



30 OCTOBER 2025

SingHealth's Regional Health Testing Process during Design

A living lab initiative for implementation an extensive prototyping and testing process

Presenter



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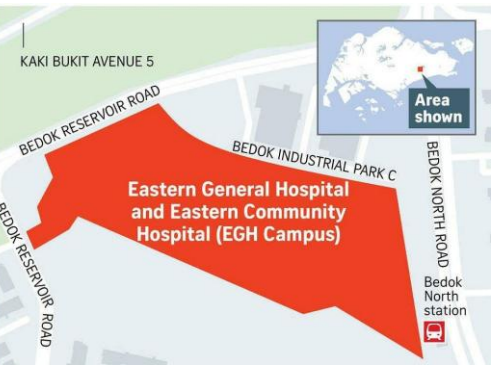
01. Project Overview

HKS

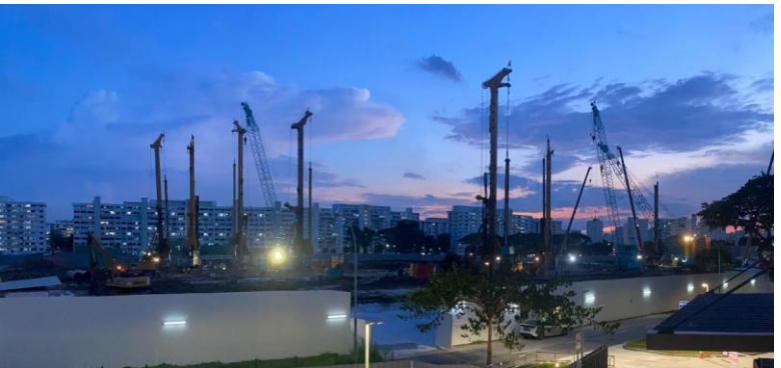
Pandemic Ready, Tech-enabled: New Hospital Campus with 1400 beds to open in the east by 2030



Source: SingHealth



Source: SingHealth
Straits Times Graphics



PROJECT OVERVIEW

Eastern General Hospital Campus



Bedok, the eastern region of Singapore



1400 bed campus



Acute care hospital



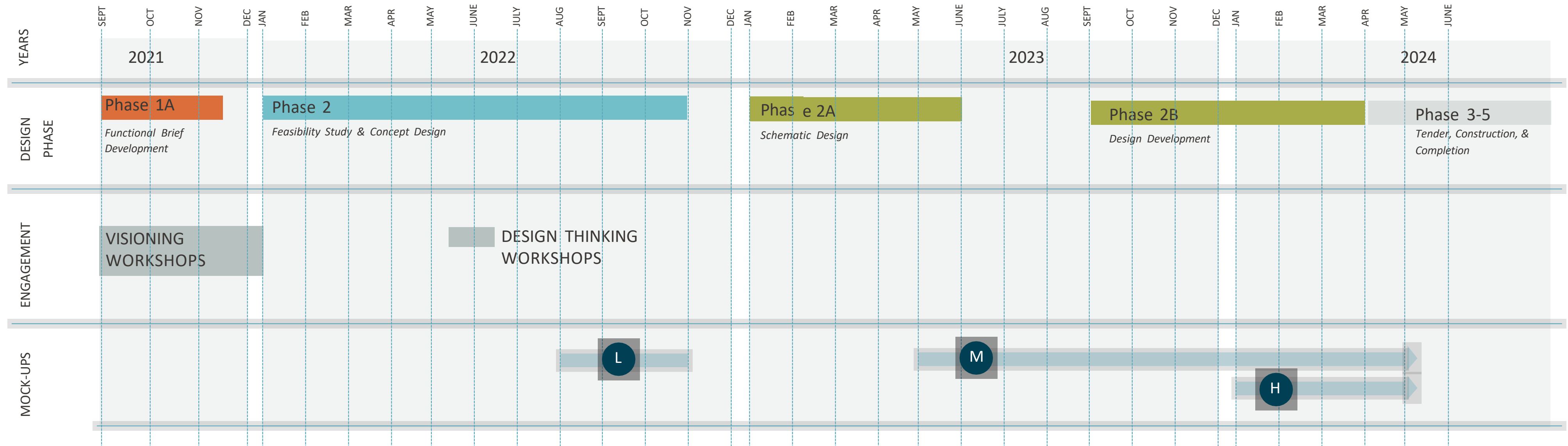
Community hospital



6.35 Hectares (9 football fields)

PROJECT OVERVIEW

Project Structure & Timeline



- L** LOW FIDELITY MOCK-UP
- M** MEDIUM FIDELITY MOCK-UP
- H** HIGH FIDELITY MOCK-UP



02. Approach


HKS

APPROACH

HEALTHCARE LIVING LABORATORY

 LEVELS:
3 storeys

 AREA
~ 5,000 sqm

 FUNCTIONS

- Prototyping space
- CAVE and VR rooms
- Viewing balcony
- Office space for consultants, govt developer, and hospital operator
- Meeting rooms



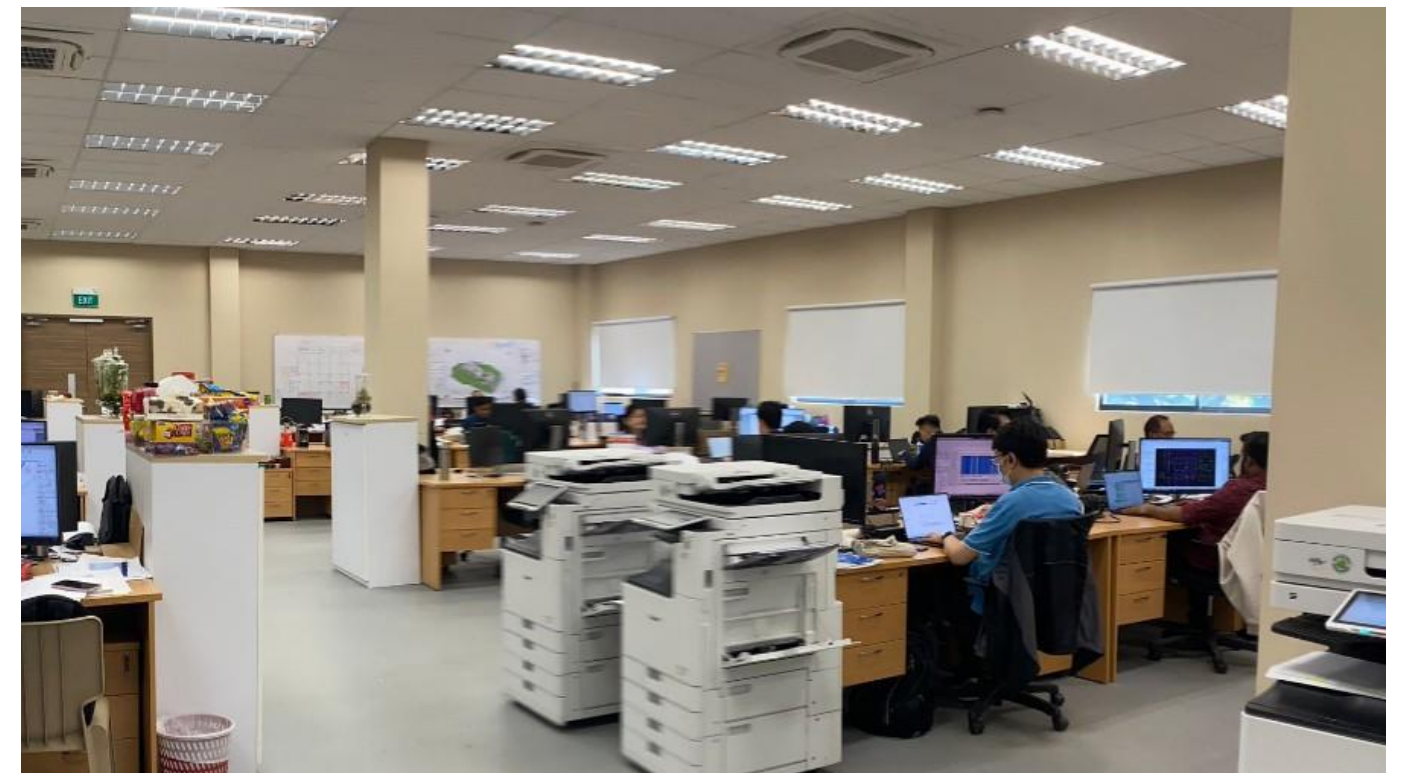
Prototyping space



CAVE/VR Rooms

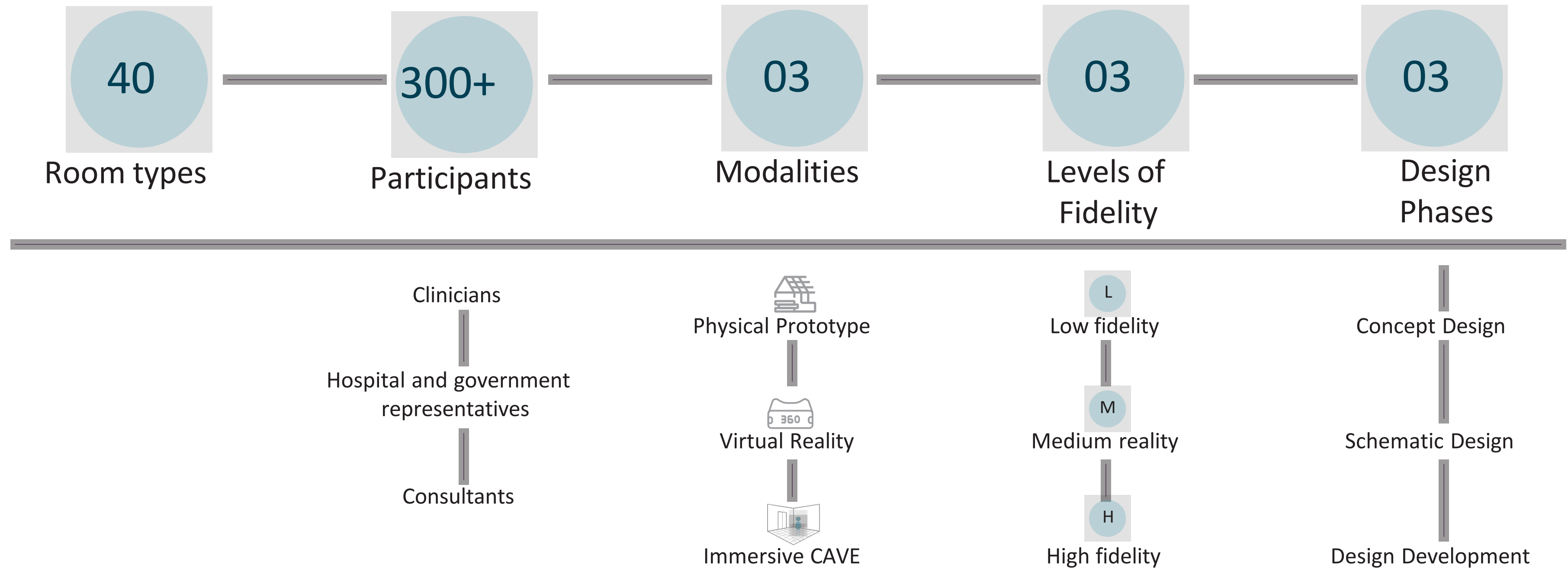


Viewing Balcony



Office Space

APPROACH
METHODOLOGY





APPROACH METHODOLOGY

CONCEPT DESIGN



Low Fidelity Mock-up

-  Physical prototype
-  Virtual Reality

2 evaluation rounds


40

Room types

SCHEMATIC DESIGN



Medium Fidelity Mock-up

-  Virtual Reality
-  CAVE

2 evaluation rounds

26

Room types

DESIGN DEVELOPMENT



High Fidelity Mock-up

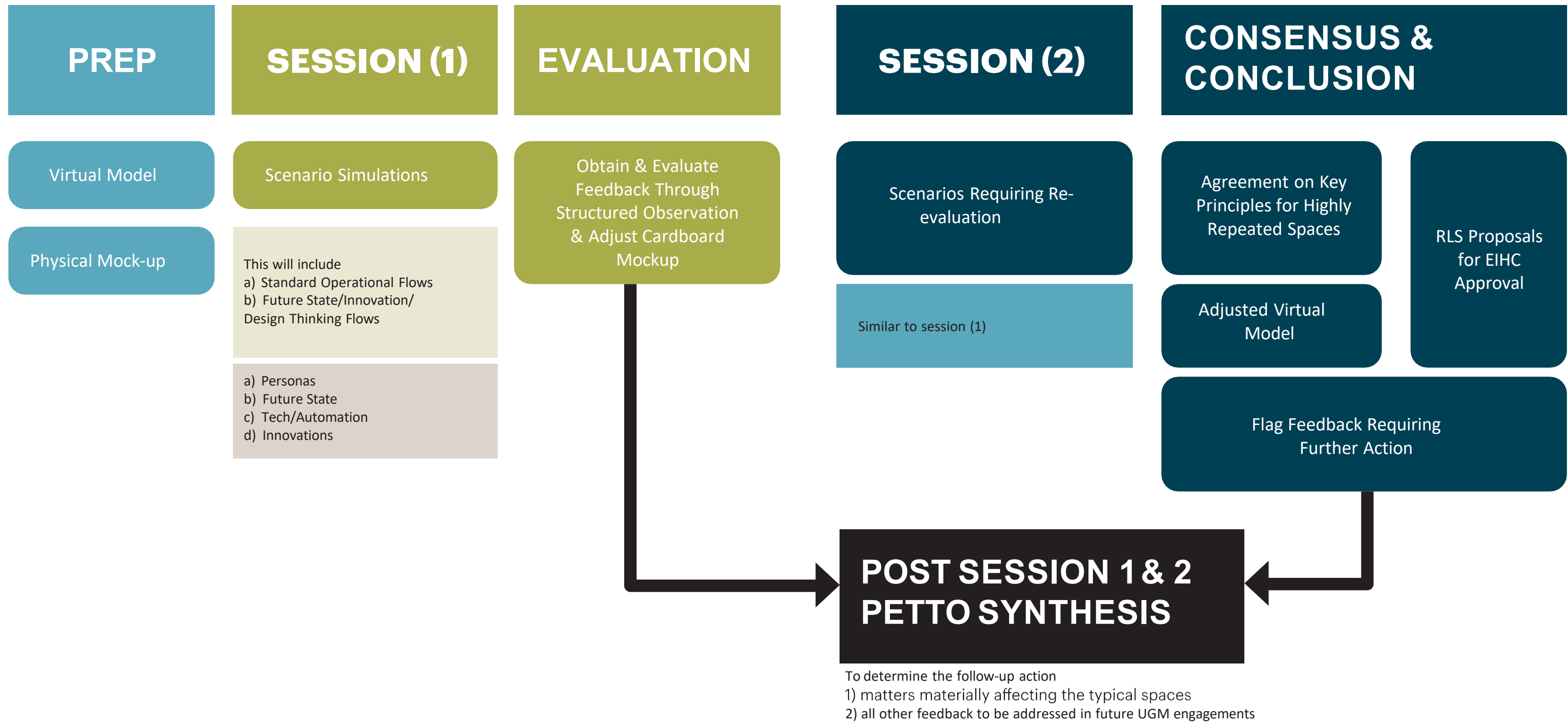
-  Physical prototype

3 evaluation rounds

12

Room types

APPROACH PROCESS



APPROACH

SCENARIO-BASED MOCK-UP EVALUATIONS

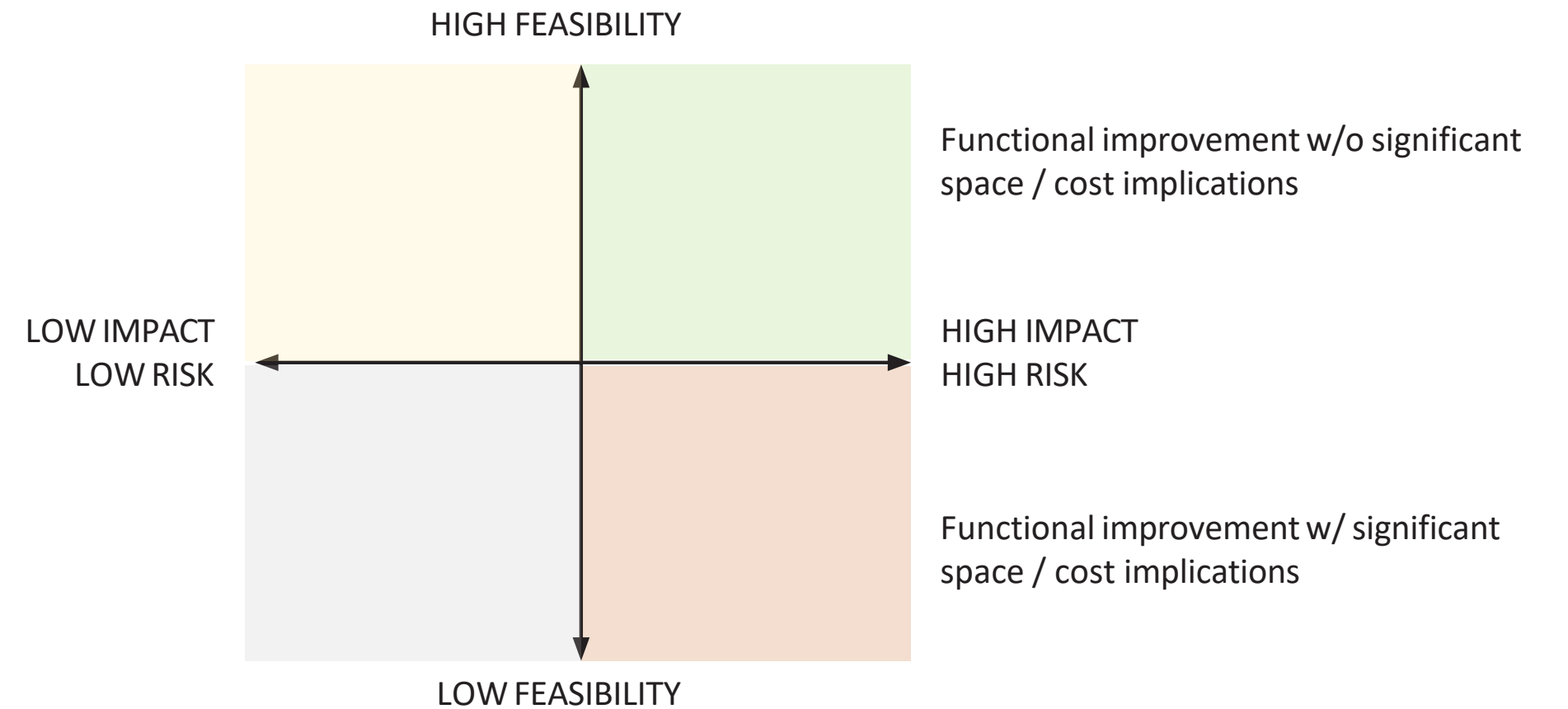
PETTO FRAMEWORK

- Person
- Environment
- Technology
- Tasks
- Operations

SYSTEM	COMPONENTS (EXAMPLE)	USER COMMENTS (EXAMPLE)
P erson	Doctors, Nurses, Patients, NOK	Staff requires back exit door, line of sight
E nvironment	Walls, Doors, Lights, AC, Temperature	Dimmable lights needed
T asks	Clinical tasks performed in room	Patient Resus trolley and E-cart needed
T echnology/Equipment	Medical Eqpt and IT	Pendants, Monitors, Sensors, IoT
O peration	SOPs, Future Projections	Physician attendant may not be needed in room in future

FEASIBILITY-IMPACT-RISK ASSESSMENT

categorize, and prioritize user insights from the evaluations for impact and feasibility based on cost, space and standardization.



APPROACH

SYNTHESIS AND ANALYSIS

302

comments were cataloged, resulting in changes within the rooms

Room/Space (if applicable)	Item Description / Summary (Context, Content, Conclusion)	PETTO	Impact	Feasibility	Action By (Responsible Party)	Due Date/ Deadline	Importance (Med. Planning Use Only)	Status (Click/Select)
Endoscopy Procedure (Small)	(Small Room): Change the label of the medication cabinet to consumables cart in the small endoscopy room	Environment	↑ (High)	↑ (High)	HKS	WG2 Spatial Mockup Report		Open/ Follow-up Required
Endoscopy Procedure (Small)	(Small Room): No objection to size of small endoscopy room	Environment			N/A	N/A		For Info/ No Action
Endoscopy Procedure (Small)	(Small Room): Nurse prep cart to be located next to endoscopic ultrasound	Environment	↑ (High)	↑ (High)	HKS	WG2 Spatial Mockup Report		Open/ Follow-up Required
Endoscopy Procedure (Small)	(Small Room): Current room size can accommodate patient bed 180 degree rotation for different procedures without extensive shifting of room equipment	Task			N/A	N/A		For Info/ No Action
Endoscopy Procedure (Large)	(Large Room): Allow for Drying Cabinet (Endodry) within Large & Large-Iso Endoscopy Room	Environment	↑ (High)	↑ (High)	EIHC/ CPG/ HKS	WG2 Spatial Mockup Report		Open/ Follow-up Required
Endoscopy Procedure (Large)	(Large Room): Change the label of the medication cabinet to consumables cart in the small endoscopy room	Environment	↑ (High)	↑ (High)	HKS	WG2 Spatial Mockup Report		Open/ Follow-up Required
Endoscopy Procedure (Large)	(Large Room): No objection to size of the room	Environment			N/A	N/A		For Info/ No Action
Endoscopy Procedure (Large)	(Large Room): Nurse prep cart to be located next to endoscopic ultrasound	Environment	↑ (High)	↑ (High)	HKS	WG2 Spatial Mockup Report		Open/ Follow-up Required
Endoscopy Procedure (Large)	(Large Room): No objection to general arrangement of equipment	Environment			N/A	N/A		For Info/ No Action
Endoscopy Procedure (Large)	(Large Room): C-Arm to be confirmed if fixed C-Arm or mobile C-Arm	Tech	↑ (High)	↑ (High)	EIHC/ CPG	Schematic Design		Open/ Follow-up Required
Endoscopy Procedure (Large-Iso)	(Large-Iso Room): Lead Apron Rack for degowning to be located at gown down/ room	Environment	↑ (High)	↑ (High)	HKS	WG2 Spatial Mockup Report		Open/ Follow-up Required
Endoscopy Procedure (Large-Iso)	(Large-Iso Room): Allow for Drying Cabinet (Endodry) within Large & Large-Iso Endoscopy Room	Environment	↑ (High)	↑ (High)	EIHC/ CPG/ HKS	WG2 Spatial Mockup Report		Open/ Follow-up Required
Endoscopy Procedure (Large-Iso)	(Large-Iso Room): Change the label of the medication cabinet to consumables cart in the small endoscopy room	Environment	↑ (High)	↑ (High)	HKS	WG2 Spatial Mockup Report		Open/ Follow-up Required

APPROACH DESIGN ITERATION

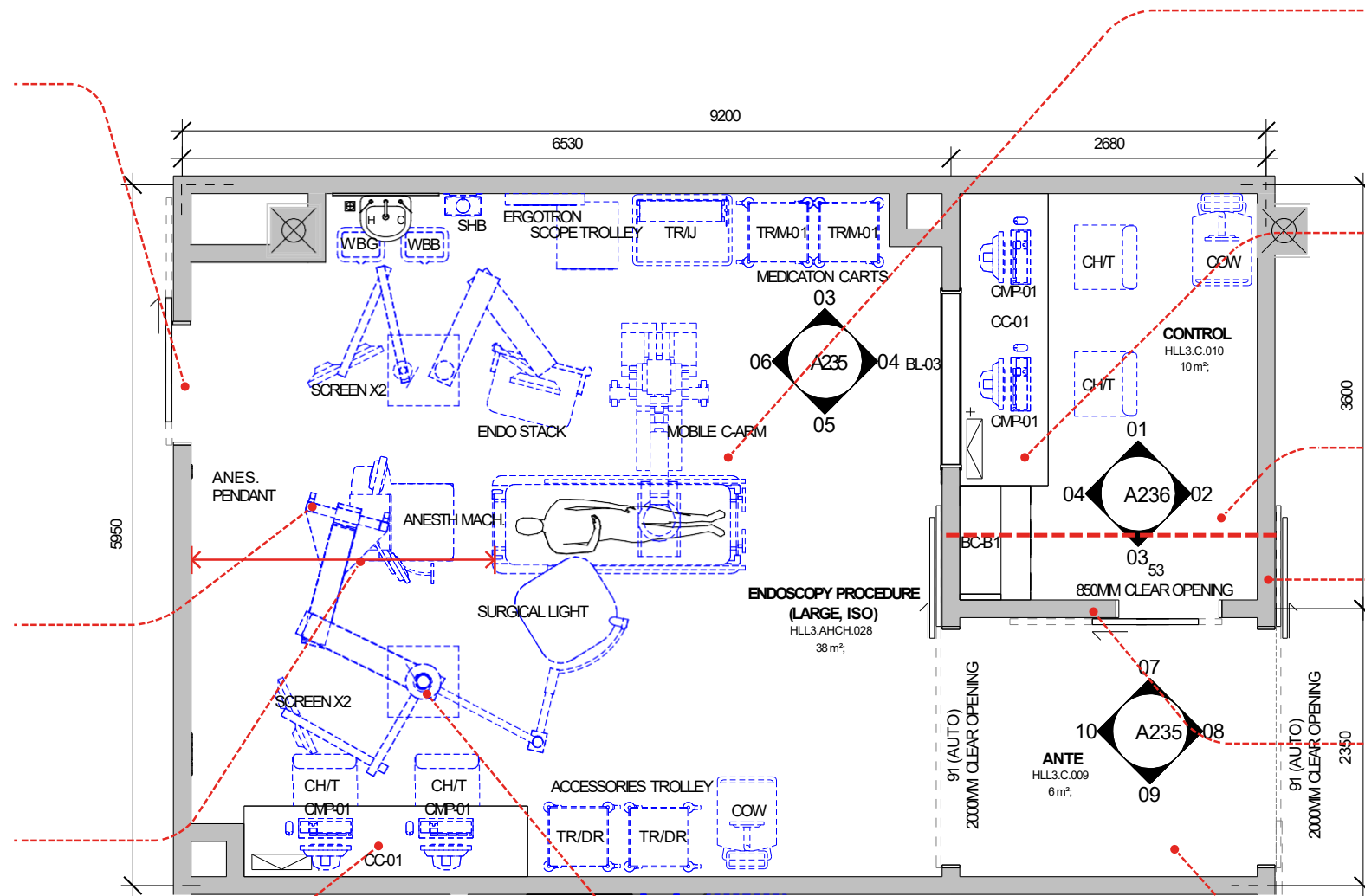
Endoscopy Session 1- User Feedback

Recommendation: Add a gown down room (ante room) with negative pressure.

Comments: Physiological monitoring on anesth. pendant.

Comments: Minimum 3m distance from west wall to patient bed.

Recommendation: Move workstation to the reporting room. No fixed equipment in the room.



Recommendation: Move patient bed to the north. Make space for C-arm to be pushed out when the transfer bed is coming in.

Recommendation: Make L-shaped table for more work space. 2 fixed workstations + 1 COW space + table top space for various items.

Recommendation: Name the room as reporting room. No separate control room is required.

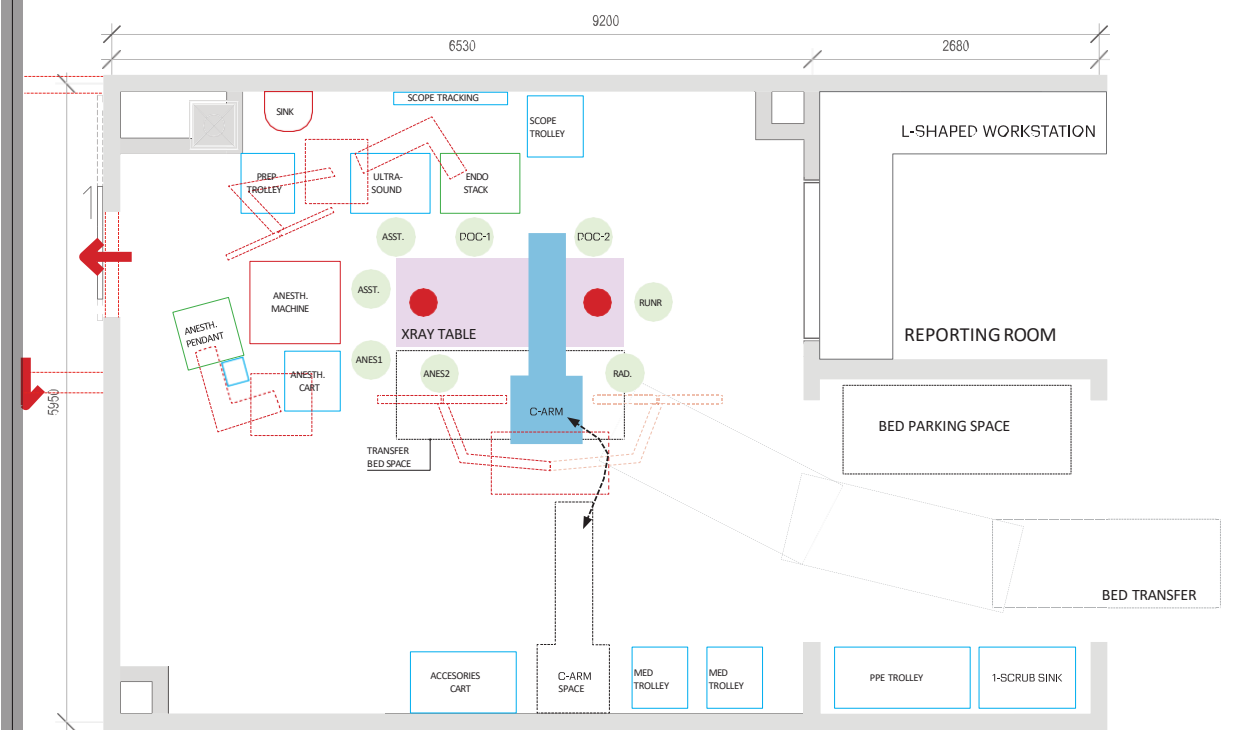
Recommendation: Remove wall between corridor and reporting room.

Recommendation: Delete door from reporting room to ante room. Shift wall north to enlarge ante room.

Recommendation: Add 1 scrub sink, PPE trolley to the ante-room.

Recommendation: Move screens for endoscopist (4 no. including slave monitors for C-Arm) to a central position so as to swivel to other side and use for colonoscopy.

Revised Layout





03. Mock-up Evaluations

HKS



CONCEPT DESIGN

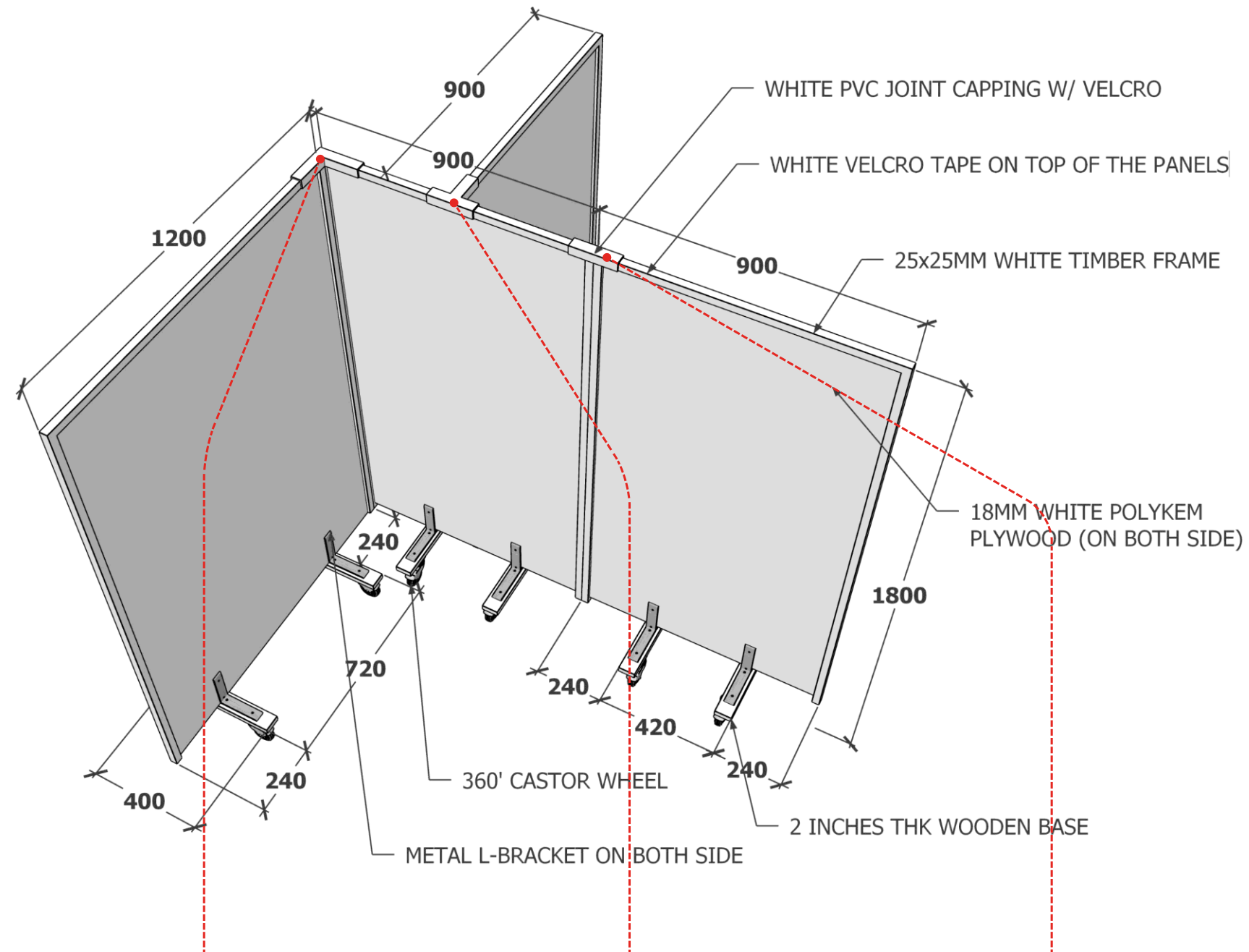
LOW FIDELITY PHYSICAL MOCK-UPS





CONCEPT DESIGN

LOW FIDELITY PHYSICAL MOCK-UP PREPARATION



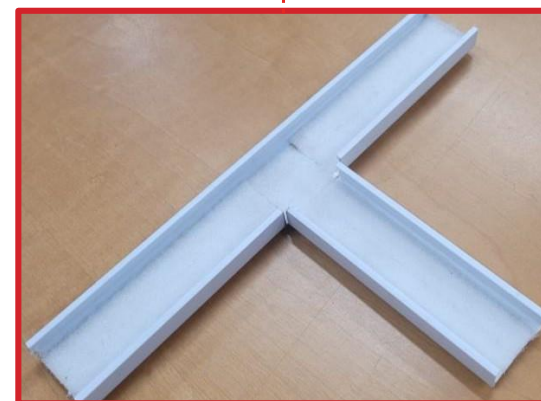
Production of Wooden Panels



Taping and Placement of Walls On-site



PVC JOINT TYPE A



PVC JOINT TYPE B



PVC JOINT TYPE C



Mock-up Equipment & Props

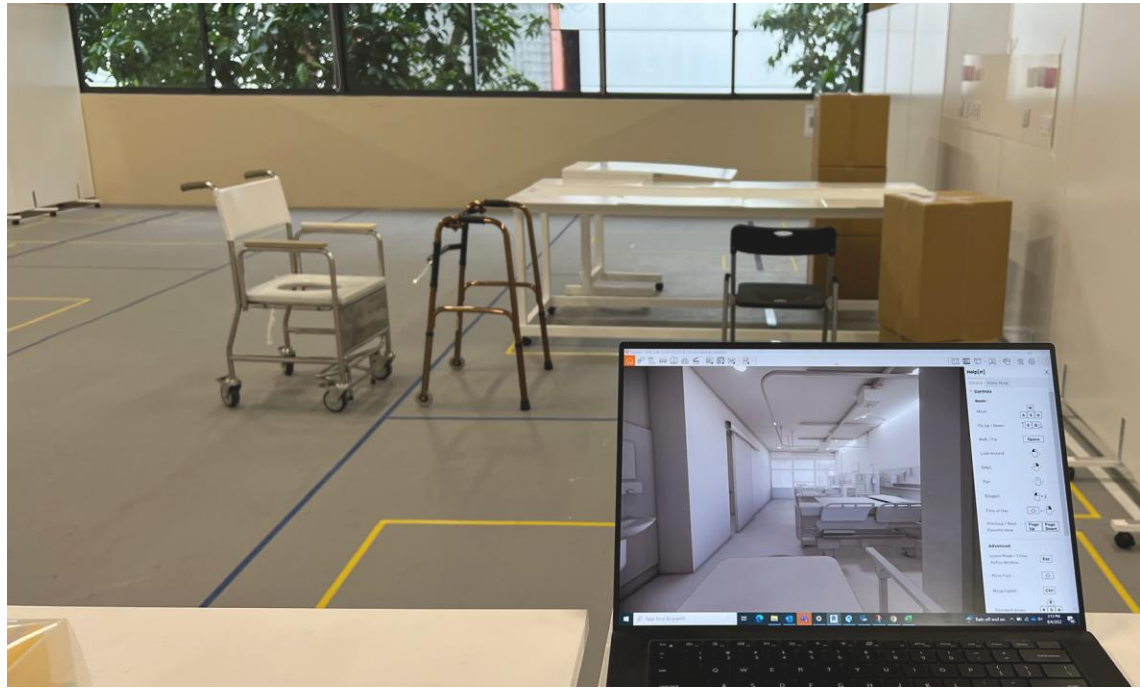




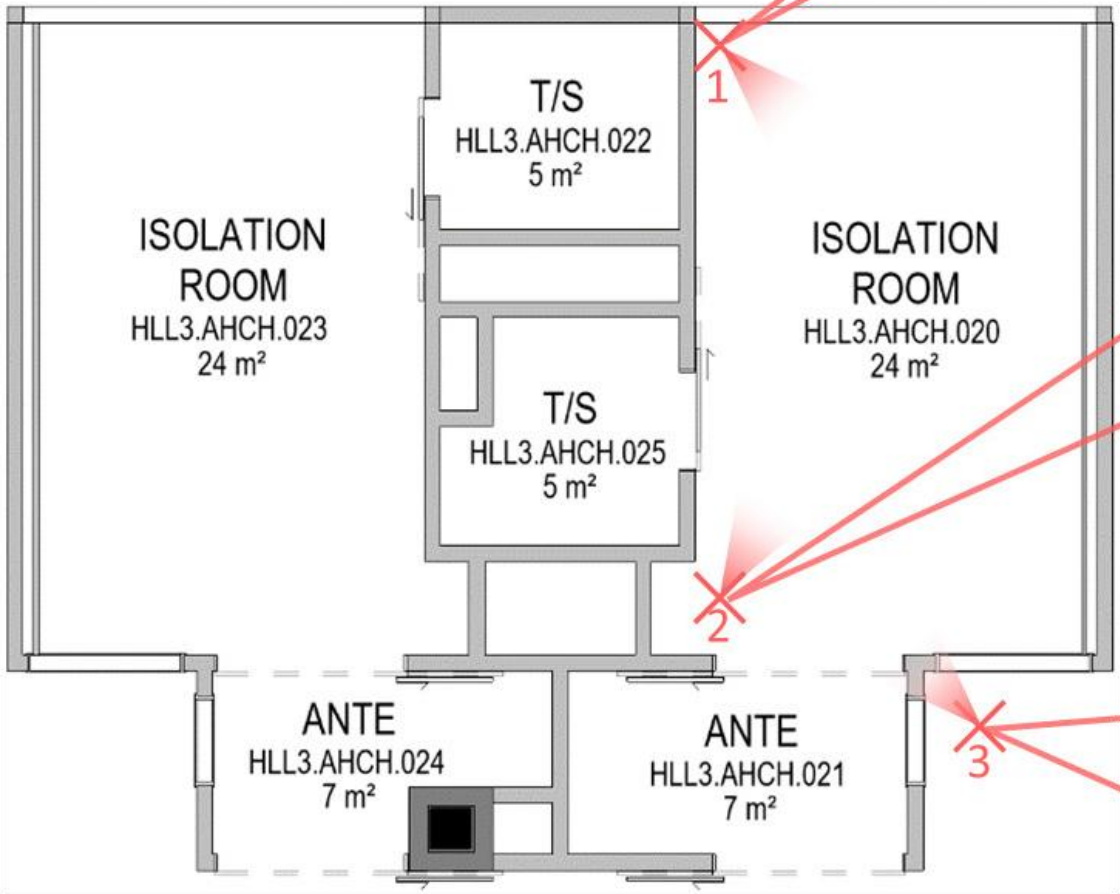
CONCEPT DESIGN LOW FIDELITY VIRTUAL REALITY



Mock-up Space



Physical props and virtual visualization



Virtual Model with scannable QR Code





CONCEPT DESIGN

LOW FIDELITY VIRTUAL REALITY



Demonstrate scanning of QR Code



Scan QR Code





SCHEMATIC DESIGN

MEDIUM FIDELITY - CAVE – 5-DIMENSIONAL IMMERSIVE PLATFORM



ENGAGING COMMUNITY LEADERS

WHY: to review public spaces within the campus and learn from their experience with similar technologies

WHO: Ministry officials, University students , Overseas delegations

HOW: ~ 23 such sessions

MODEL REQUIREMENT: Required a higher level of model detailing.



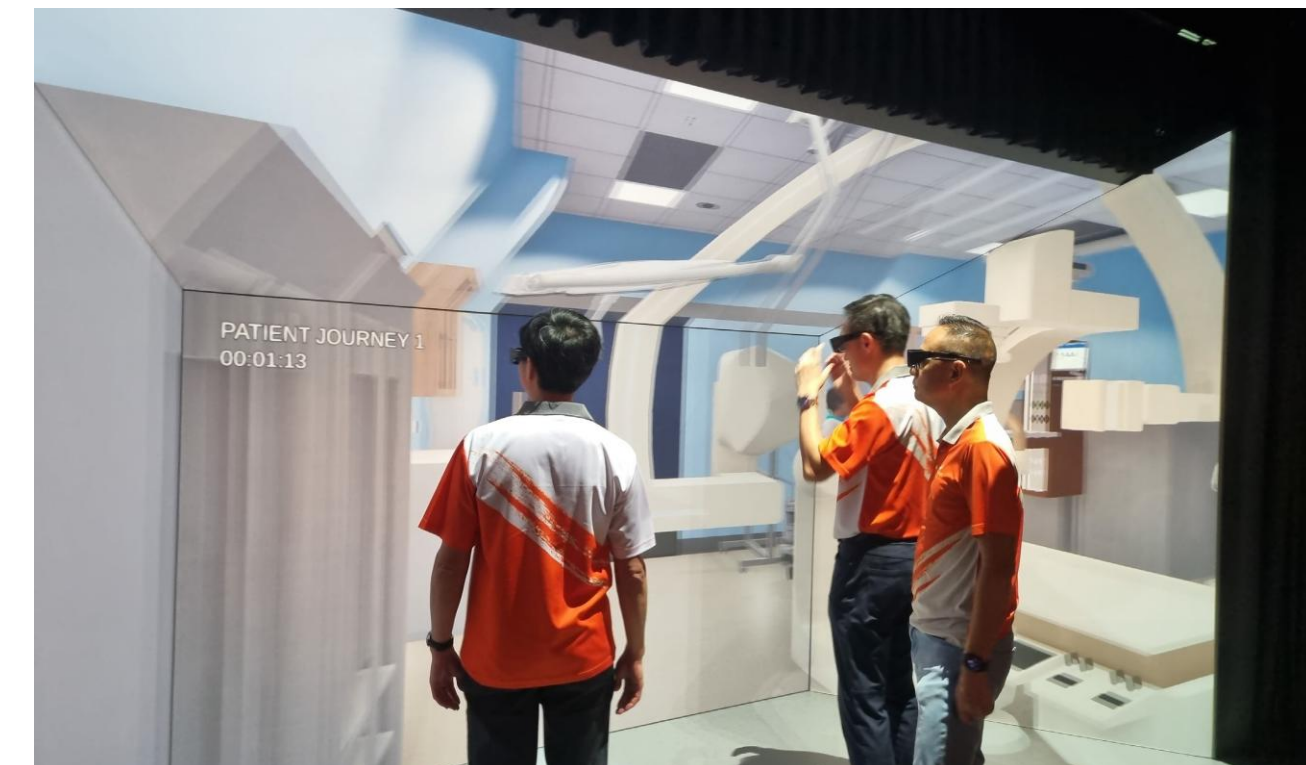
ENGAGING CLINICAL USERS

WHY: to review specialty rooms/spaces for details

WHO: Clinical users like nurses, providers, surgeons

HOW: project 2D Data on one side of the room and engage them in the CAVE

MODEL REQUIREMENT: Required working models and not finished to Interior Design grade.



ENGAGING FACILITY MANAGERS

WHY: to ensure feasibility of day-to-day functioning such as access into the ceilings, ability to maintain various engineering systems such as plumbing, ACMV, IT etc.

WHO: Facility managers

MODEL REQUIREMENT: Required all co-ordinated engineering models,



DESIGN DEVELOPMENT

HIGH FIDELITY PHYSICAL MOCK-UPS

High fidelity mock-ups were an opportunity for users to provide feedback based on the insights gained from earlier prototyping stages.

- materials for certain key areas were repeated in several spaces such as patient rooms, consult rooms etc.
- finishes and colors were not of the final build quality
- real medical equipment such as trolleys and Beds were put in place to enact real-world patient transfer and other scenarios.





04. Takeaways

HKS

TAKEAWAYS

Implications for Practice

WHY MOCK-UPS?

Early confirmation

Establishing parameters for typical and highly repetitive modules enabled:

- Smooth transition from Concept to Schematic Design
- Reduced time-consuming studies and re-work in the later stages
- Ensured adequate space was dedicated to critical clinical processes

Building Enthusiasm and User Engagement

- Clinicians were enthusiastically engaged in the project from an early stage where there was still flexibility to test innovations and improve on existing designs
- The team was able to obtain early “buy-in” which expedited approval Processes and reduced adverse comments in later stages.

TAKEAWAYS

Implications for Practice

Mock-up space (HLL) was designed with same column grid module as actual hospital – this allowed for accurate simulation of structural constraints.

Plywood panels on wheels: Painted white, in 2 sizes of 900 and 1.2m allowed us to make a wide variety of rooms and adjust room dimensions on the fly, with velcro clips for stability. Low walls simulated windows. The panels are re-usable, allowing multiple rounds of testing to be conducted, and can continue to be used in future.

Moveable equipment: Scenario testing was greatly enhanced by wheeled carts simulating sinks, beds, and trolleys, boxes of various size for equipment, and actual carts, wheelchairs, and beds borrowed from partner hospitals.

Technology: QR codes pasted on the walls allowed clinicians to do self-guided tours and better imagine the space. The physical mock-ups at all stages were supplemented with 3D models as both were needed during the review.

TAKEAWAYS

Lessons Learned

01

Visit existing facilities and precedent study prior to mock-ups:

- 1. Invest time to do a cross-sectional benchmarking before embarking on the mock-up journey.*
- 2. Define the base design prior to iterating, so that there is a basis of comparison for cost/benefit analysis.*
- 3. An honest and transparent analysis of ongoing problems and staff workarounds would reduce risk of repeating mistakes, or “reinventing the wheel”.*

02

Balance expectations: Create Flexible, Collaborative Mock-Ups to address needs of different audiences

03

Recognize pros and cons of an in-house VR development team versus external consultant



Thank you...

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HKS

HKS website

