

Dept. of Architecture &  
Engineering Design Centre  
Cambridge University



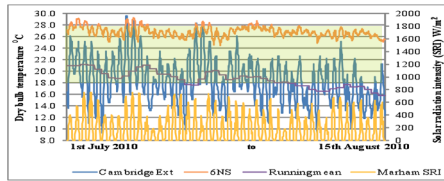
Design Transformation  
Group, DDEM,  
The Open University

De<sup>2</sup>RHECC

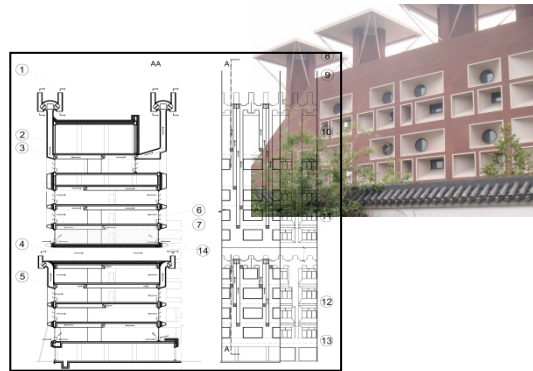
Design and Delivery of Robust Hospital  
Environments in a Changing Climate

# Design and Delivery of Robust Hospital Environments in a Changing Climate

## Local Climate Models



## Adaptation Strategies



## Building Simulations

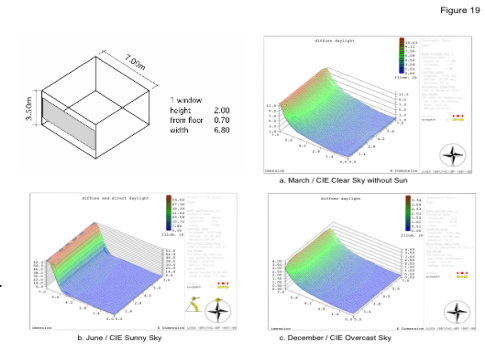
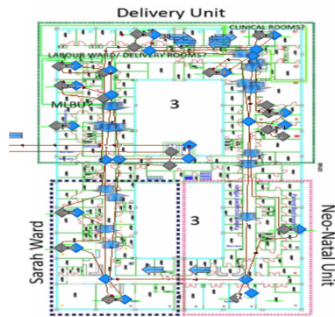
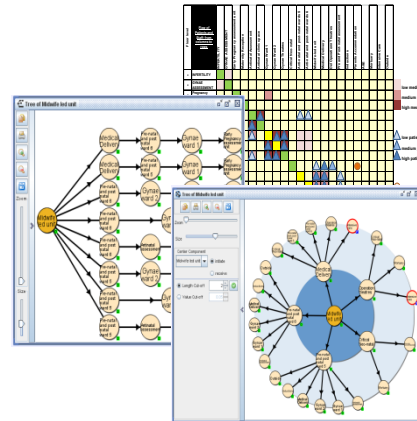


Figure 19

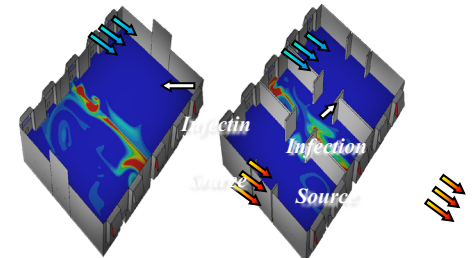
## “In-use” Modelling and Simulation



## Connectivity Models



## Infection Pathway Studies



**De<sup>2</sup>RHECC**

Design and Delivery of Robust Hospital Environments in a Changing Climate

# Resilience

Shocks to infrastructure, random attack or weather events (incl COE)



# Effects of Climate Change on Health

## Rising temperatures & heat waves

H/W life threatening (2003 - 30,000 deaths)

- Not a harvesting effect
- Night reprieve

- *young children*
- *the elderly*
- *cardiac & kidney disease sufferers*
- *people with disabilities*
- *open-air or heat process workers*

# Understanding resilience: multiplicity of definitions

## British Standard BS25999 for Business Continuity Management (BCM PT 1&2)

### *Dictionary definition*

Rebounding, recoiling. (*OED*)

### *Engineering resilience*

Focuses on maintaining an equilibrium

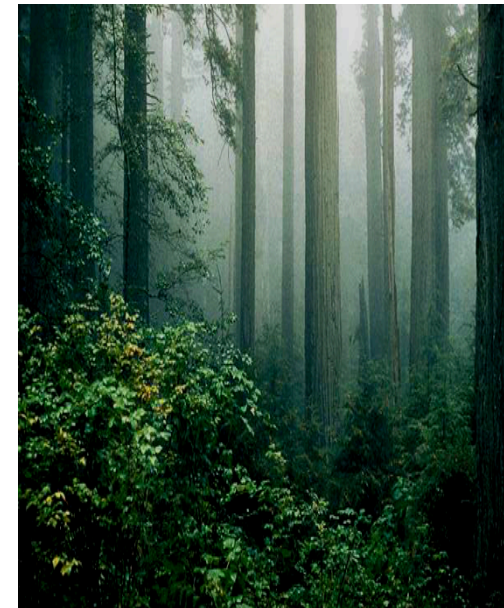
### *Materials Resilience*

Materials absorb energy when deformed and release it when unloaded *G.E.Dieter 1961*

### *Ecological Resilience*

The level of disturbance that can be absorbed without changing essential structure, control mechanisms and function

- The degree of system self-organisation
- Capacity for adaptation/ transformation



# Delphi Study

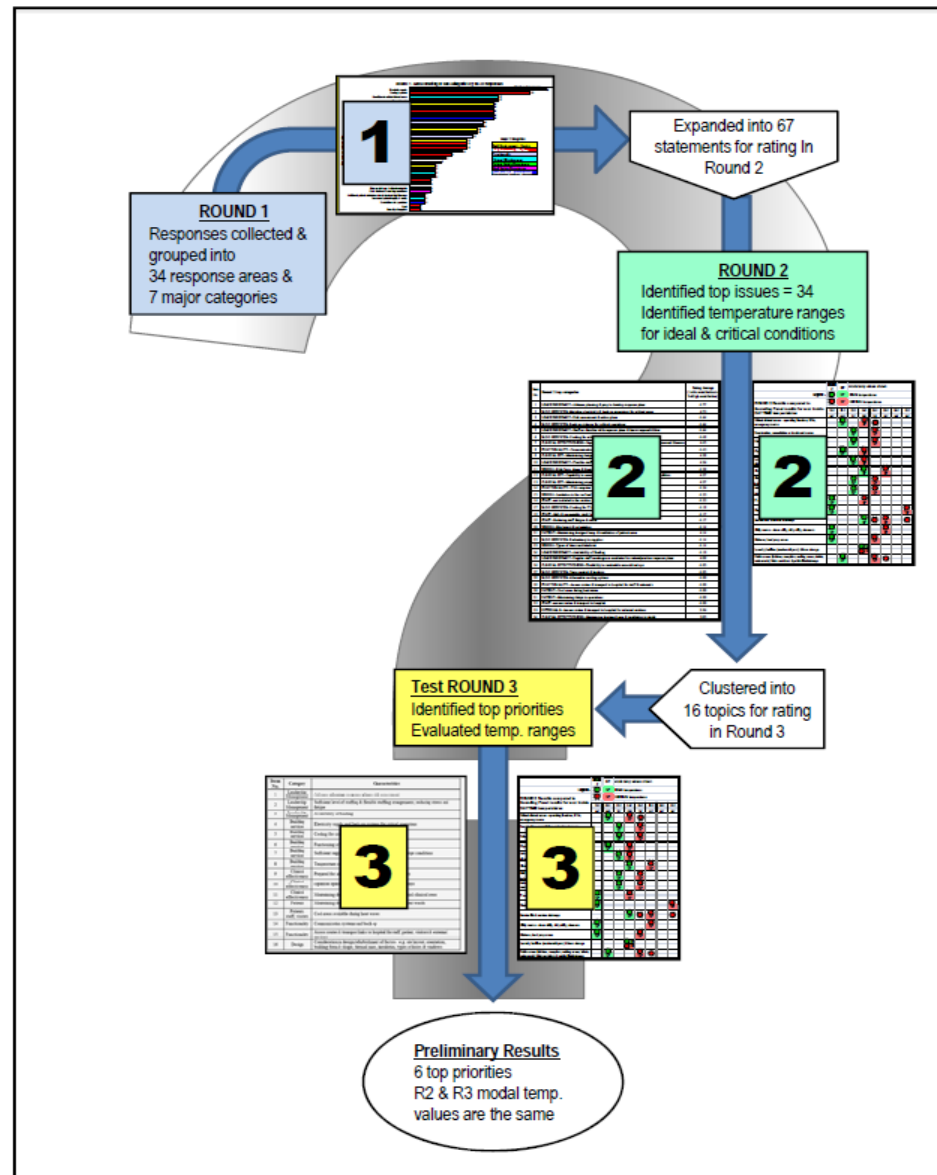


Figure 1. Delphi process for defining resilience illustrates the three-round survey, the key

# Staff view of resilience

Respondent	K	I	G	M	A	H	S	P	E	J	B	L	Tot
Identity (professionalism)	✓				✓						✓	✓	4
Response under pressure	✓	✓		✓	✓	✓	✓	✓	✓				8
Resources - soft and hard (Capacity/ flexibility)		✓	✓	✓		✓					✓	✓	6
Recovery from adversity								✓					1
Sensitivity/support									✓		✓		2
Structure and agency (choice)										✓			1
Efficiency (success/value)			✓									✓	2

**Resilience:** The ability to cope with change or pressure and recover quickly from difficult situations; while maintaining a sense of professionalism; and using resources intelligently to sensitively support patient care.

# Resilience can emerge (not guaranteed)



- property of systems
- only becomes visible when systems are tested by shocks or constraints.



# Resilience

## Surprise

- *Continuous evaluation*
- *a sense of unease*
- *Resources; flexibility/  
slack*
- *redundancy/  
distributed systems*



# Too resilient?



# Options

- Adaptation/ reconfiguration
- Changing models of care

*Change will involve some degree of risk*



# Modelling hospital complexity

- Patient journeys
- People flow
- Dependencies
- Connectivities
- Environment



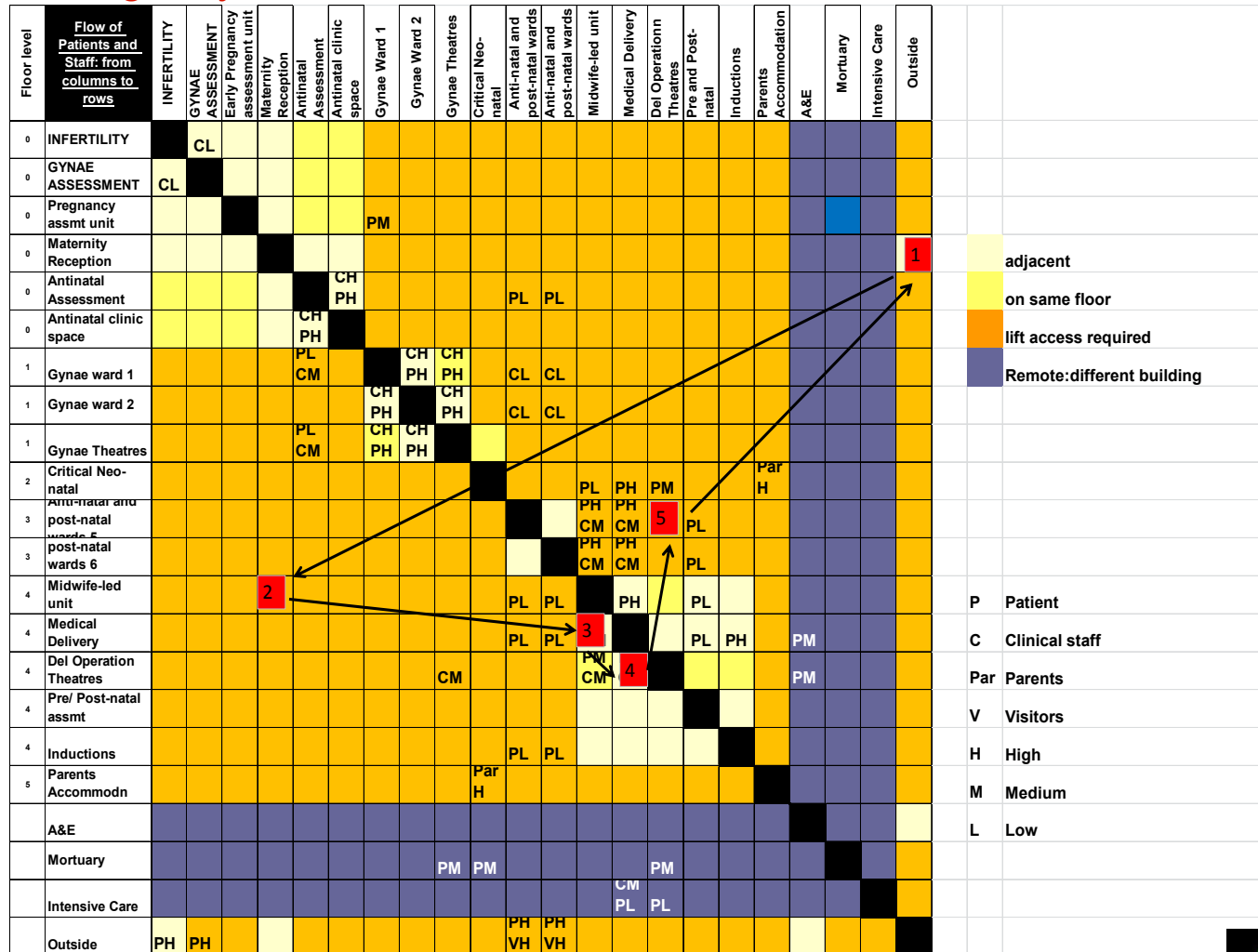
# Medical dependencies & change

Floor level	Flow of Patients and Staff: from columns to rows	INFERTILITY	GYNAE ASSESSMENT	Early Pregnancy assessment unit	Maternity Reception	Antinatal Assessment	Antinatal clinic space	Gynae Ward 1	Gynae Ward 2	Gynae Theatres	Critical Neo-natal	Anti-natal and post-natal wards 5	Anti-natal and post-natal wards 6	Midwife-led unit	Medical Delivery	Del Operationn Theatres	Pre and Post-natal assessment	Inductions	Parents Accommodation	A&E	Mortuary	Intensive Care	Outside
0	INFERTILITY	Black	Light Pink																				
0	GYNAE ASSESSMENT	Light Pink	Black																				
0	Pregnancy assmt unit			Black				Light Pink															
0	Maternity Reception				Black																		
0	Antinatal Assessment					Black																	
0	Antinatal clinic space						Black																
1	Gynae ward 1			Black		Light Pink		Black	Light Pink	Dark Red		Light Pink	Light Pink										
1	Gynae ward 2							Black	Dark Red	Dark Red													
1	Gynae Theatres					Light Pink		Dark Red	Dark Red	Black													
2	Critical Neo-natal										Black												
3	Anti-natal and post-natal wards 5											Black											
3	post-natal wards 6												Black										
4	Midwife-led unit													Black									
4	Medical Delivery													Light Pink	Black								
4	Del Operation Theatres									Light Pink					Black	Dark Red							
4	Pre/ Post-natal assmt																Black						
4	Inductions																	Black					
5	Parents Accommodn																		Black				
	A&E																			Black			
	Mortuary																				Black		
	Intensive Care																					Black	
	Outside																						Black

low medical  
medium medical  
high medical

# Patient journey

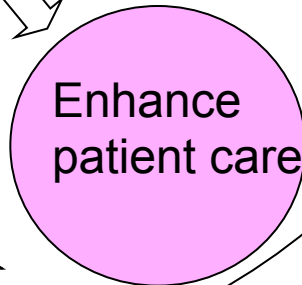
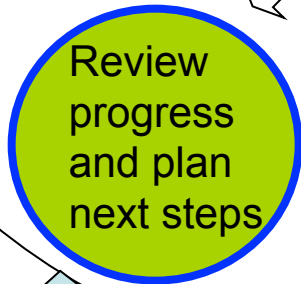
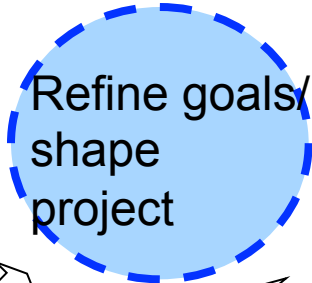
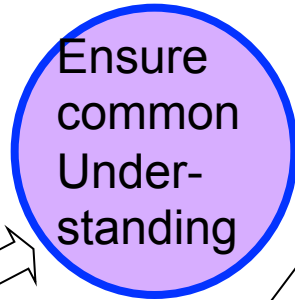
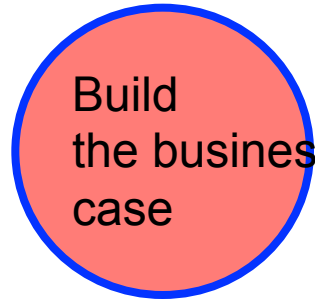
## Emergency caesarean



# MANAGE

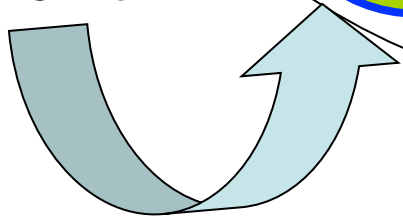
EXPLORE

CREATE



EVALUATE

Starting Point



# Building health and resilience



**This runs on  
money and  
makes you fat**



**This runs on  
fat and saves  
you money**

***thank you***