Evaluation of design strategies for flexibility and adaptation in healthcare buildings

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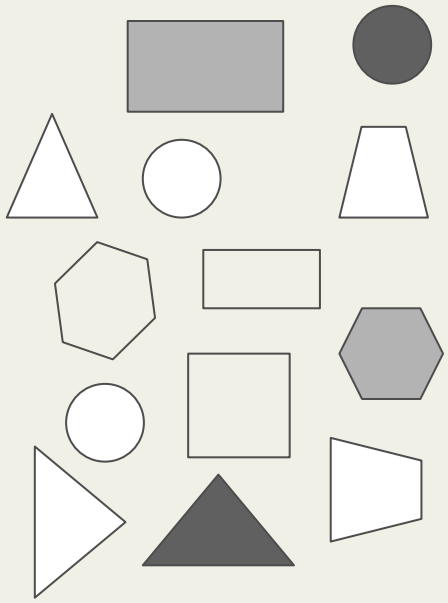
KEY PROPOSITIONS

There's general agreement that design for flexibility and adaptation is desirable in healthcare infrastructure

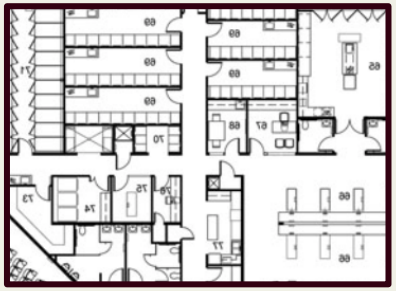
Numerous alternative design strategies for flexibility and adaptation have been put forward

Alternatives must be **evaluated** to identify the preferred design strategy



alternative design strategies

evaluation process



preferred design strategy

TWO TYPES OF EVALUATION

RETROSPECTIVE

Task: evaluation of actual performance after construction and use

Method: data collection – surveys, observations, records

Result: how did the design strategy actually perform?

Backward looking – evaluating old decisions

PROSPECTIVE

Task: evaluation of expected performance at design stage

Method: simulation – calibrated with data from buildings in use

Result: how is the proposed design strategy expected to perform?

Future oriented – making new decisions

*Studies carried out by Dr Nirit Pilosof

RETROSPECTIVE EVALUATION

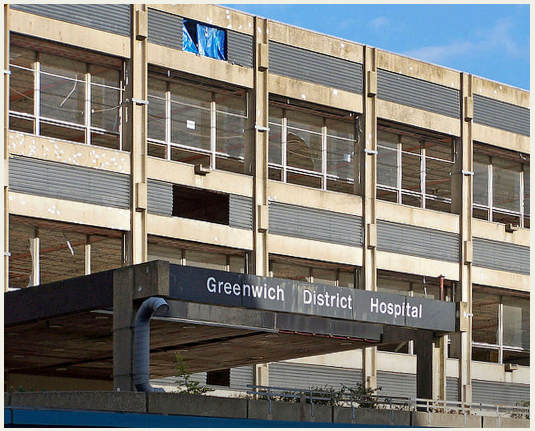
Case studies

SIMPLE/PRAGMATIC

Northwick Park Hospital,
London 1965-72
(Llewellyn-Davies Weeks)

***Sammy Ofer Heart Building**,
Israel 2008–11
(Sharon/Ranni Ziss)

COMPLEX/EXPENSIVE



Greenwich Hospital,
London 1965-72
(DHSS (Government))

***McMaster Health Science Centre**, Canada 1965-72
(Zeidler}

RETROSPECTIVE EVALUATION

Case study findings – summary

SIMPLE/PRAGMATIC

Northwick Park Hospital – 1965-72

- in use after 50 years
- fewer internal changes than expected
- unsuitable for today's needs
- was the strategy a success or failure?

Sammy Ofer Heart Building – 2008–11

- capacity for future growth used up in 8 years
- assignment of uses to floors inefficient and hard to change
- long-term performance uncertain

COMPLEX/EXPENSIVE

Greenwich Hospital – 1965-72

- demolished after 30 years
- was the strategy a failure?

McMaster Health Science Centre – 1965-72

- in use after 50 years
- fewer changes than expected
- was the strategy over-designed?

RETROSPECTIVE EVALUATION

Conclusions

Even with good data, it is hard to be certain whether the design strategy for flexibility and adaptation in an existing building was a success or failure:

- every life-history is a special case, but a successful strategy must work for many different life histories
- managerial and other issues impinge on the way a hospital evolves

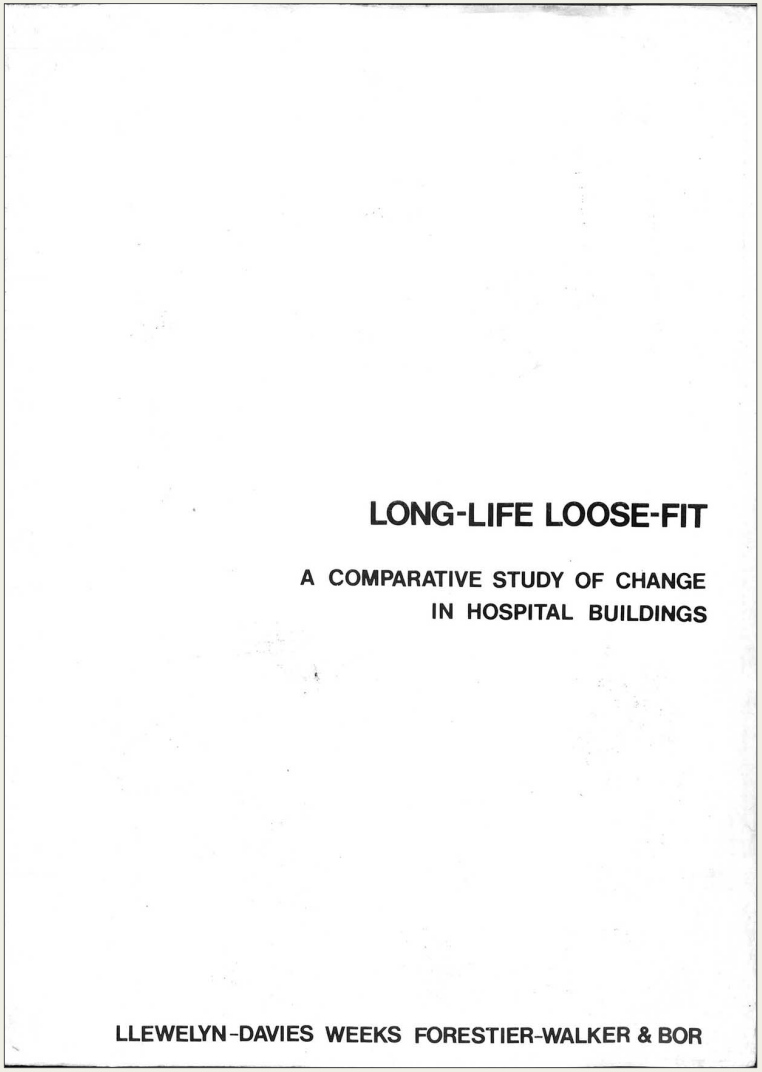
The success or failure of past designs (if it can be determined) may have limited relevance for current requirements and new designs

Learning from hospitals in use is the main source of knowledge/understanding for the design of new hospitals

PROSPECTIVE EVALUATION

Peering into the future – surveys are impossible, hence the need for simulation

Precedent for prospective evaluation: Llewelyn-Davies study of 1973

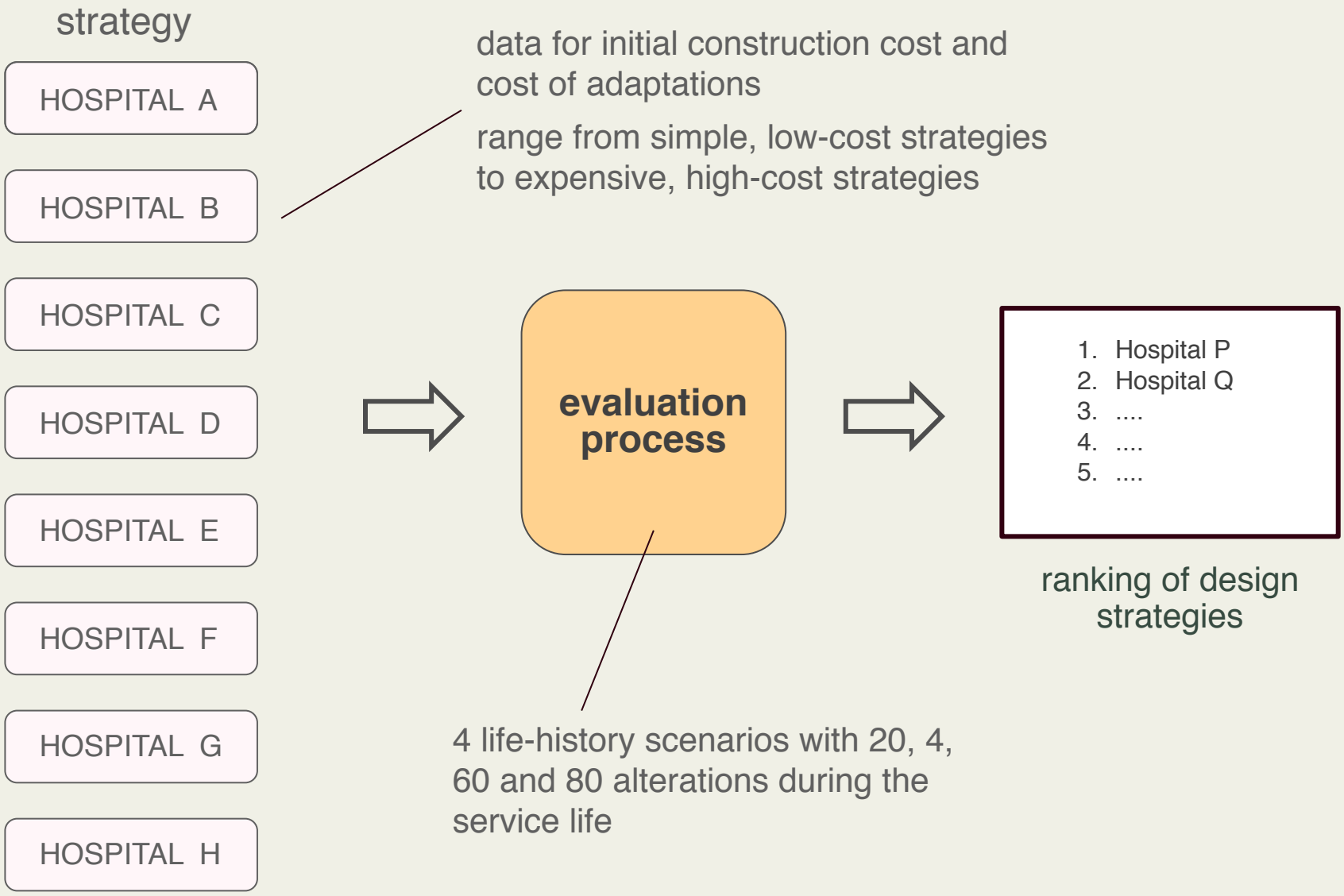


Northwick Park Hospital

Objective: to make a systematic comparison of alternative design strategies then being proposed

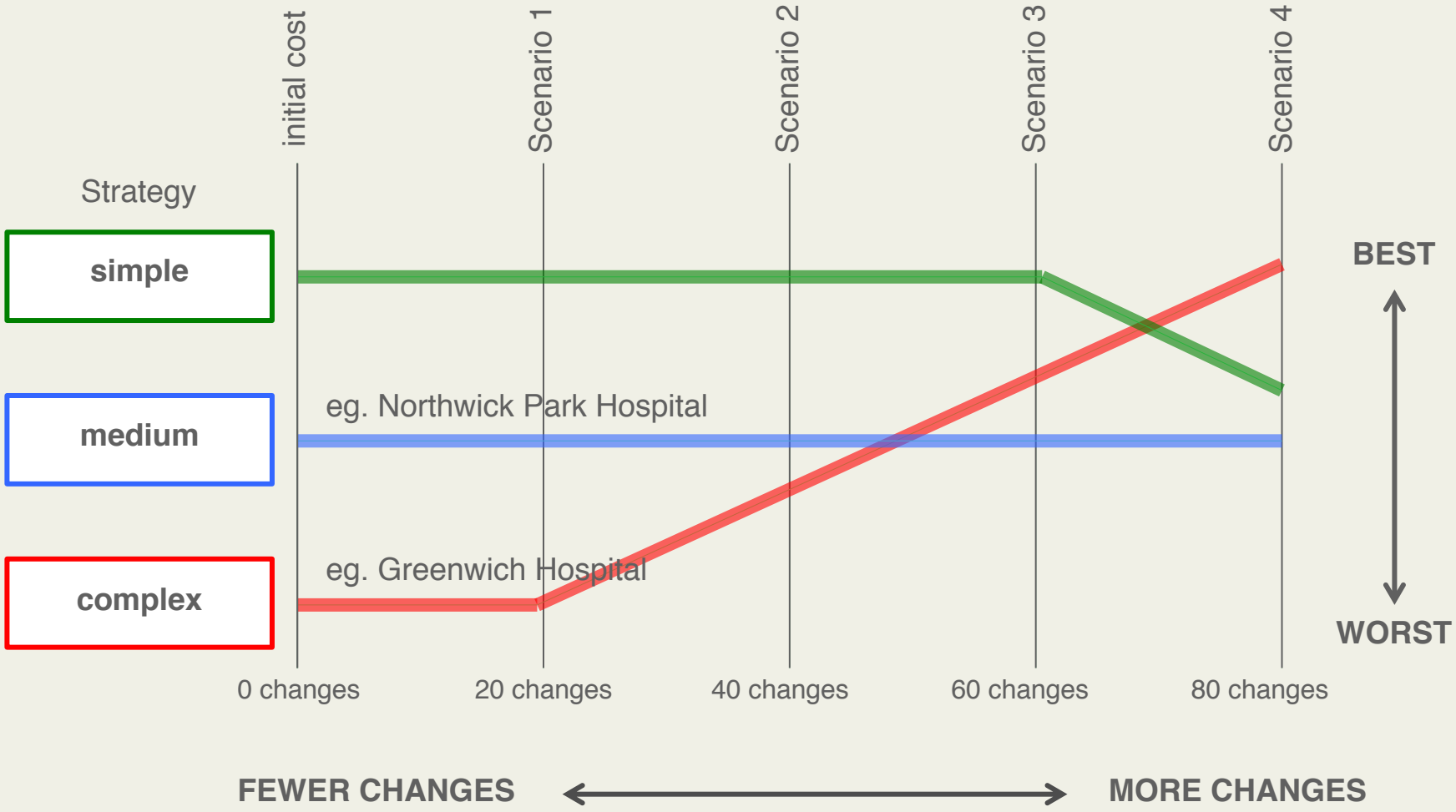
A cost-based study, assessing whether the extra construction cost of complex/expensive strategies for flexibility and adaptation would be justified by service life savings

Llewellyn-Davies study of 1973
8 alternative design strategies and 4 life-history scenarios



Llewellyn-Davies study of 1973

Ranking according to expected life-cycle cost (initial cost + cost of changes) for the four (or five) scenarios



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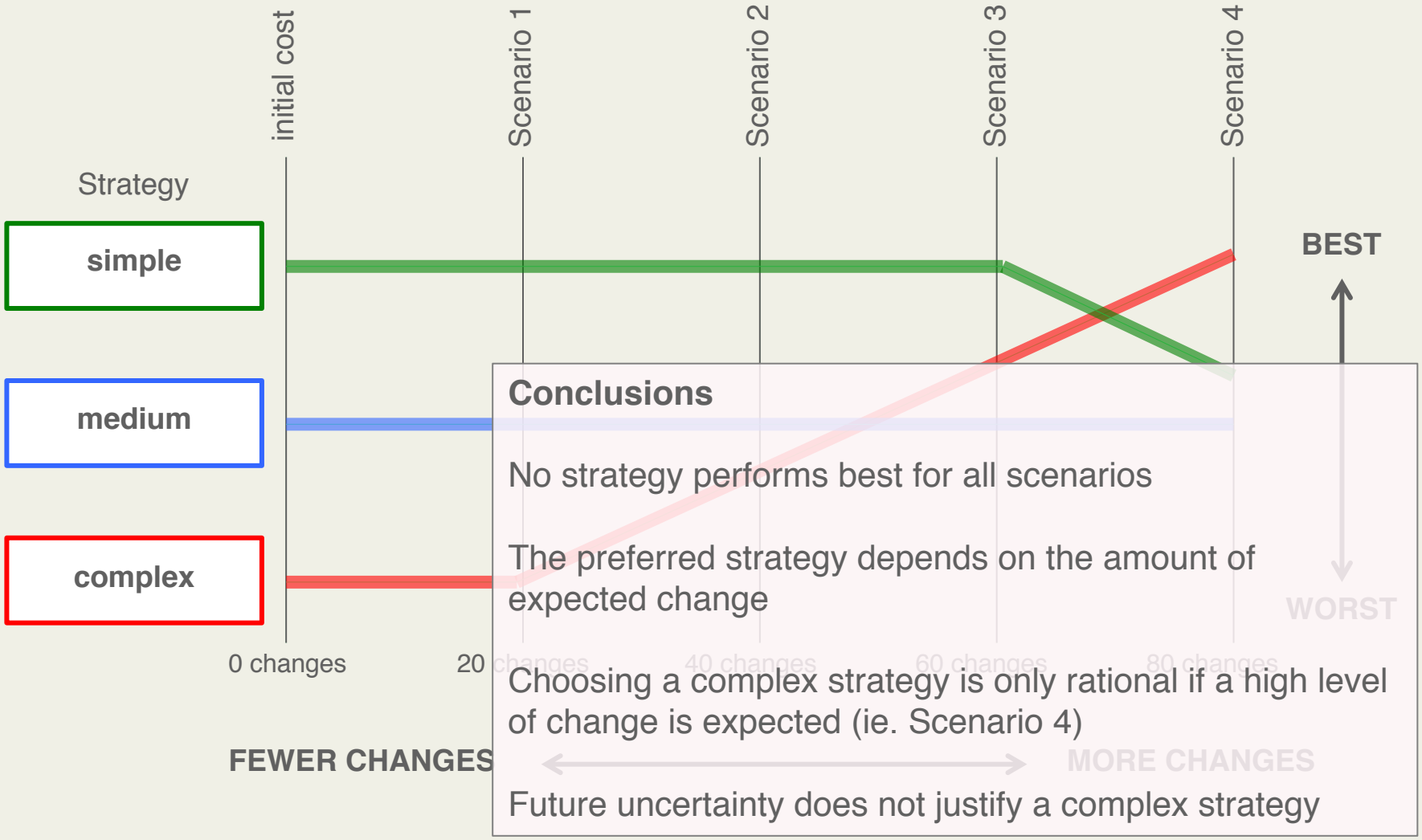
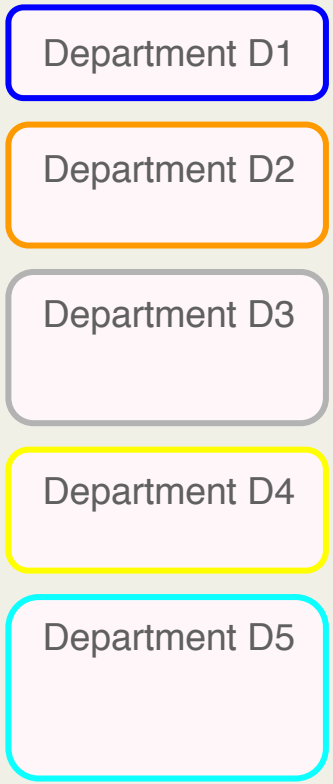


PROSPECTIVE EVALUATION – UPDATED

New example using computer-based simulation

At design stage the future life-history of a hospital cannot be predicted, so many computer-generated life-histories (Monte Carlo simulation) are used to evaluate alternative design strategies



WORKED EXAMPLE

Hospital with 5 departments of varying size (5,000 to 12,000 m2)

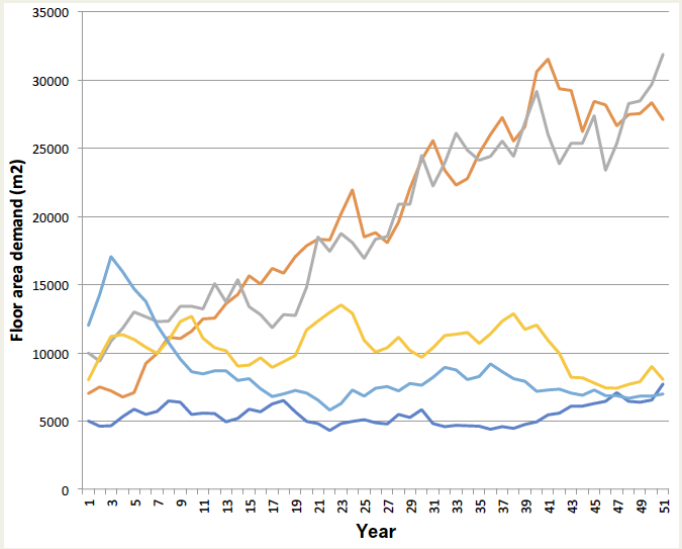
Each department's floor area demand can grow or shrink in each year of the simulated 50-year life-histories

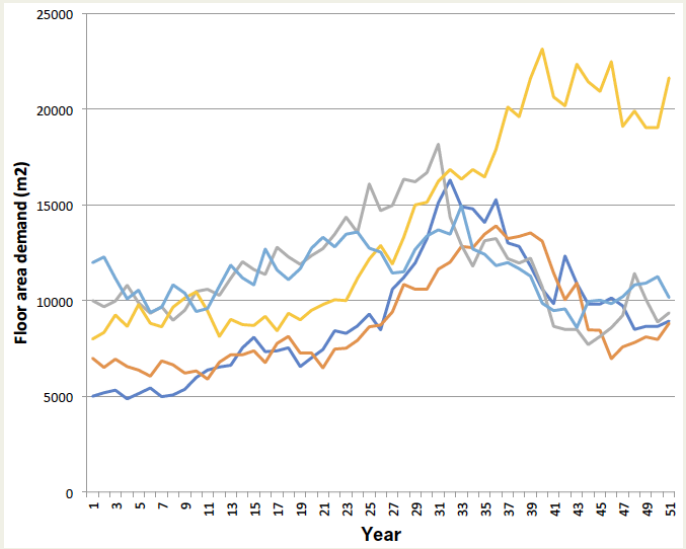
Floor area is exchanged between growing and shrinking departments, incurring and adaptation cost

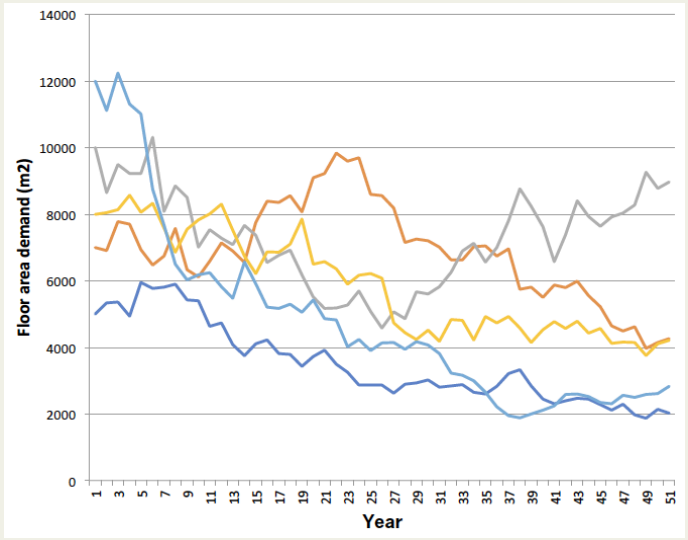
Like the 1973 precedent, it is a cost-based study comparing life-cycle costs (initial cost + adaptation costs) over 50 years

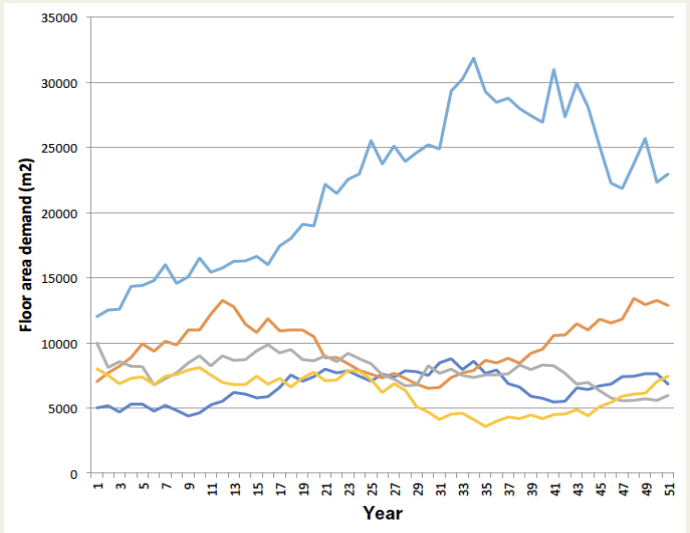
2000 simulated 50-year life-histories used for evaluating the design strategies

Four specimen life-histories of departmental growth and shrinkage



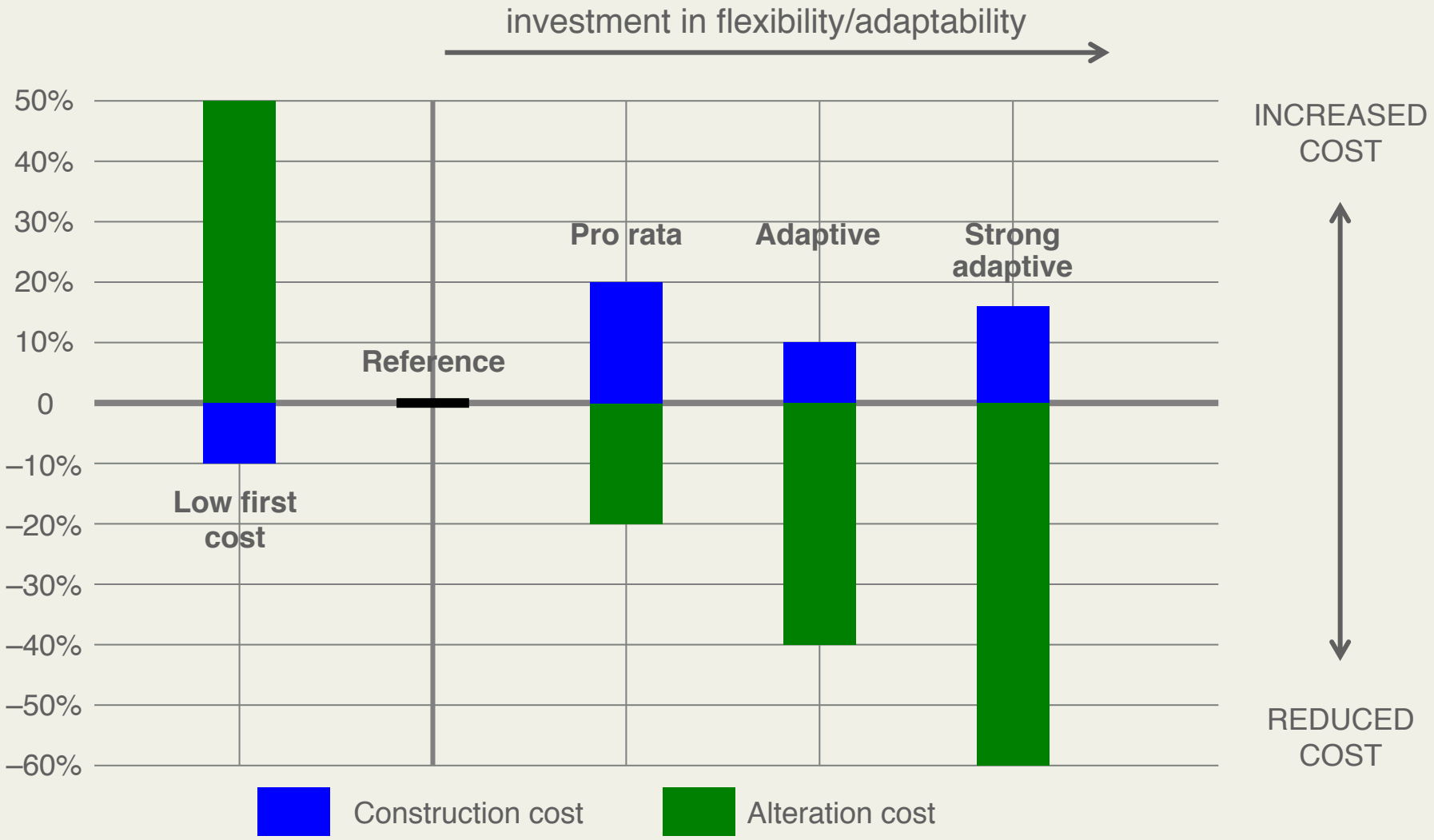






Five alternative design strategies, defined by cost – initial cost and cost of adaptations

- ‘Reference’ strategy and four variations



Results of prospective evaluation using simulation, for three different values of σ (sigma) – low, medium o rhigh rates of annual growth or shrinkage

Figures are average life cycle cost over 2000 simulated life histories (in £m)

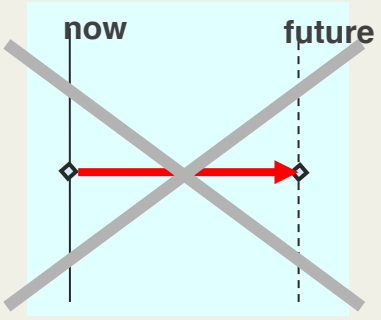
As in the 1973 study, the ranking of strategies is highly dependent on the expected rate of growth and change

	low first cost	reference	pro rata	adaptive	strong adaptive
low σ	* 277	286	311	295	301
medium σ	314	* 313	337	314	316
high σ	419	390	392	347	* 339

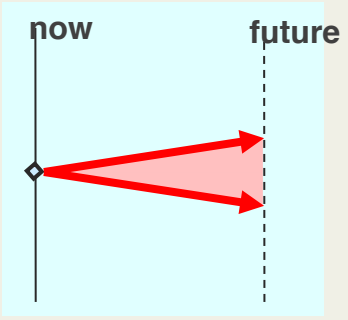
THE LIMITS OF DESIGN FOR FLEXIBILITY

The future is uncertain, hence the desire for flexibility in healthcare buildings – but no design strategy can be universally flexible

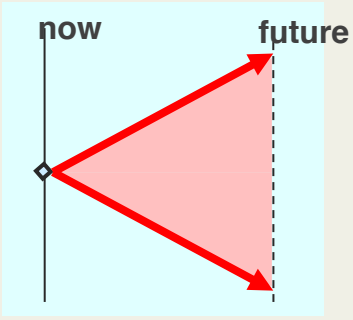
It's necessary to define the expected range of possible future outcomes – this is much more feasible than precise predictions



Precise prediction



Some change



Extensive change

Although a flexible design can be proposed without an **explicit** statement of expected future outcomes – the design itself carries an **implicit** statement of expected future outcomes

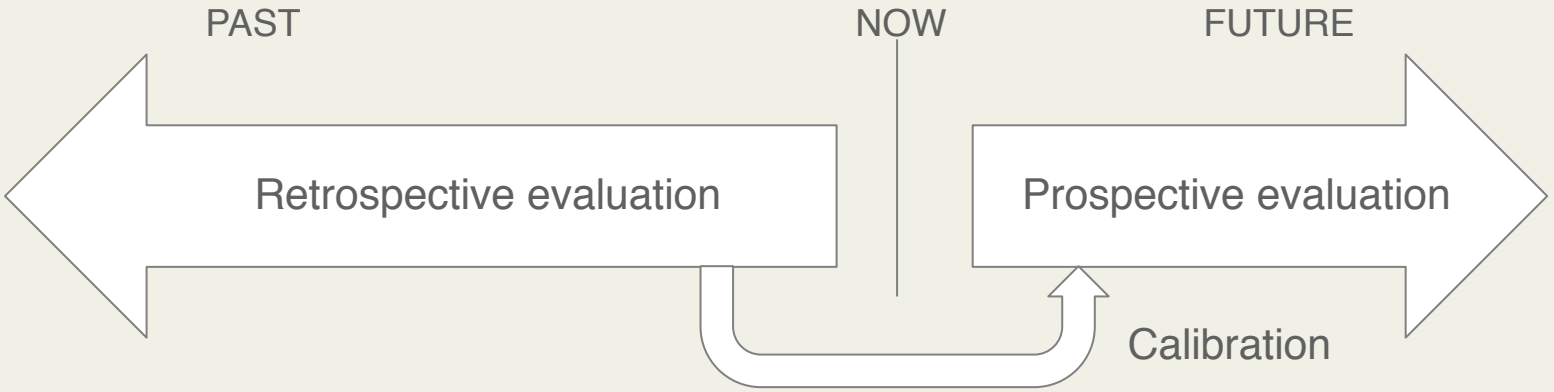
For example, a complex and expensive strategy is only reasonable if extensive change is expected

KEYPOINTS FOR PROSPECTIVE EVALUATION USING SIMULATION

- Simulation models should be simple – quick to re-run many times with new input values
- It is a tool for exploring, evaluating and developing design strategies during the design process
- It is not a black box that produces the ‘right’ solution
- The modelling approach can be applied in many ways – customised to take account of factors of interest other than cost (so long as they can be quantified)
- Many other aspects of healthcare design and management can benefit from simulation studies, as well as design for flexibility

CONCLUSIONS – RETROSPECTIVE AND PROSPECTIVE EVALUATION

- Retrospective evaluation of existing buildings provides limited guidance about strategies for flexibility/adaptation in new designs
- Prospective evaluation applies to the selection of strategies at design stage
- Prospective evaluation involves an explicit (preferably) or implicit proposition about the extent of future change – this relies on understanding/knowledge gained from retrospective evaluation
- Therefore both types of evaluation contribute to good decisions about long-lasting healthcare buildings/infrastructure.



WHERE TO FIND OUT MORE

Retrospective and prospective evaluation is discussed in more detail in the chapter ‘Simulation: Tools for Planning for Change’ in the forthcoming book *Healthcare Architecture as Infrastructure,* edited by Stephen Kendall (to be published by Routledge).

The book has ten chapters on aspects of the ‘Infrastructure Model’ of design for healthcare facilities, by an international panel of authors, including Dr Nirit Pilosof who carried out two of the hospital studies described above.

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