Hemodynamic monitoring</li> <li>• Pacing stimulator</li> <li>• FFR, IVUS, OCT</li> <li>• Cardiac robotics</li> </ul> |
| Vascular surgery | <ul style="list-style-type: none"> <li>• Vascular ultrasound</li> <li>• IVUS</li> <li>• Vascular robotics</li> </ul>  |
| Neurosurgery     | <ul style="list-style-type: none"> <li>• Surgical microscope</li> <li>• Surgical navigation</li> </ul>  |

# 6 Define the imaging requirements

## Choose the imaging functionality required

Different clinical applications have very different imaging requirements. Before deciding upon the type of X-ray system that you want to use in your Hybrid Suite, it is useful to decide upon the functionality that you will need from that system. The chart provides an overview of the most common types of imaging functionality for cardiac, vascular, and neuro procedures that are performed in the Hybrid Suite.

The chart provides an overview of the advantages provided by fixed high end X-ray imaging for vascular, cardiac, spine and neuro procedures that are performed in the Hybrid Suite. It provides high quality imaging support to enhance the visualization of devices and

anatomical details. Besides 2D X-ray imaging, physicians can use intra-procedural 3D X-ray imaging to support planning, treatment, and post-op checks. Different imaging modalities can be combined into one image to provide live image guidance during procedures. Other imaging modalities can provide additional imaging support during procedures, and can be viewed on the main display monitors.



“The hybrid operating room combines the advantages of a surgical Suite with advanced high-quality imaging techniques.”

Professor M. Lachat

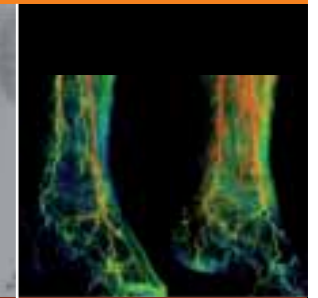
## Imaging requirements for vascular procedures

### 2D X-ray imaging

Digital subtraction angiography (DSA) is a well-established 2D X-ray imaging technique that visualizes blood vessels in the human body. For vascular procedures, masking and bolus chase are frequently used to visualize lower peripheral vasculature. Performing perfusion imaging during vascular procedures helps clinicians to identify the severity of a patient's condition before endovascular interventions.



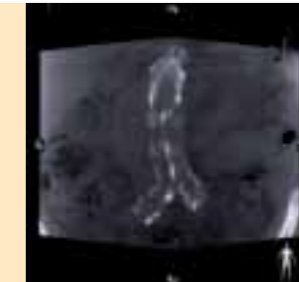
2D vascular (DSA)



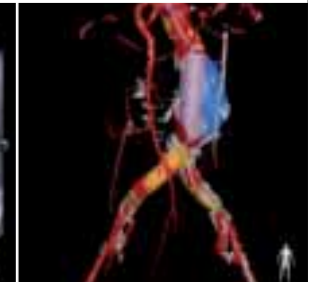
2D Perfusion

### Intra-procedural 3D X-ray imaging

A 3D image can be created using 3D rotational angiography (3DRA) or cone-beam CT (XperCT). This allows clinicians to access CT-like imaging with superb resolution in the Hybrid Suite to assess bone, soft tissue, and contrast-enhanced vessels. These images can support planning, treatment, and post-op checks.



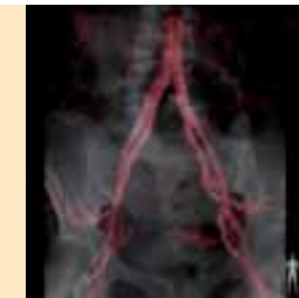
XperCT



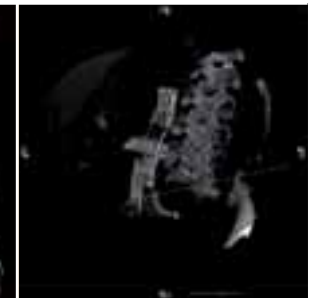
3DRA

### Live 3D image guidance

To provide live 3D image guidance for vascular procedures such as EVAR and TEVAR, different imaging modalities can be combined into one image. For example a pre-procedural CT or MR or intra-procedural 3DRA image could provide a roadmap for a fenestrated EVAR procedure or a percutaneous endoleak treatment.



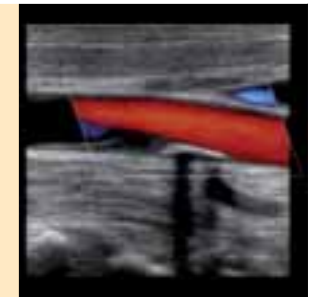
3D Roadmap



XperGuide

### Other imaging modalities

Other imaging modalities used to support vascular procedures include ultrasound imaging. It provides accurate, reliable and real-time information about soft tissue during vascular procedures. For instance, duplex ultrasound is often used to guide vascular access. IVUS (intravascular ultrasound) uses ultrasound technology to visualize from inside blood vessels.



Vascular Ultrasound

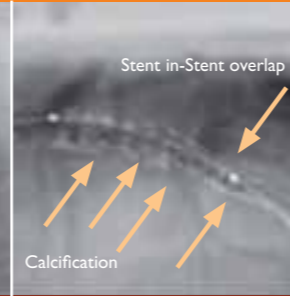
## Imaging requirements for cardiac procedures

### 2D X-ray imaging

Angiography is a well-established 2D X-ray imaging technique that visualizes blood vessels in the human body. It does this by showing the difference between an initial fluoroscopic acquisition and a fluoroscopic acquisition after injecting contrast agent. Software tools are available to enhance stent visualization in the coronary arteries. These can show the stent in relation to the vessel wall to support clinicians in checking positioning before and after deployment of balloons and stent devices, and to confirm stent expansion.



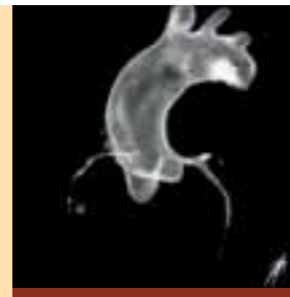
2D interventional X-ray



StentBoost

### Intra-procedural 3D X-ray imaging

A 3D rotational scan can be used to produce a CT-like 3D image that visualizes anatomy and contrast-enhanced vessels with superb resolution in the Hybrid Suite. This image supports planning, treatment, and post-op checks.



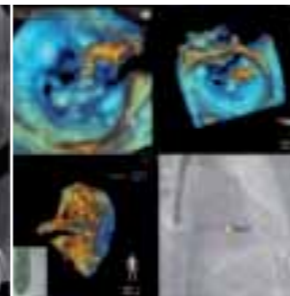
3DRA

### Live 3D image guidance

To provide live 3D image guidance for TAVR or Mitral Valve procedures, different imaging modalities can be combined into one image. For example, a pre-procedural CT could provide a roadmap combined with live fluoroscopy for TAVR. Or Live 3D TEE (transoesophageal echocardiography) can be combined with live fluoroscopy to provide guidance for Mitral Valve procedures, LAA closure, or septal defect closures.



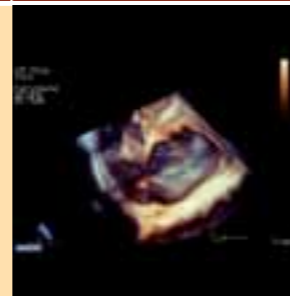
HeartNavigator



EchoNavigator

### Other imaging modalities

There are many other imaging modalities used to support cardiac procedures. For instance, Live 3D echocardiography allows the viewing of Mitral Valves, Aortic Valves, Atrial Septum, the Left Atrial Appendage, and all chambers of the heart with unique perspectives. IVUS (intravascular ultrasound), ICE (intracardiac echocardiography), OCT (optical coherence tomography), and FFR (fractional flow reserve) are just a few of the techniques that can provide more information about cardiac pathology.



Live3D TEE

## Imaging requirements for neuro procedures

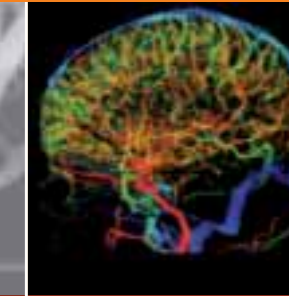
### 2D X-ray imaging

A live fluoroscopy image overlaid on subtracted images provides 2D roadmapping to support neuro procedures.

Performing perfusion imaging during procedures helps clinicians to identify the severity of a patient's condition before neurology interventions and verify the effect and completeness of treatment immediately afterwards.



Roadmapping



2D perfusion

### Intra-procedural 3D X-ray imaging

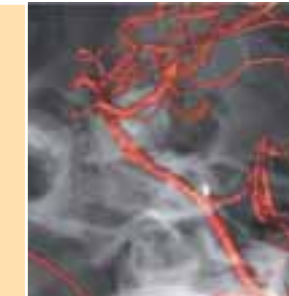
A 3D image can be created using 3D rotational angiography (3DRA) or cone-beam CT (XperCT). This high-resolution image shows tiny details of opaque intracranial devices to help clinicians avoid complications during neuro procedures. It can visualize the location, size, and direction of occlusions in brain vessels by displaying the vessel structure before and after the clot.



XperCT

### Live 3D image guidance

To provide live 3D image guidance for neuro procedures such as AVM treatment, different imaging modalities can be combined into one live 3D image. For example, a pre-procedural CT could provide a roadmap combined with live fluoroscopy for AVM treatment. Pre-acquired CT or MR images can be overlaid with the live fluoro image to create a 3D roadmap that provides live image guidance through cerebral vascular structures.



3D roadmap

### Other imaging modalities

Other imaging modalities can be used to support neuro procedures. A surgical microscope is often used to produce an enlarged image of the operative field that is too small to be seen by the naked or unaided eye.



Surgical Microscope

## 7 Choose the X-ray imaging system

One of the key differentiators of a Hybrid Suite is that it usually offers access to high end X-ray imaging. There are, however, many different types of X-ray systems that can be considered. Floor mounted systems, ceiling mounted system, the FlexMove system and biplane systems can all be found in the Hybrid Suite. The system you choose will

depend on the types of procedures that you perform and on the physical characteristics of the room itself. However, ceiling mounted monoplane systems and the FlexMove system are by far the most common solution. All of these solutions have their advantages and disadvantages as shown in the table below.



Floor mounted monoplane systems



Ceiling mounted monoplane systems



FlexMove systems



Biplane systems

|          | Floor mounted monoplane systems   | Ceiling mounted monoplane systems   | FlexMove systems   | Biplane systems  |
|----------|---|---|--|--|
| <b>+</b> | <ul style="list-style-type: none"> <li>Can be used when there are constraints in ceiling height or ceiling strength</li> </ul>  | <ul style="list-style-type: none"> <li>Does not block anesthesia</li> <li>Does not take up floor space and can be parked at the foot end of the table or out of the way</li> <li>Allows head to toe imaging without moving the table</li> </ul> | <ul style="list-style-type: none"> <li>Does not block anesthesia</li> <li>Does not take up floor space and can be parked out of the way</li> <li>Allows head to toe imaging without moving the table</li> <li>Allows optimal patient access with standby position</li> <li>Allows optimal flexibility</li> </ul> | <ul style="list-style-type: none"> <li>Allows biplane imaging, which can be a clinical necessity for specific applications such as neuroradiology, pediatric cardiology, and electrophysiology</li> </ul>              |
| <b>-</b> | <ul style="list-style-type: none"> <li>Blocks anesthesia space</li> <li>Takes up significant floor space</li> <li>No flexibility in parking position</li> <li>Need to move the table for head to toe imaging</li> </ul> | <ul style="list-style-type: none"> <li>Poses requirements on ceiling height</li> </ul>  | <ul style="list-style-type: none"> <li>Places additional requirements on ceiling height</li> </ul>   | <ul style="list-style-type: none"> <li>Two stands might hinder surgical workflow and anesthesia</li> <li>A biplane system always includes a floor stand and a ceiling stand, with the disadvantages of both</li> </ul> |
|          | Use only when there are siting constraints  | Good choice   | Optimal choice   | Use only for specific clinical applications, like neuro or pediatrics  |

## 8 Determine the type of table

The operating table used in the Hybrid Suite should meet the requirements of both surgeons and interventionalists. This can be challenging because surgeons want to work with a table that has a breakable tabletop. To get the best images, interventionalists

need a table that is radiolucent and will allow coverage of the patient over a broad area so they use one piece tables.

The advantages and disadvantages of both options are shown below.



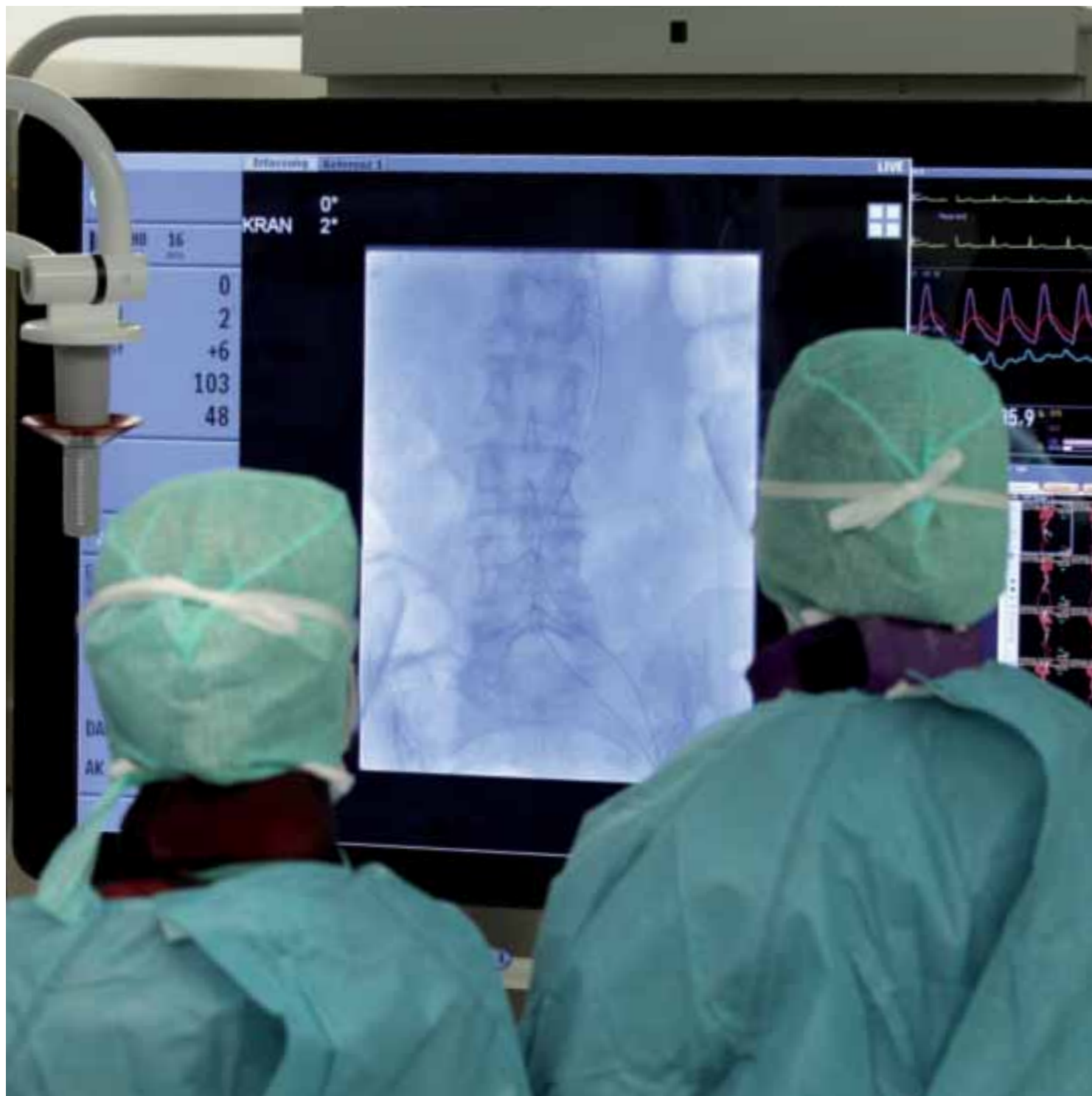
Angio table



OR table

|          | Angio table  | OR table   |
|----------|--|--|
| <b>+</b> | <ul style="list-style-type: none"> <li>Fully integrated with X-ray system</li> <li>Free floatable tabletop, which interventionalists are used to</li> <li>Optimized for interventions</li> <li>Tilt and cradle movement</li> </ul> | <ul style="list-style-type: none"> <li>Fully integrated with X-ray system</li> <li>The OR table is available with a flat, carbone fiber tabletop for interventional use or a breakable tabletop for surgery</li> <li>Optimized for surgery and for hybrid usage</li> </ul> |
| <b>-</b> | <ul style="list-style-type: none"> <li>No breakable tabletop: does not support complex surgical positioning</li> </ul>   | <ul style="list-style-type: none"> <li>Only available as a motorized floatable table</li> </ul>  |
|          | If the main users are interventionalists that are used to an Angio table, this is the preferred solution   | Increases flexibility and the variety of surgical procedures in the OR<br>If the main users are surgeons, an OR table could be considered<br>If you plan to do significant neurosurgical or orthopedic procedures, an OR table is advised                                  |





## 9 Define required video solutions

There are many different video signals and displays present in the Hybrid Suite, and video switching is a must have for these environments. Before you install a standard video switching solution, it's useful to consider all of the ways you want to use the information going in and out of the room and videos of the procedures themselves. This ensures that you get the video solution that will enhance your clinical operations.

### Multimodality imaging in the Hybrid Suite

The room should be set up to handle video and imaging inputs from all imaging and information sources that you anticipate needing. These include ECG, heart rhythm mapping, hemodynamic systems, CT, MR, ultrasound, X-ray, endoscopy, operating or room cameras... the list goes on. Being able to consult these images during a procedure can enhance decision making.

### Communicating inside the hospital

Very advanced procedures are usually performed in the Hybrid Suite. For that reason, most facilities find it very valuable to have a video streaming solution to allow communication and exchange of information with other locations inside the hospital. This allows videos of the procedure to be shared with other rooms and groups for training or consultation purposes.

### Communicating outside the hospital

You can use video streaming for outside hospital teleconferencing. This allows you to demonstrate cases to a congress or a different location for teaching purposes or share cases with off-site colleagues for consultations.

"By using FD20 with XperCT we can obtain CT-like images quickly without needing to move to the imaging room. We can check for small amounts of staining or leakage, and if there is a problem we can go on to perform secondary treatment."

Dr. Tetsuya Fukuda,  
National Cerebral and Cardiovascular Center in Osaka, Japan



## We can help you define your requirements

We can support your facility during this phase by providing advice on requirements and sharing best practices.

A reference site visit is also highly recommended at this point. As a turnkey solution provider, Philips can also manage all equipment purchasing activities.

# How

do we design the room  
around different procedures

What can we do to make it a  
pleasant working environment

How do we make the  
environment flexible

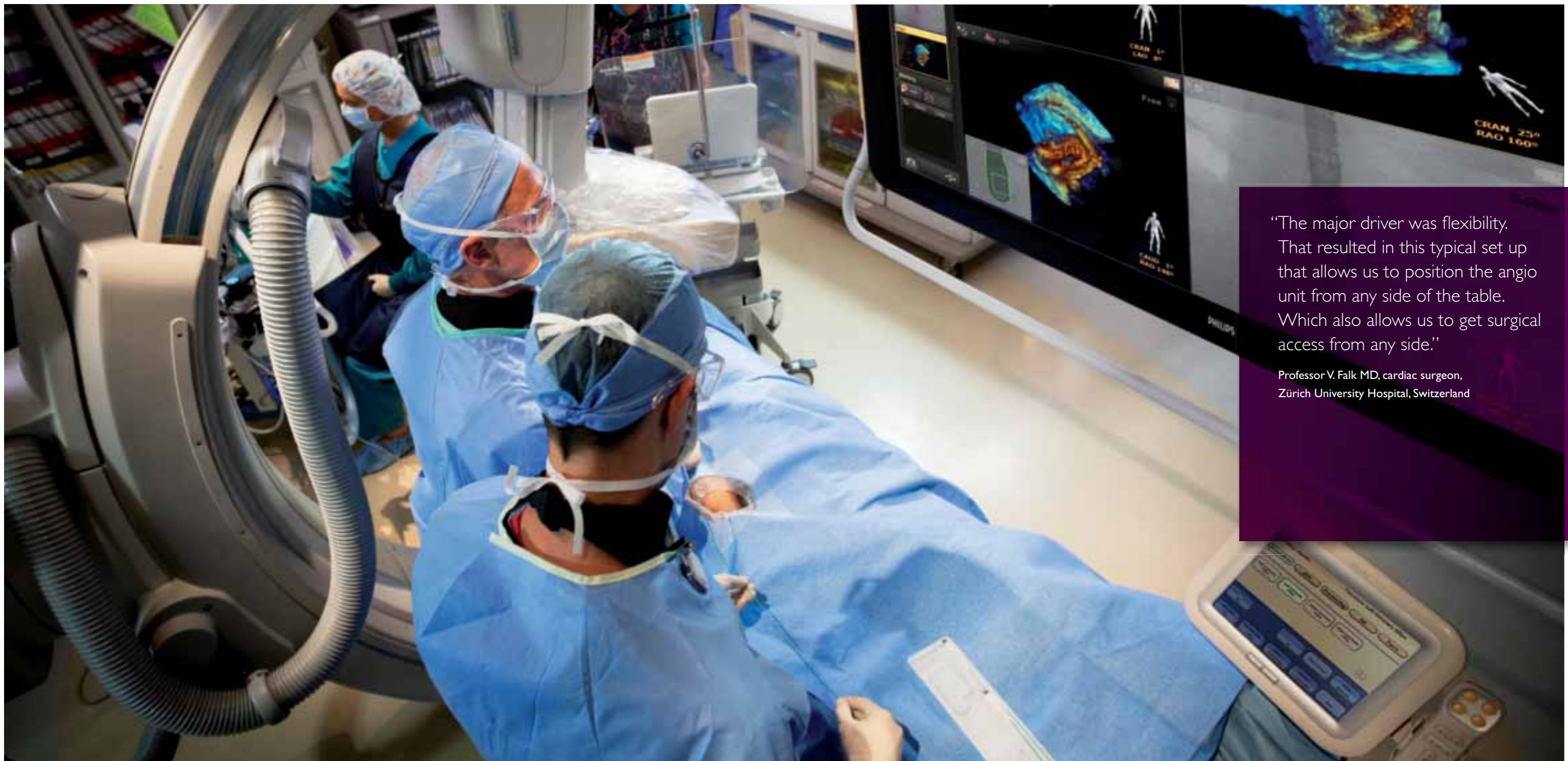
# Where

should we set up  
the displays for the  
best visibility

- 1 Consider all the equipment and workflows involved
- 2 Map out different options
- 3 Allocate enough space
- 4 Apply the “empty floor” philosophy
- 5 Leave the anesthesia work area free
- 6 Plan flexible C-arc positions
- 7 Carefully plan set-up of displays
- 8 Create a pleasant working environment
- 9 Account for specific clinical requirements

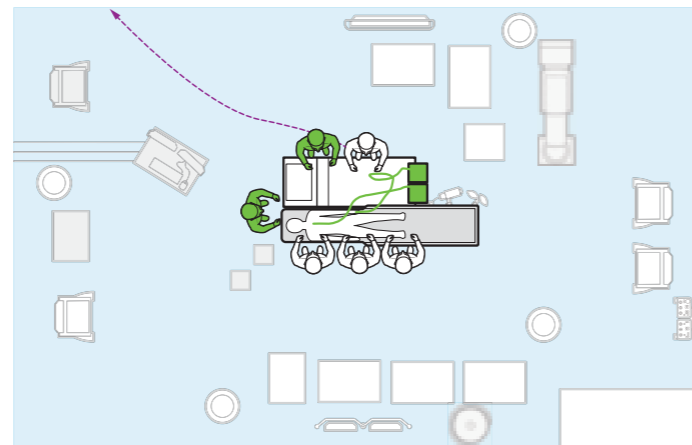
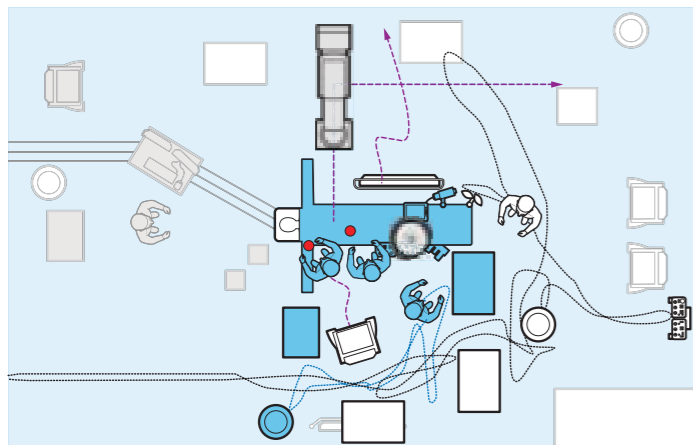
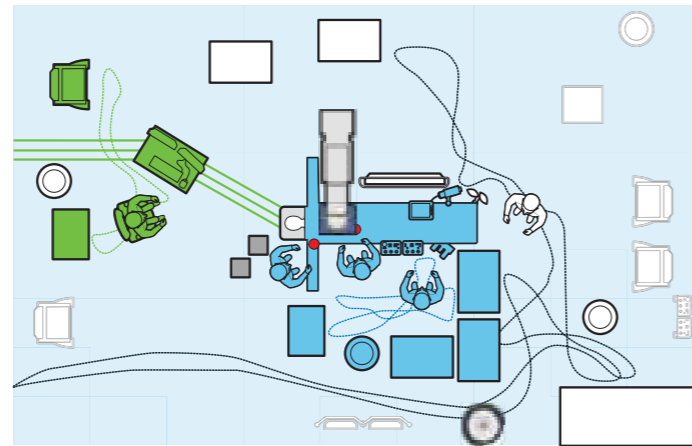
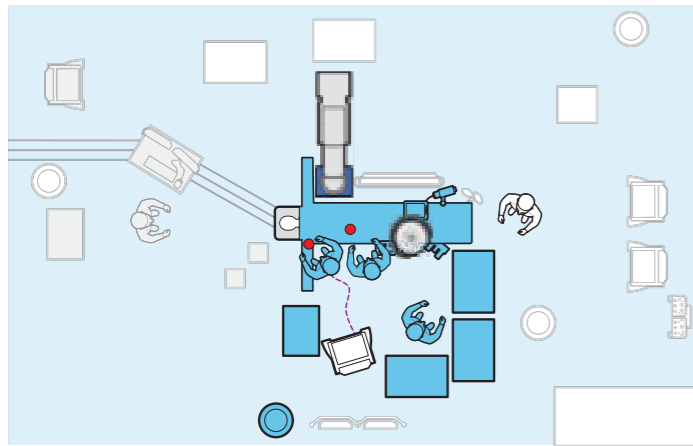
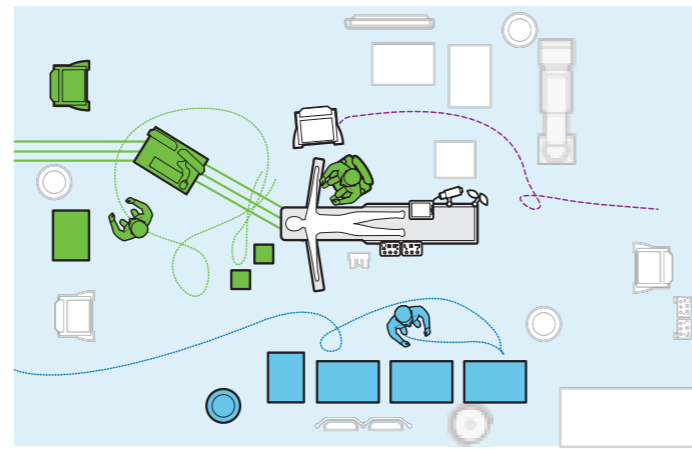
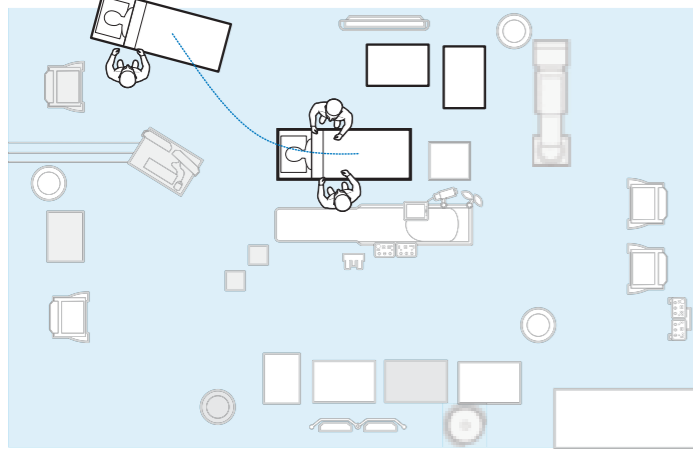
Design the room layout

4



“The major driver was flexibility. That resulted in this typical set up that allows us to position the angio unit from any side of the table. Which also allows us to get surgical access from any side.”

Professor V. Falk MD, cardiac surgeon,  
Zürich University Hospital, Switzerland



# 1 Consider all the equipment and workflows involved

There is a great deal of equipment that has to be moved in and out of the Hybrid Suite, as well as patients and different treatment teams. What's the best layout for all the equipment? How can you quickly switch from one type of procedure to another? These factors make it challenging to create a room layout that allows you to treat patients effectively and efficiently.

When designing the layout of the Hybrid Suite, it is important to consider all of the equipment and workflows involved. If you look at the general space and workflow in the lab, of course the patient is in the middle of the area. Anesthesia works at the head of the patient, while medical staff work on the other sides of the patient. Other staff are also moving in and out of the room.

- **Patient**  
The design should take into account patient transportation in and out of the room.
- **Surgical and interventional staff**  
A radiologist or cardiologist works on the side of the patient. They may also need access to an ultrasound system, EP mapping system, etc. The lighting and monitor booms

should be positioned to ensure that staff have good patient coverage for the different procedures.

- **Surgical equipment**  
Instrument trays, a crash cart, ultrasound system, heart lung machine, etc. have to be placed within reach on the sides of the table.
- **Anesthesia**  
Anesthesia may monitor multiple procedures simultaneously so they need easy access to the hallway. In most cases this determines where the anesthesia side of the room is located.
- **Other staff**  
Consider which walking routes are used and allow space for these in the room.

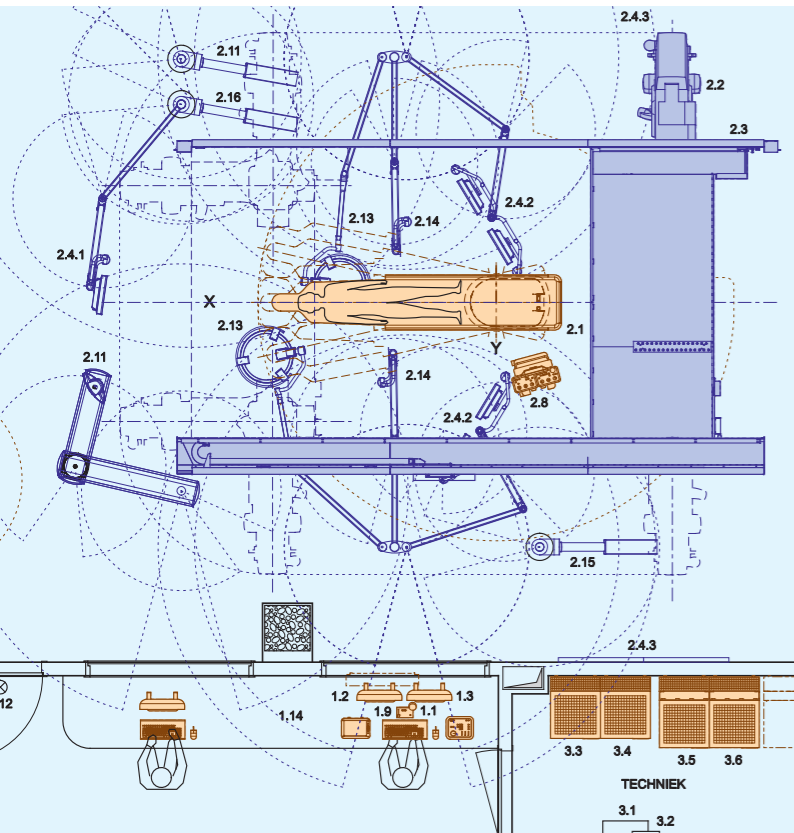
< The curved lines in the schematics show the typical flow of people in and out of the room.

## 2 Map out different options

It's important to get the room design right before you start installing expensive equipment. Using three dimensional drawings to simulate different set-ups based on your

procedure mix can help you create the best layout for your needs. This can help you avoid costly oversights and workflow bottlenecks in your final result.

A virtual 3D room plan can help you create the best layout for your needs.



## 3 Allocate enough space

At least 50 square meters of space is needed and an area of 70-80 square meters is ideal. Besides the Hybrid Suite, you should include a scrub room, storage for disposables and supplies, a recovery room, technical room, and prep room if desired.

You might need a control room as well, although that is not included in all Hybrid Suites.



## 4 Apply the “empty floor” philosophy

To ensure maximum flexibility and access to the patient, the best solution is not connecting any equipment to the floor to leave it empty.

One exception to this rule may be the patient table. That is why ceiling mounted X-ray

systems are the most common solutions used in Hybrid Suites. Ancillary equipment, such as anesthesia, lead shields, etc., can be placed on ceiling mounted booms.



## 5 Leave the anesthesia work area free

The anesthesia area is full of equipment and considered less sterile than other areas of the room. It is best not to place an X-ray system in this position. This is another reason that a floor mounted X-ray system is not the optimal solution for a Hybrid Suite.



## 6 Plan flexible C-arc positions

When planning your room, carefully consider the range of movements that your C-arm can support. The more flexibly you can move it, the better you can use your room for different procedures.

Several procedures commonly performed in a Hybrid Suite, such as TAVR, are done from both the right and left side of the patient.

That means the C-arc needs to be able to move to both sides of the table. Also, when the room is being used for open surgical procedures, the C-arc needs to be parked as far away from the table as possible.

The best way to do this is to park it at the foot side of the table so it does not interfere with anesthesia.



## 7 Carefully plan set-up of displays

For many hybrid procedures access to the patient from both sides of the table is crucial. Therefore displays are usually needed at both sides of the table. Consider carefully the placement of regular monitors and large screen displays so that everyone can see them when needed.

"Halo array" of displays placed in a circle above the heads of staff

Large multi-signal display screen (Philips FlexVision XL)





## 8 Create a pleasant working environment

A Hybrid Suite is a room where very long and complex procedures are being performed by many different people. There are many things that can be done to create an atmosphere that helps people feel more relaxed and confident as they work.

You can use ambient lighting solutions to create different lighting environments for different stages of the procedure. This creates a pleasant environment where everyone enjoys working.



## 9 Account for specific clinical requirements

Each Hybrid Suite will have a different layout depending on the specific procedures performed and physical characteristics of the room.

The diagram shows a number of factors to keep in mind when designing your room layout.

|  |  |
|--|--|
| <b>Vascular applications</b>               | <ul style="list-style-type: none"><li>• You should be able to park the C-arc at the foot end of the table, preferably, for open procedures</li><li>• You need a long table for below-the-groin applications</li><li>• For EVAR procedures, space needs to be left at the patient's feet for long guidewires</li><li>• Room should be made for vascular specific equipment, like vascular ultrasound, IVUS, and in some cases vascular robotics</li></ul>   |
| <b>Cardiac applications</b>                | <ul style="list-style-type: none"><li>• For TAVR procedures, you should be able to place the C-arc on the right side (to create working area for the surgeon for transapical access) and left side (for transfemoral or other access routes) of the patient</li><li>• Echography equipment needs to be placed at the head end the table in addition to anesthesia</li><li>• The C-arm should be able to perform a rotational scan from a side position when the patient is intubated</li><li>• Room should be made for cardiac specific equipment, cardiopulmonary bypass equipment, ECMO, cardiac ultrasound, hemodynamic monitoring, pacing stimulator, FFR, IVUS, OCT, and cardiac robotics</li></ul> |
| <b>Neuro and spine applications</b>        | <ul style="list-style-type: none"><li>• Anesthesia equipment is placed towards the foot end of the table</li><li>• Room should be made for neuro specific equipment, like surgical microscope and surgical navigation</li></ul>  |
| <b>Room with a laminar air flow system</b> | <ul style="list-style-type: none"><li>• If a laminar air flow system is installed on the ceiling, the ceiling rails for a ceiling mounted X-ray system will need to be installed inside the laminar air flow field or outside of the laminar air flow field</li></ul>  |
| <b>Orthopedic and spine applications</b>   | <ul style="list-style-type: none"><li>• Carefully evaluate the type of X-ray system and ensure that it allows 3D scanning in combination with a spine table. Not all vendors are able to deliver such a solution</li></ul>   |
| <b>Trauma Hybrid Suite</b>                 | <ul style="list-style-type: none"><li>• The workflow between ER, CT (if applicable) and Hybrid Suite needs to be optimized to minimize the distance travelled by patient from ambulance or helicopter to the treatment area</li><li>• Due to the large amount of people present, plan for even more space if possible</li></ul>  |



## We can help you design your room layout

Philips can provide room drawings and 3D room planning tools to facilitate the room design process. We have experience in guiding this process and can give you advice based on your clinical needs and workflow. As a turnkey solution provider, Philips could also manage interactions with all different suppliers of equipment in the room.

How do we work  
as a team

How do we reduce the patient and staff X-ray dose

How  
do we train our staff

How do we  
work safely

How do we  
use the full  
room capacity

- 1 Organize multidisciplinary teams
- 2 Provide proper training for staff
- 3 Implement dose awareness and reduction measures
- 4 Get scheduling and staffing right
- 5 Organize your supply chain
- 6 Have equipment available

Optimize usage of the Hybrid Suite

5



“I think our cardiologists very much appreciate working in the Hybrid Suite and also the concept of shared leadership during these cases which is actually very new. But I think in the best interests of the patient.”

Professor V. Falk MD, cardiac surgeon,  
Zürich University Hospital, Switzerland

# 1 Organize multidisciplinary teams

Working in the hybrid operating room requires an interdisciplinary team made up of surgeons, interventionalists, anesthesiologists, radiology technicians, nurses, and other specialists. Experience has shown that training interdisciplinary teams to work together requires additional training time.

It is important to create a dedicated team and train them to work efficiently together. They should train together so that they work as a routine, well-oiled machine. They should know what to expect from each other and how to handle unforeseen issues. This ensures that the team can react quickly to provide the most efficient and optimal treatment possible for the patient. It may be very helpful to assign super-users among staff that receive more in-depth training on handling equipment in the lab. The Heart Team is a good example of an interdisciplinary team. The SYNTAX and PARTNER trials have shown the effectiveness of a Heart Team for complex procedures.

## How to implement multidisciplinary teamwork

A dedicated team should be formed to handle specific types of procedures. A leader should be defined for each type of procedure. The leader can change depending on the type of procedure being performed.

Treatment planning should be done by staff from different disciplines, surgery, radiology, anesthesiology, etc.

The team should be fully briefed before each procedure. Pre- and post-procedural flows should be coordinated between different departments, including the patient ward, anesthesia, ICU/recovery, and the Hybrid Suite. Pertinent staff like surgical nurses, perfusionists, etc., should also be scheduled on standby in case of an emergency.

Protocols should be established for:

- Roles and responsibilities
- Preparation and material handling
- Placement and operation of equipment
- Procedural workflow
- Clean-up

“The specialties of interventional radiology and vascular surgery bring more to each other when they work together.”

Dr. Barry T. Katzen,  
M.D., Medical Director, BCVI, Miami, USA.





## 2 Provide proper training for staff

The success of your Hybrid Suite depends on the success of your people. They need to master clinical procedures and medical systems so that they are ready to perform the moment your Suite is open for patients. As techniques and tools evolve, and staff change, you need to support your people in continually growing and developing. Because as they improve, your facility can better serve your patients and work more efficiently and cost-effectively.

Our comprehensive clinical, technical, and continuing education programs are designed to make it easy for your people to learn difficult topics and advance their personal development and performance.

To meet your individual training needs, we offer a full range of training possibilities. Courses can be followed in a classroom setting or via e-learning online. Demonstrations can be given on-site in your own Hybrid Suite or off-site in one of our training facilities or at another clinical location.

### Teamwork training

Courses are available to teach a multidisciplinary team the skills they need to work together. This can be done in a real lab environment using a simulation.

Participants learn their role and responsibilities within the team, and can practice them during a simulated procedure. The team also learns how to work and communicate effectively with each other.

### Equipment training

Train your staff on the basic and advanced system functionality to help them get the most out of their equipment. Appoint expert users who can help teach other staff members. For teams that focus on specific procedures, you can also set-up dedicated clinical courses to learn about new techniques and developments in a specific field.

### Specialty training

The Hybrid Suite is a new working environment for many staff. They should be trained on additional topics such as:

- Working with X-ray and other equipment
- Sterility protocols
- Workflow
- Radiation safety

### 3 Implement dose awareness and reduction measures

X-ray dose awareness is a special area of attention for the Hybrid Suite because not all staff members may be used to working in an environment with an X-ray system. This is also a special area of focus of Philips as a manufacturer of X-ray equipment. Based on our experience, there are three aspects related to X-ray dose that should receive attention in a Hybrid Suite:

- Increase dose awareness
- Use advanced dose reduction technology
- Promote healthy working practices

#### Increase dose awareness

A continuous improvement and quality program should be established to monitor and reduce X-ray exposure in the Hybrid Suite. Staff should be trained on the use of X-ray dose during procedures following the ALARA principle (as low as reasonably achievable). The DICOM Radiation Dose Structure Report function on your X-ray system collects and exports data about X-ray exposures and can be used to reduce X-ray dose.

Staff should wear personal dose meters to measure the amount of X-ray dose that they receive. In addition, your facility could consider using Philips DoseAware which provides instant, time-stamped feedback

in the examination room so medical staff can immediately adjust their working habits to decrease radiation exposure.

#### Use advanced dose management technology

These include:

- **Low dose imaging chain**

Your X-ray system should be equipped with built-in dose management capabilities that will deliver exceptional image quality and X-ray dose efficiency. These can include beam filtration to filter out soft or non-diagnostic X-rays, flexible dose settings, removable grids and others.

Involve your medical physicist and be sure to ask vendors for evidence of dose management in relation to maintaining good clinical image quality.

- **Fusion imaging**

Using pre-acquired CT images to create a 3D volume that is overlaid on a live fluoroscopy image for imaging guidance can reduce the amount of X-ray dose used in the Hybrid Suite.

- **Dual axis rotation**

An X-ray system that can perform a dual axis rotation has the potential to reduce

#### DoseAware\*

DoseAware is an important set of tools designed to help reduce medical radiation exposure to physicians and staff. It includes a personal dose meter to help users track when and where dose was acquired so they can take appropriate action during a procedure. The colored display in the examination room helps staff easily check their exposure level with one glance.

A dose management system provides cumulated data that enables staff to analyze dose trends as input for improving clinical processes.



X-ray dose and contrast medium. That is because all desired imaging views are acquired in a single run.

- **Stent enhancement**

Software is available that enhances stent visualization in the coronary arteries. This has the potential to shorten procedure times and the use of X-ray for visualizing difficult to image devices.

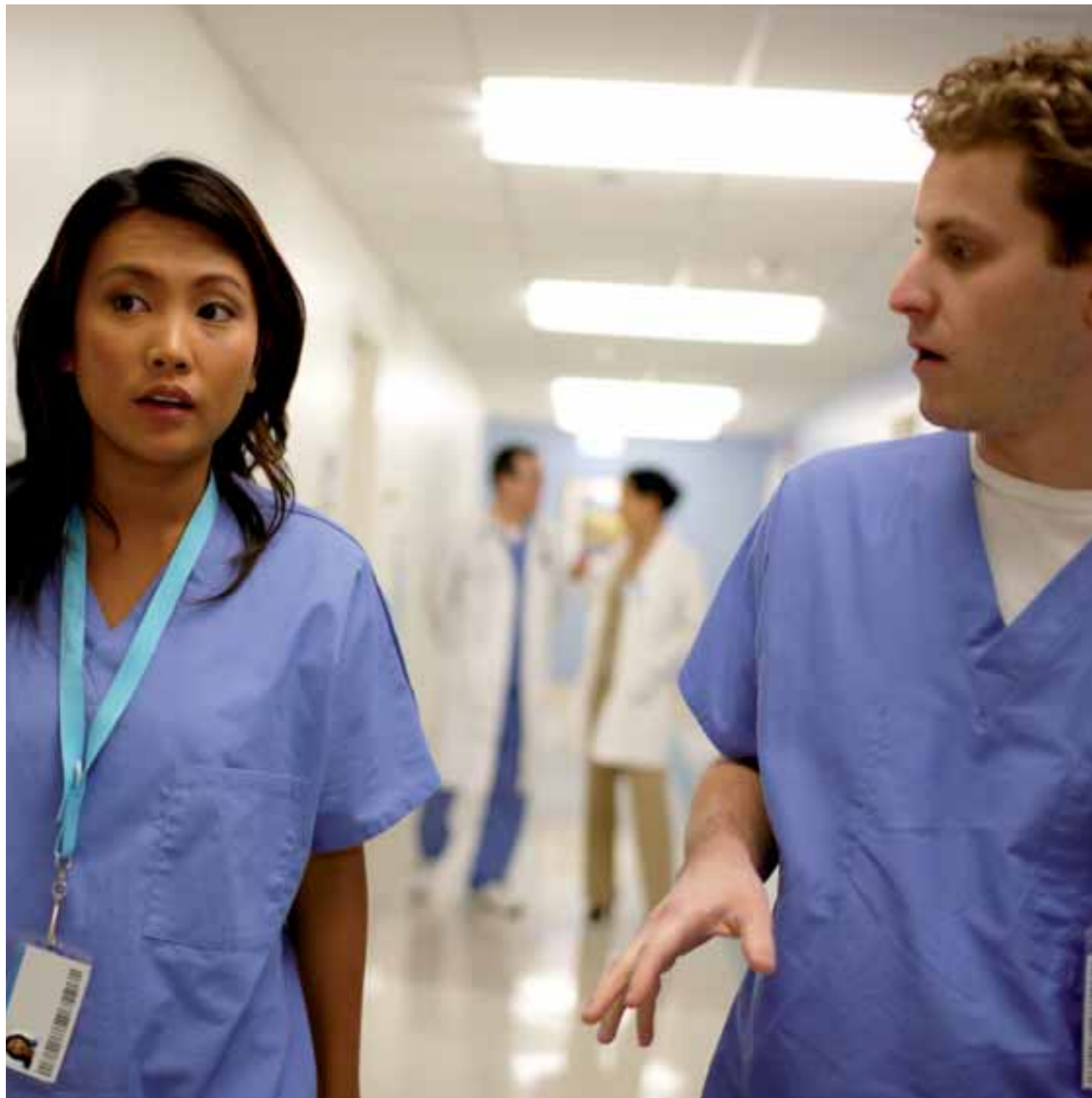
#### Promote healthy working practices

How the users of the Hybrid Suite behave can have a significant impact on X-ray dose management. Here are some best practices to follow:

- Increase the distance between the tube and the patient
- Reduce the distance between the patient and the detector

- Collimate, and use shutters and wedges
- Stand on the detector side of the X-ray system
- Stand away from the X-ray field, if possible leave the room during image acquisition
- Limit radiation time as much as possible
- Apply low frame speeds when possible
- Use personal protection (lead skirts, gloves, thyroid protection, in-room lead shields, radioprotective patient drapes)
- Reduce steep projections if possible
- Select low dose X-ray protocols for fluoroscopy and acquisition

\* DoseAware is not a replacement for the thermoluminescent dosimeter (TLD) as a legal dose meter.



## 4 Get scheduling and staffing right

Your Hybrid Suite is a costly investment. To make sure you get the highest return on your investment, you should carefully manage the usage of your Hybrid Suite. The following section highlights some of the crucial areas that are often overlooked by facilities. They can make a tremendous difference in the success of your Hybrid Suite.

### **Get scheduling and staffing right**

The complex procedures performed in the Hybrid Suite involve a team of highly trained medical personnel who are often specialists in their field. When forming the teams that work in this Suite, it is advisable to have more than one person trained for each task so that you have a back-up in case a staff member is unavailable.

Every moment that this room is not being used costs your facility money, so you do not want to waste any time.

One way to help prevent delays or cancellations is to pay extra attention to scheduling to ensure that everyone needed is on hand for their time slot. It is also important to decide in advance how to handle emergency cases, unexpected delays or complications to ensure efficient usage of your Hybrid Suite.



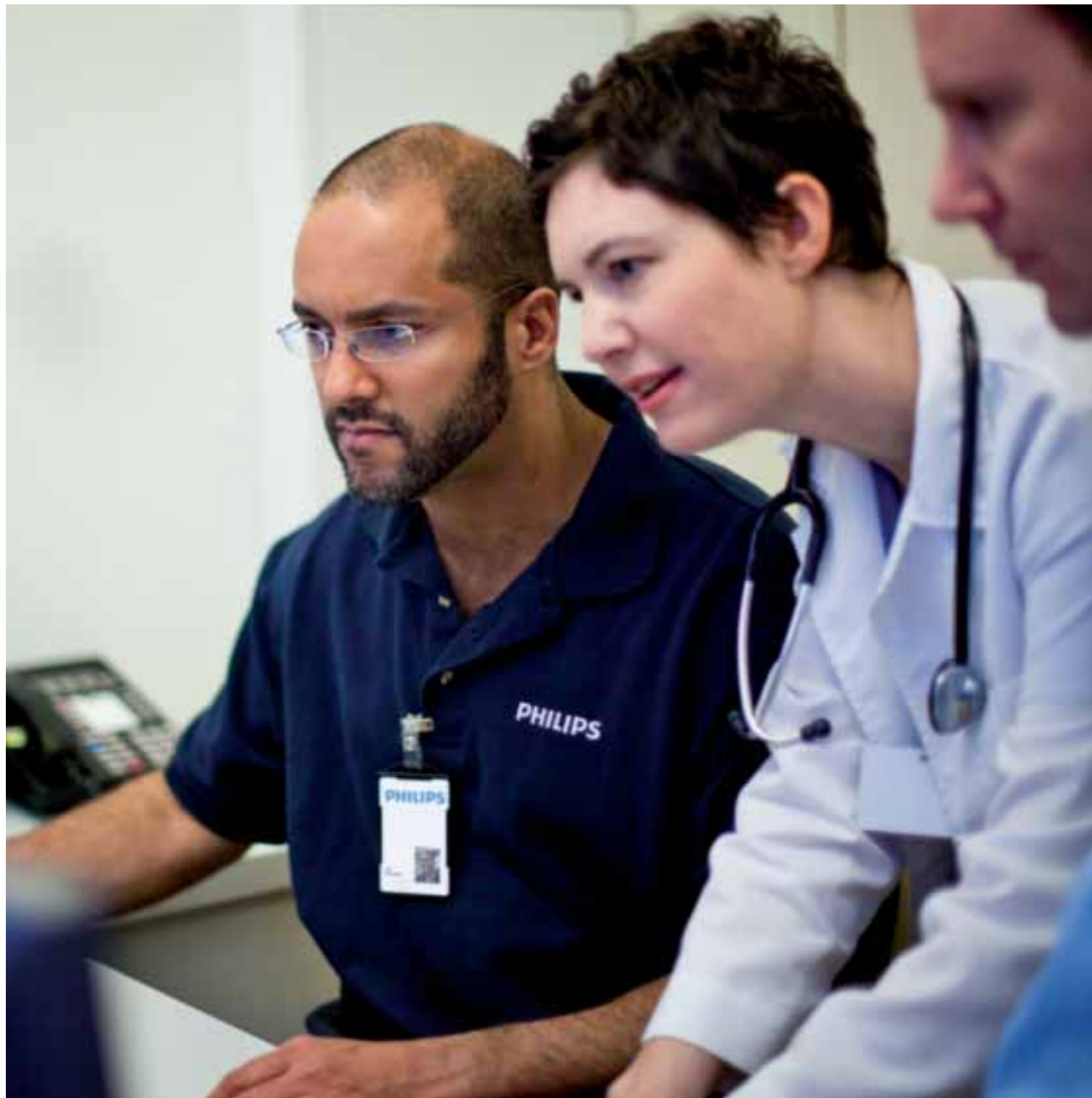
## 5 Organize your supply chain

The supplies required by surgery are different from those used for interventional procedures, and these supply chains are usually managed by different people.

When you bring these two worlds together in one room, it is also important to merge the different supply chains. Some issues to

consider: how and where to store materials, how to mark and track materials received, how to record materials used. Sorting these issues out beforehand ensures that you have the right materials in the right place at the right time to avoid critical delays or shortages.





## 6 Have equipment available

There can be dozens of pieces of highly advanced equipment in a Hybrid Suite, all of which need to be prepared, maintained, and updated. It is useful to appoint one person or team to manage all of this equipment as well as their contracts and suppliers. This prevents a certain system from being unavailable for a procedure because maintenance is being performed. More critical, it prevents a system from failing when it is needed during a procedure.

Facilities can often bundle the management and contracts for all of the equipment for a Hybrid Suite through one equipment supplier to streamline this process. This can save time and money, while guaranteeing set performance levels for the equipment.



## Philips can help you organize for a successful Hybrid Suite

Philips can help your facility manage the installation process and provide training and advice on utilization of the room. Of course, after the Hybrid Suite is in operation, a continuous improvement process should be started to ensure the highest return on this valuable investment.

Our comprehensive education program is designed to support clinical excellence, maximize use of advanced system features and capabilities, optimize workflow and staff productivity, and foster professional growth and teamwork. We offer a wide range of clinical, technical, and continuing education courses to meet your facility's needs.

We can provide comprehensive service for the Hybrid Suite which could include upgrades to new features and functions to help you achieve the clinical and financial results you need.

We hope that this book has provided more information on the important issues involved in establishing a Hybrid Suite. Philips has experienced consultants and project managers who can help you take the next step, whether it's performing an audit of your caseload, assessing your facilities or drawing up a financial plan. Please contact your local Philips representative if you have any questions or would like further information.

© 2013 Koninklijke Philips Electronics N.V. All rights are reserved.

Philips Healthcare reserves the right to make changes in specifications and/or to discontinue any product at any time without notice or obligation and will not be liable for any consequences resulting from the use of this publication.

Printed in The Netherlands  
4522 962 91701 \*APR 2013

**How to reach us**  
[www.philips.com/healthcare](http://www.philips.com/healthcare)  
[healthcare@philips.com](mailto:healthcare@philips.com)

**Product information**  
[www.philips.com/surgery](http://www.philips.com/surgery)

