

Dynamics of a performance management system: performance information to performance knowledge

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OUTLINE

- Introduction
 - ┆ Kaplan and Norton's balanced scorecard
- The NHS performance policy and issues
- Performance framework evaluation
 - >> Mental model
 - >> Definition of a dynamical system model
 - // steps and details
 - >> Simulation of a model system
 - // method, results and analysis
 - >> Evaluation and knowledge
- Summary
- Q&A



Introduction

- Systems: physical and logical
- Operators needs information and knowledge about the system to complete required tasks
- Information and prescriptions
 - Indicators → Information-base
 - Information about the instrument, e.g. organisation
 - Prescription ← information + knowledge based upon Organisation, Environment and various dynamics
- Performance dashboard of a car, an aeroplane and the NHS: comparative?





Patient Focus (PF)

6 months Inpatient Waits (P1)

Total Inpatient Waits – percentage of Plan (P2)

13 weeks Outpatients Waits (P3)

Cancelled Operations non-readmission (K5)

Breast Cancer Treatment (P7)

Delayed Transfer of Care (P8)

Clinical Focus (CF)

Clinical Negligence (C1)

Emergency Readmission – overall (C4)

Emergency Readmission for Children (C5)

Emergency Readmission for Fractured Hip (C6)

Emergency Readmission for Stroke (C7)

Capacity and Capability Focus (CC)

Data Quality (CC1)

Staff Satisfaction Survey (CC2)

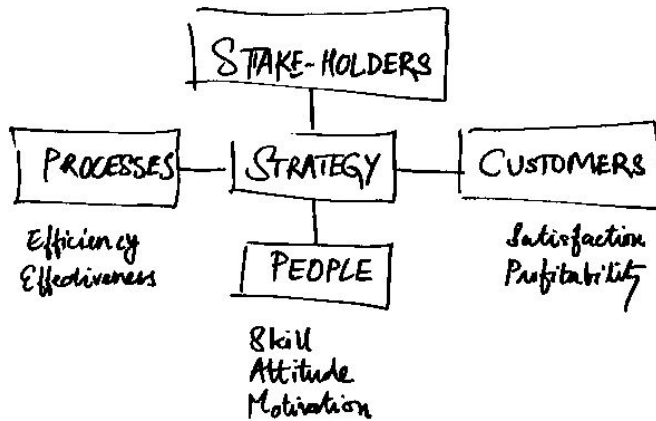
Junior Doctors' Hours (CC3)

Sickness Absence Rate (CC4)

Information Governance (CC5)

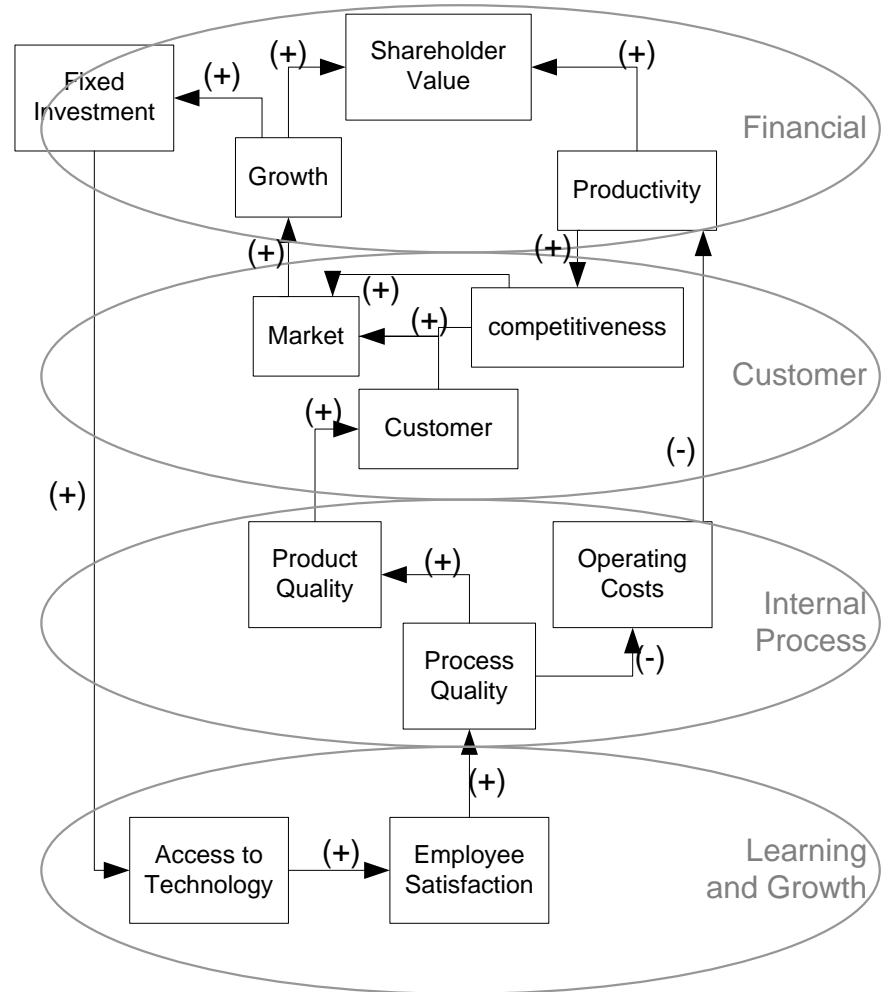
↑ Balanced Scorecard (BSC)

THE SCHEME/THEME THAT MADE BSC POPULAR



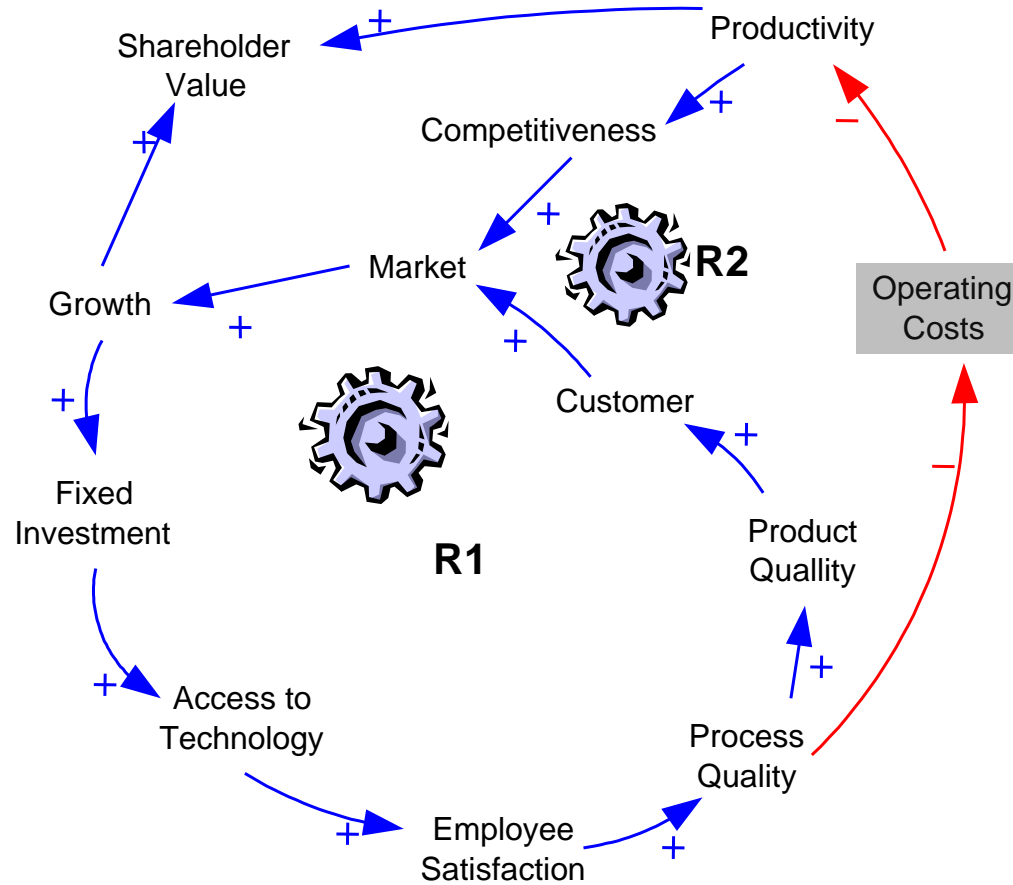
- Dimensions
- Inter-relationships
- Strategy – at hub

Kaplan and Norton
(1996, 2001, 2004)



Strategy map published by Solano *et al* (2003)

↑ Balanced Scorecard (BSC) & Strategy



Representation as CLD for strategy map published by Solano *et al* (2003)



The NHS performance policy and issues

- Overview
 - Performance management system (performance measurement system)
 - Star ratings (policy), a key feature of the NHS Plan (2000)
 - Performance ratings (tool)
 - Tool → Policy → System (and its objectives)
- Policy and aim
 - Targets related to the performance indicators
 - Improve all performance aspects
- Issues
 - Criticism about the Star Rating (performance measurement framework)
 - Recurring concerns, e.g. increase in Emergency Readmissions

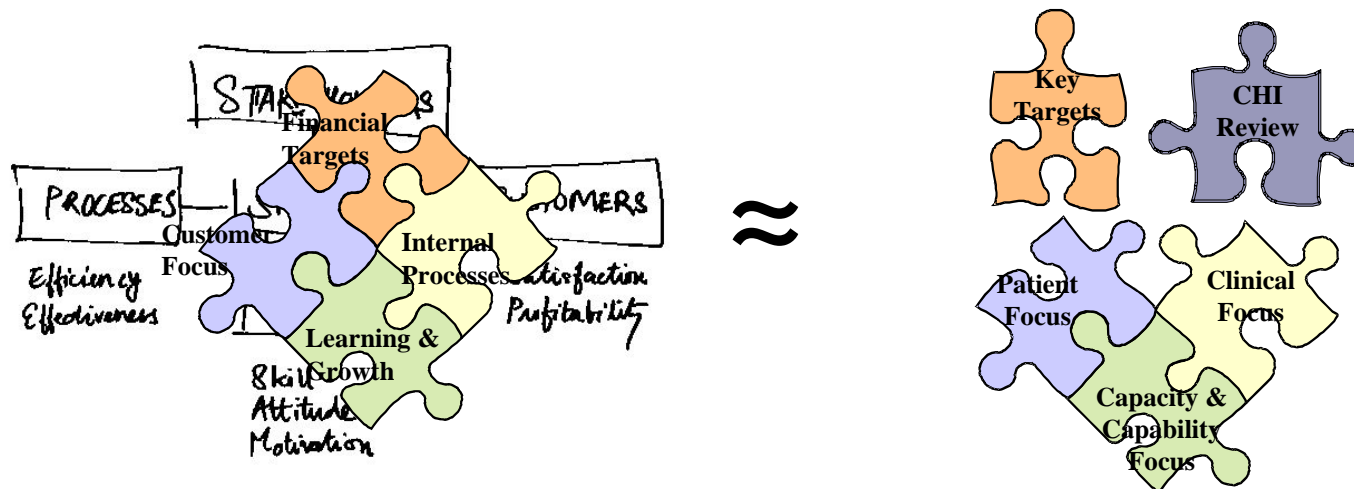


Performance framework evaluation

- Formative evaluation of the framework based on performance information
 - What framework can achieve?
 - What performance an average participant local trust hospital can plan for?
 - Improving the framework based on the performance data and observations (primary objective)
- Four components of the methodology
 - >> Mental model
 - >> Dynamic Interaction model
 - >> Simulation model
 - >> Evaluation

>> Mental model

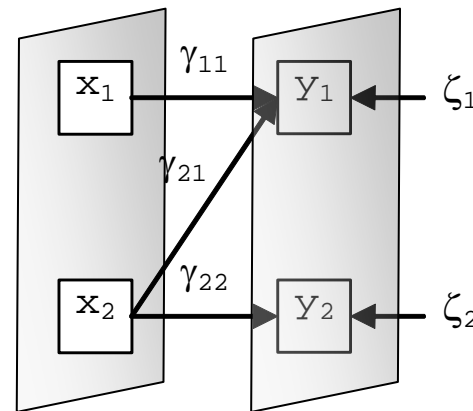
- Mental model:
 - Balanced scorecard based framework
 - 'Patient', 'clinical', and organisational 'capability and capacity' dimensions



>> Definition of a dynamical system

- Approach: quantitative structural analysis
 - Use of model structure based on time-lag assumption and structural equation modelling

- Model structure



- Data
- Process
 - Heuristic (based on significant estimate criterion)
- Outcome

\\ Performance indicators

■ Performance Ratings: Balanced Scorecard based performance indicators

	Indicators	2001/2002	2002/2003
Patient Focus	A&E emergency admission waits (4 hours)		✓
	Better hospital food		✓
	Breast cancer treatment within a month	██████████	██████████
	Cancelled operations	██████████	██████████
	Day case booking		✓
	Delayed transfers of care	██████████	██████████
	Nine month heart operation waits		✓
	Outpatient A&E survey - access & waiting		✓
	Outpatient A&E survey - better information, more choice		✓
	Outpatient A&E survey - building relationships		✓
	Outpatient A&E survey - clean, comfortable, friendly place to be		✓
	Outpatient A&E survey - safe, high quality, co-ordinated care		✓
	Paediatric outpatient did not attend rates		✓
	Patient complaints procedure		✓
	Privacy & dignity*	██████████	██████████
	Six month inpatient waits	██████████	██████████
	Thirteen week outpatient waits	██████████	██████████
	Total inpatient waits	██████████	██████████
Waiting times for Rapid Access Chest Pain Clinic		✓	
Clinical Focus	Clinical Negligence	██████████	██████████
	Deaths within 30 days of a heart bypass operation*	██████████	██████████
	Deaths within 30 days of selected surgical procedures*	██████████	██████████
	Emergency readmission to hospital following discharge	██████████	██████████
	Emergency readmission to hospital following discharge for children	██████████	██████████
	Emergency readmission to hospital following treatment for a fractured hip	██████████	██████████
	Emergency readmission to hospital following treatment for a stroke	██████████	██████████
	Returning home following hospital treatment for fractured hip		✓
	Returning home following hospital treatment for stroke		✓
	Infection control procedures	██████████	██████████
	Methicillin Resistant Staphylococcus Aureus (MRSA) bacteraemia improvement score		✓
Thrombolysis treatment time		✓	
Capacity and Capability Focus	Consultant appraisal		✓
	Data quality	██████████	██████████
	Fire, Health & Safety		✓
	Information Governance	██████████	██████████
	Junior doctors' hours	██████████	██████████
	Sickness absence rate	██████████	██████████
	Staff opinion survey	██████████	██████████

* variables related to special practices or high proportion of missing information

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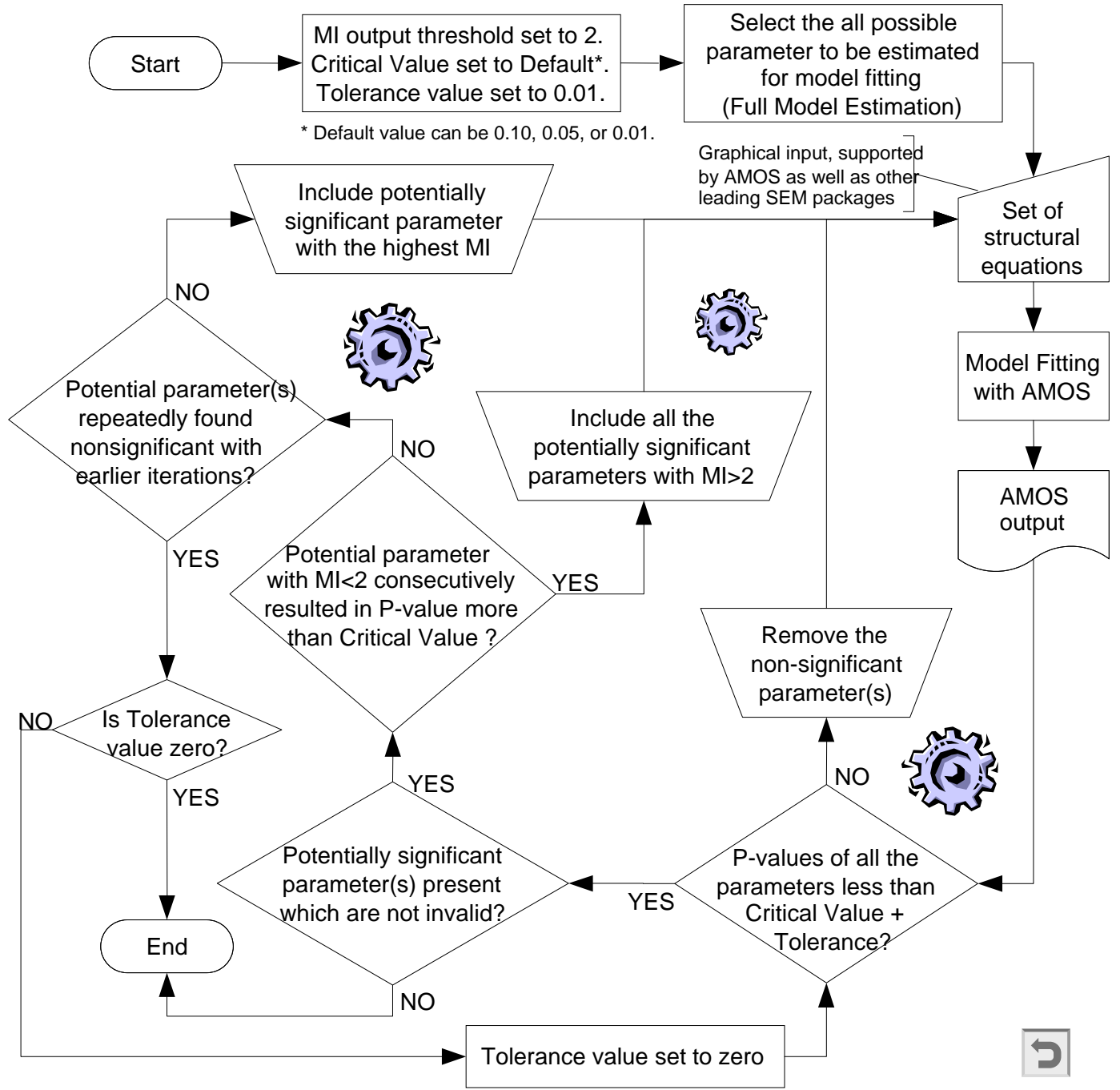
Capacity and Capability Focus (CC)

- Data Quality (CC1)
- Staff Satisfaction Survey (CC2)
- Junior Doctors' Hours (CC3)
- Sickness Absence Rate (CC4)
- Information Governance (CC5)

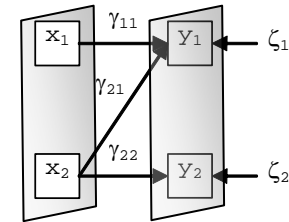
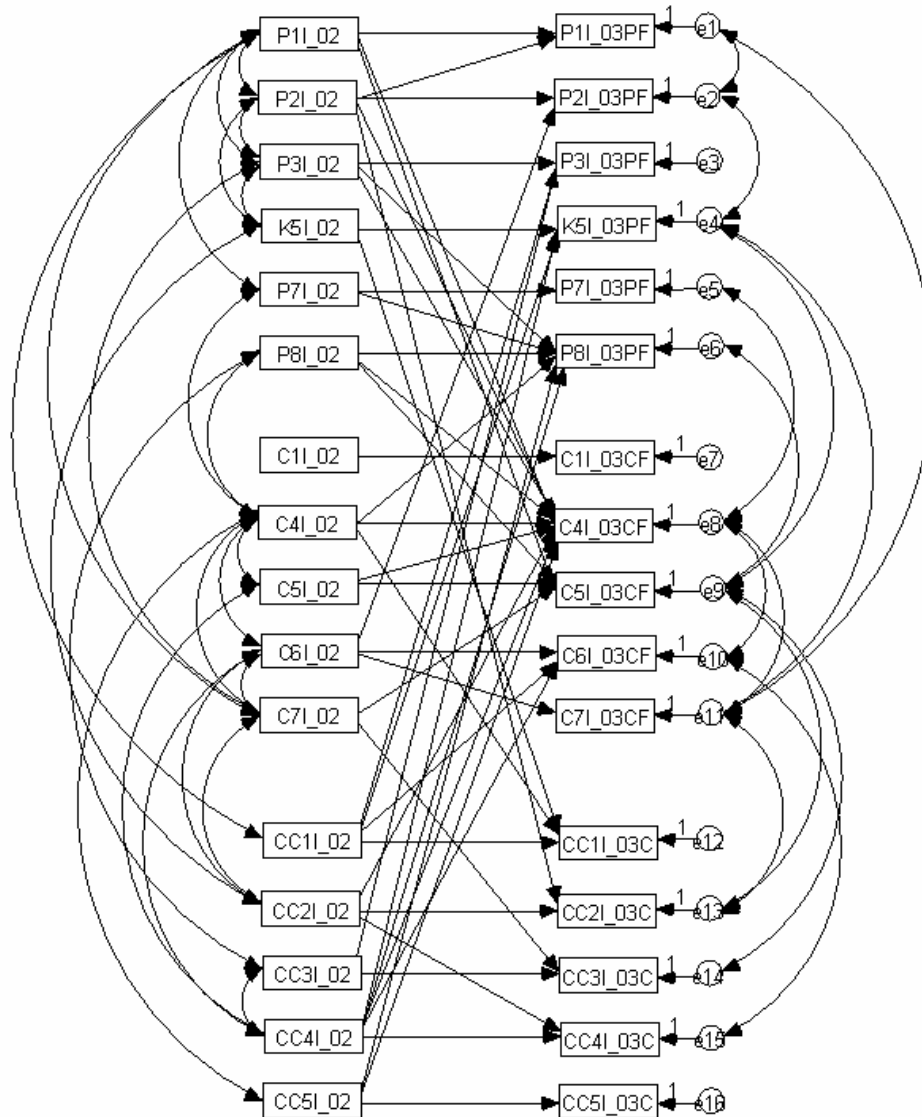


Stepwise Selection - FULL model Start

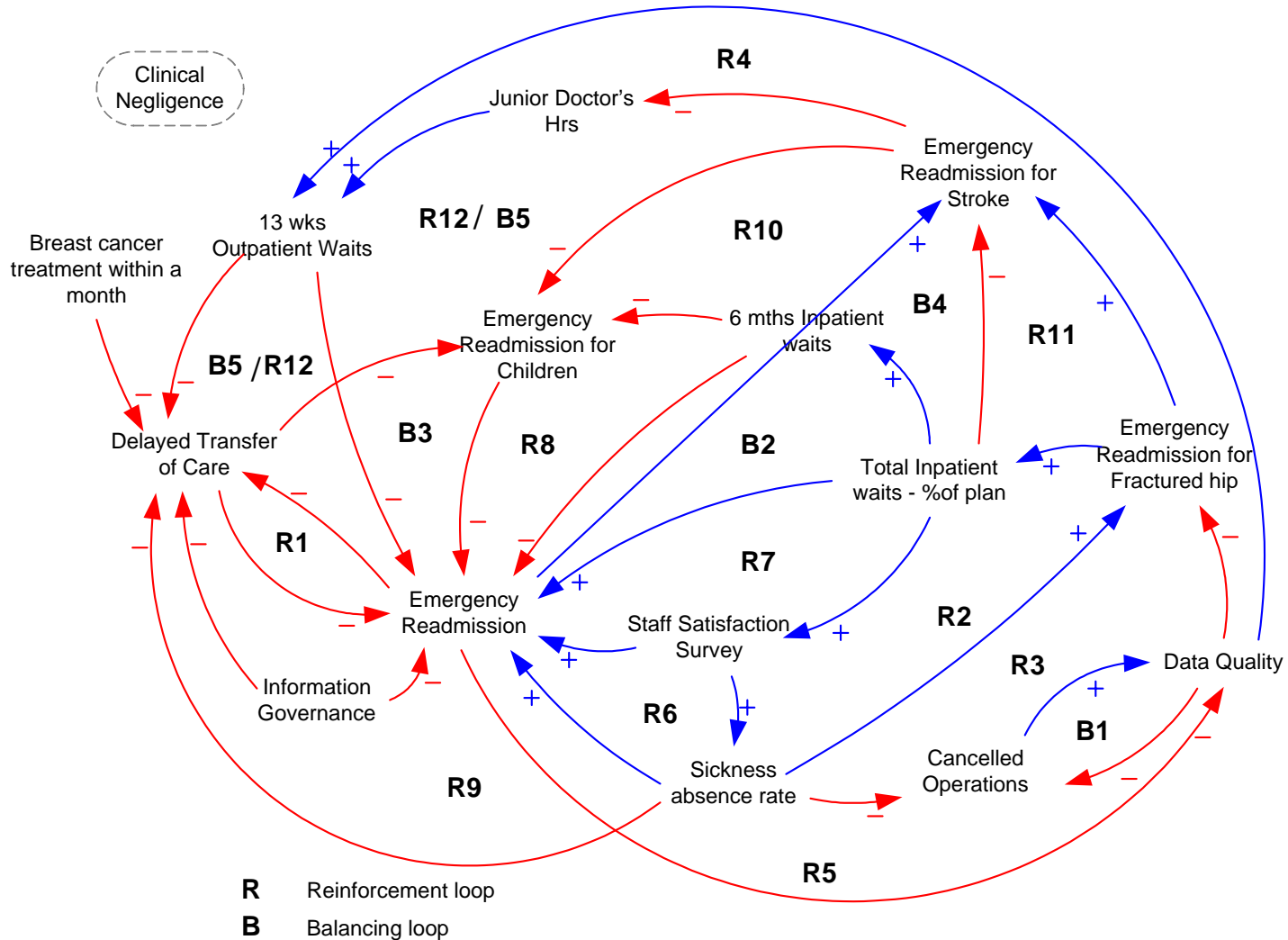
Model Investigation with A-Step-Forward and A-Lot-Backward



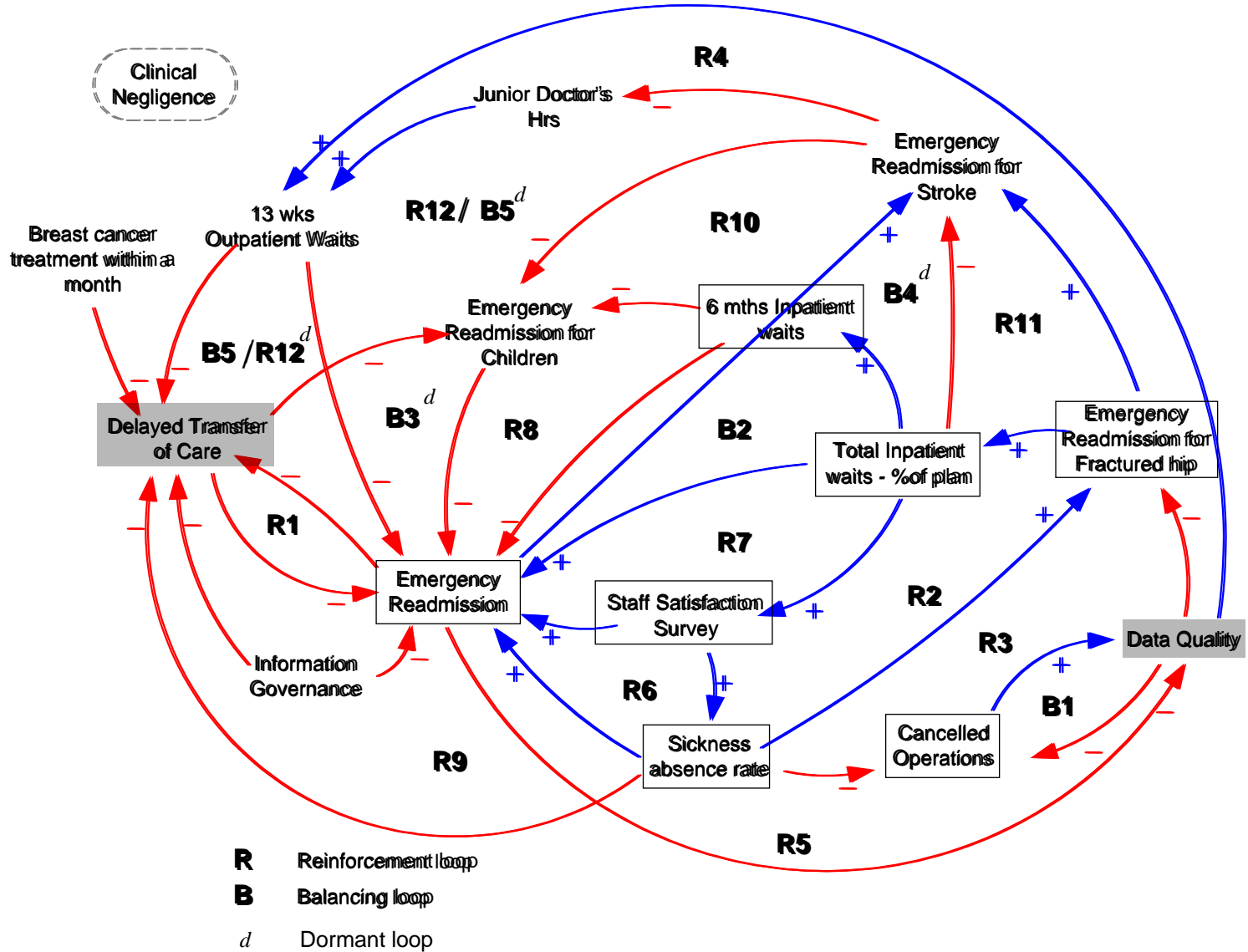
\\ Path diagram



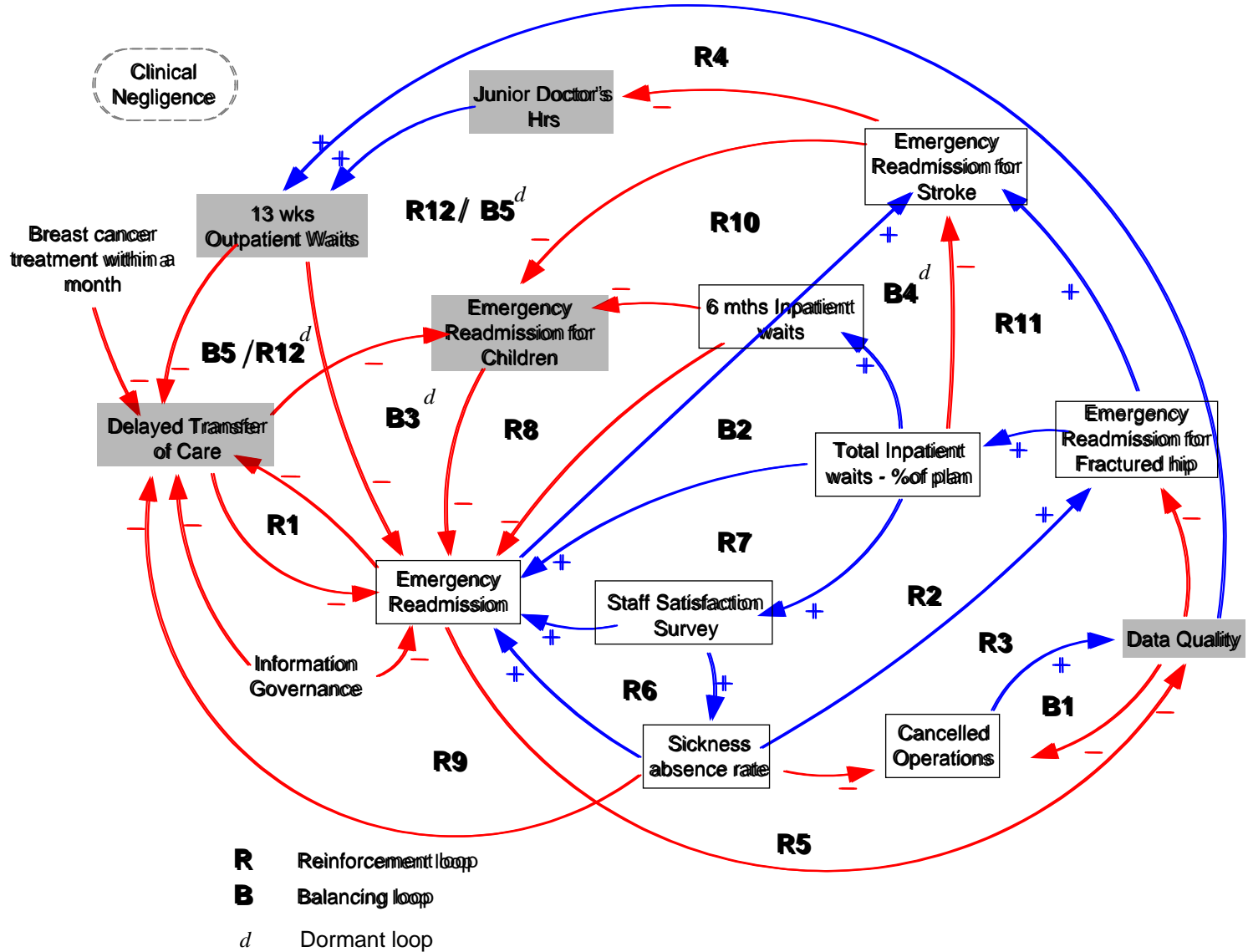
\\ Map of interrelations



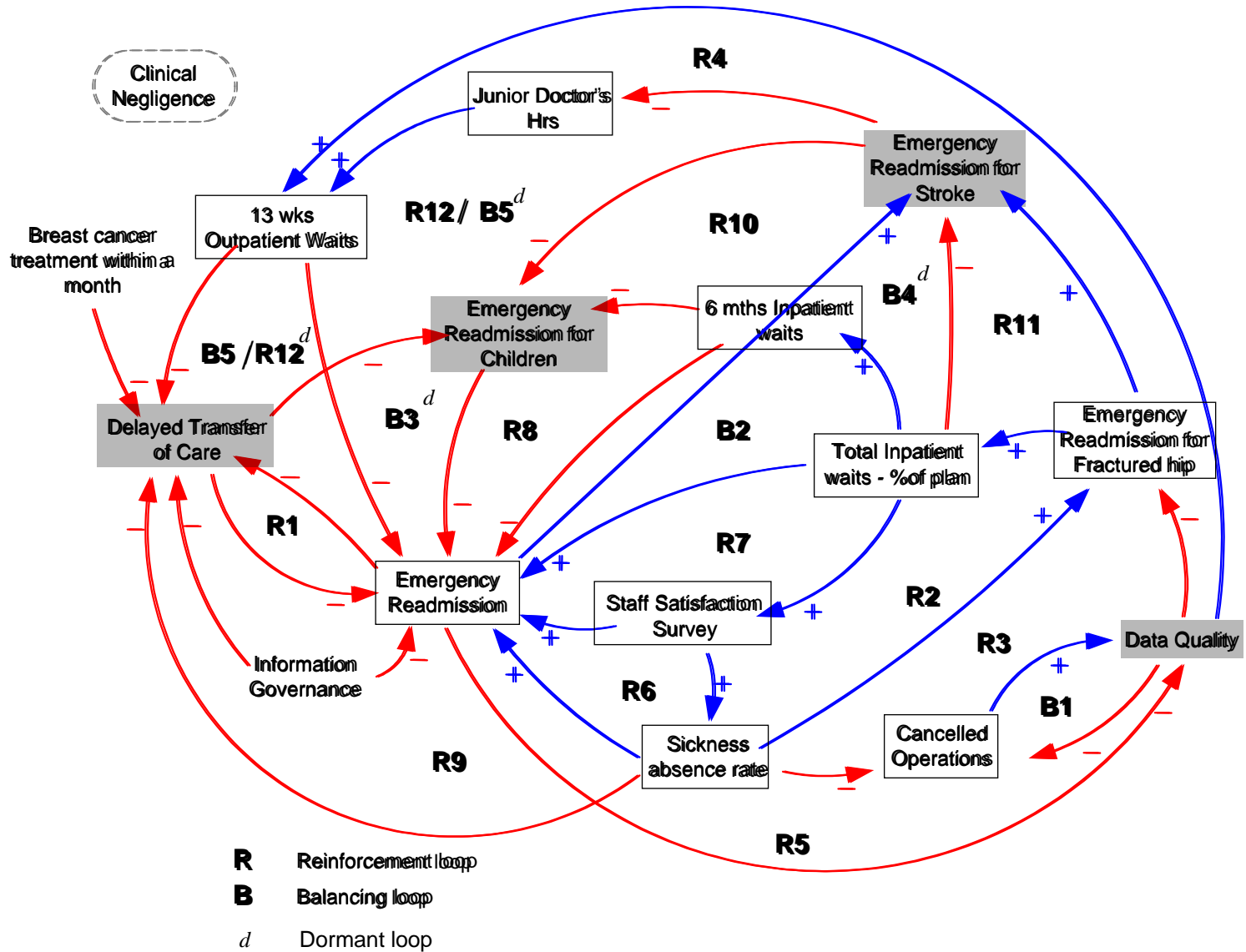
\\ Intervention: Improving ER



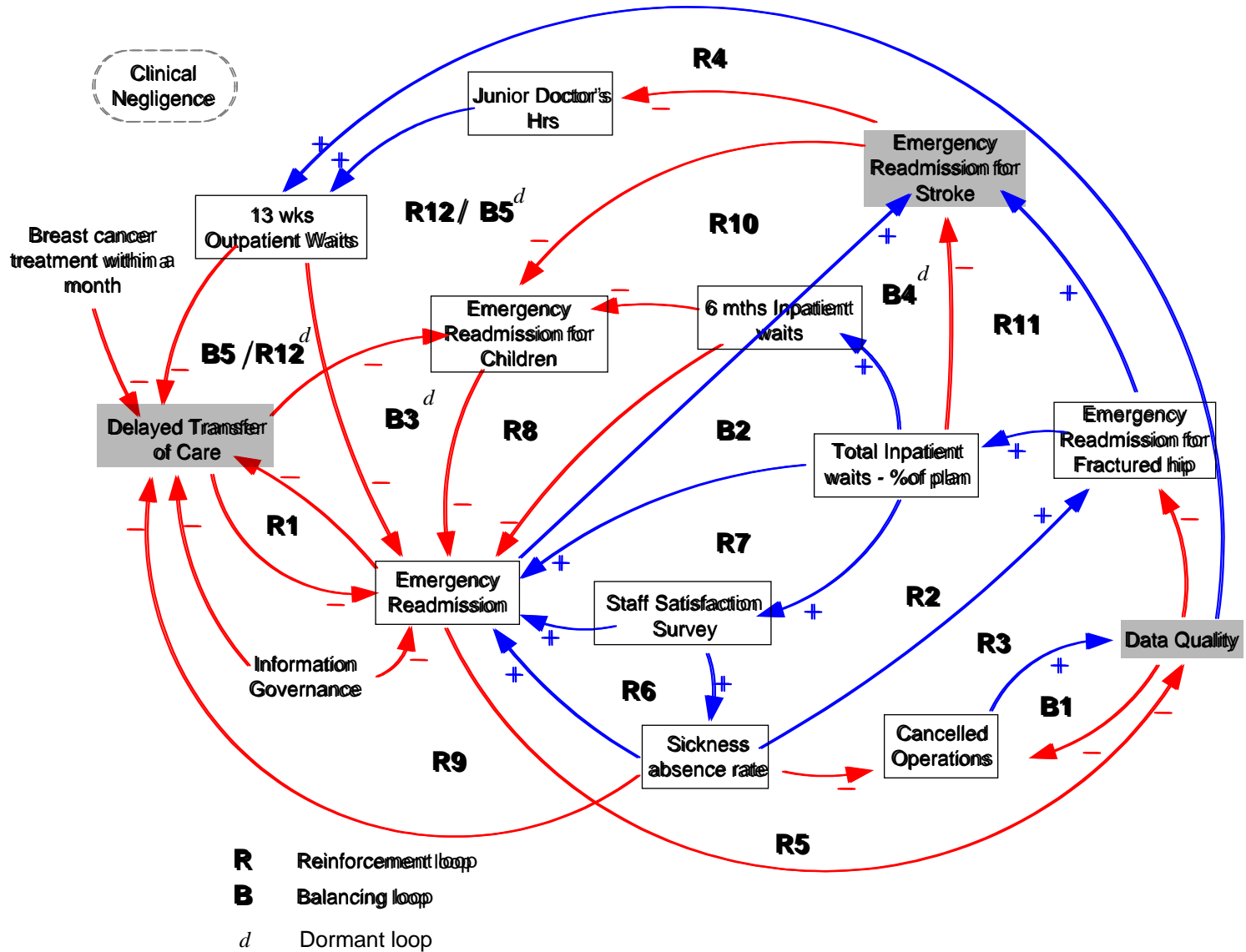
Scenario A



Scenario C





Scenario B



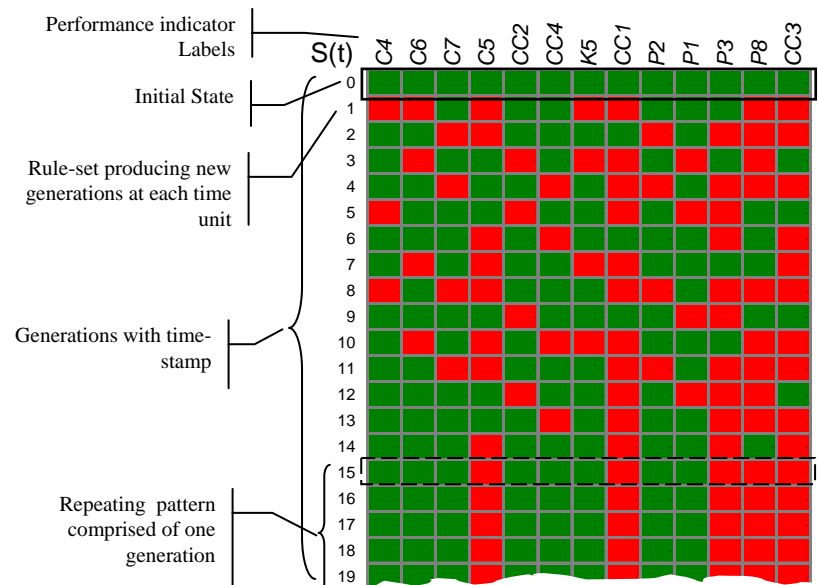
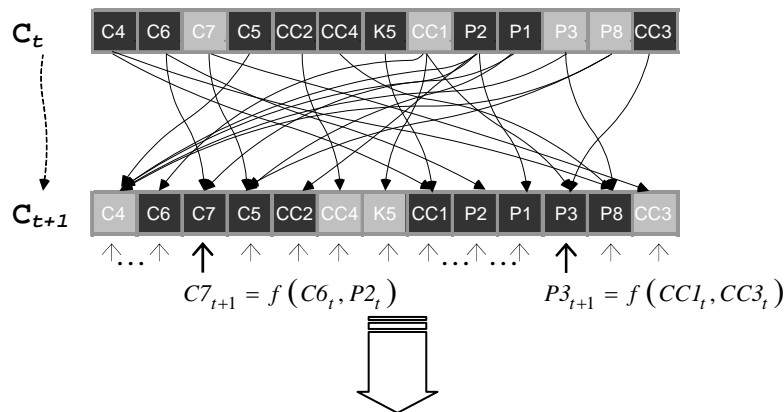
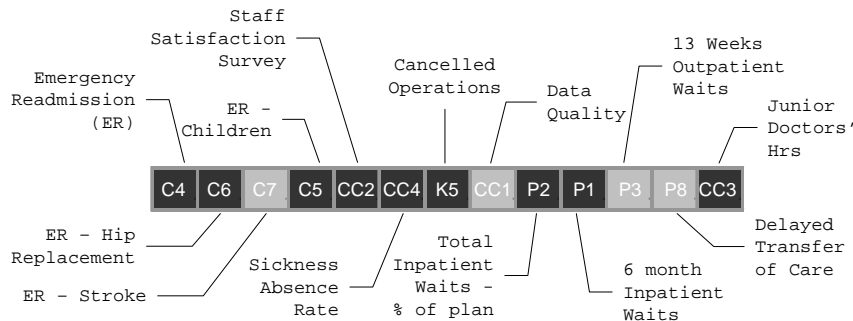
\\ Synthesis of the scenarios A, B and C

Performance Variables (affected by the feedback loops)		Improvement in Emergency Readmission		
		Scenario A	Scenario B	Scenario C
Patient Focus	6mths Inpatient waits	0	0	0
	Total Inpatient waits-%of Plan	0	0	0
	13wks Outpatient waits	not compromised	0	0
	Cancelled Operations	0	0	0
	Delayed Transfer of Care	not compromised	1	1
Clinical Focus	Emergency Readmission	0	0	0
	Emergency Readmission for Children	not compromised	0	not compromised
	Emergency Readmission for Fractured hip	0	0	0
	Emergency Readmission for Stroke	0	not compromised	not compromised
Capacity & Capability Focus	Data Quality	not compromised	1	1
	Staff Satisfaction Survey	0	0	0
	Junior Doctors' Hrs	not compromised	0	0
	Sickness absence rate	0	0	0

 not compromised
 compromised

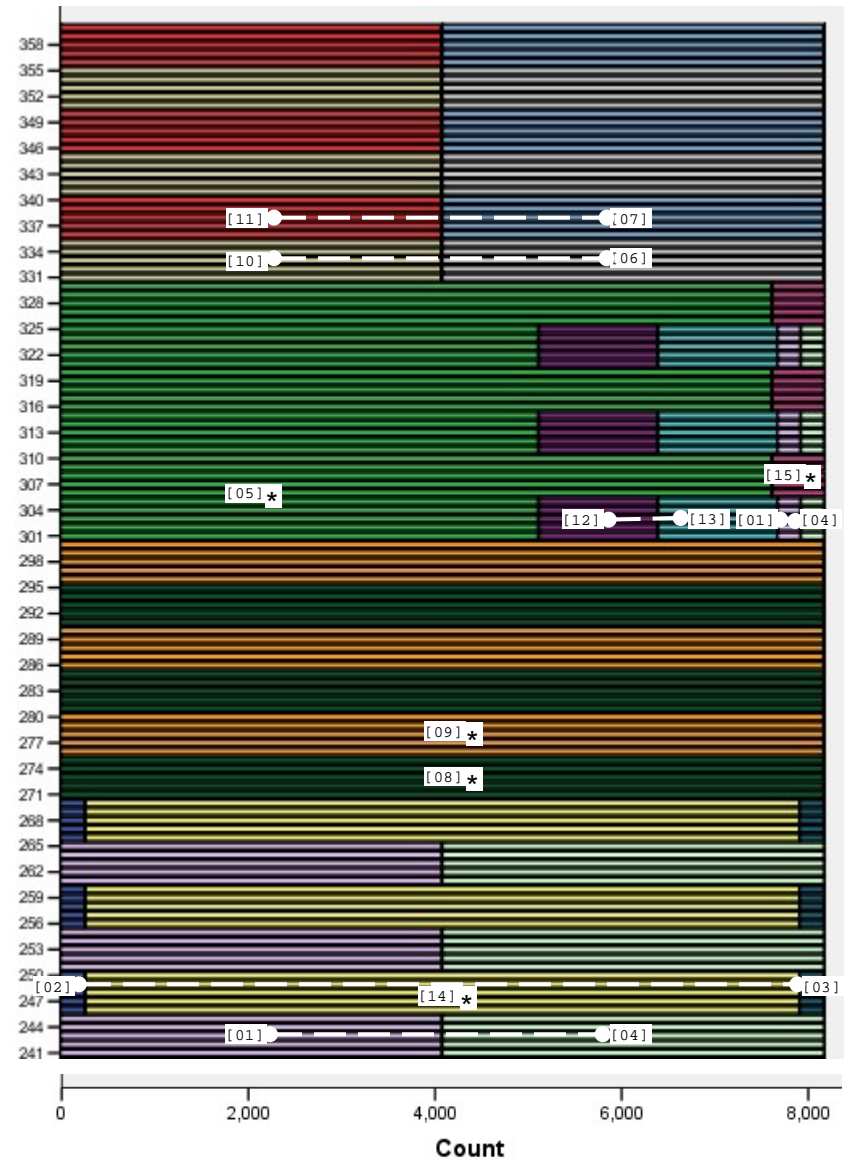
>> Simulation of a model system

- Cellular automata based model simulations

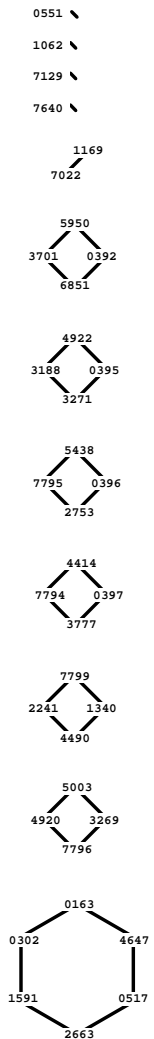
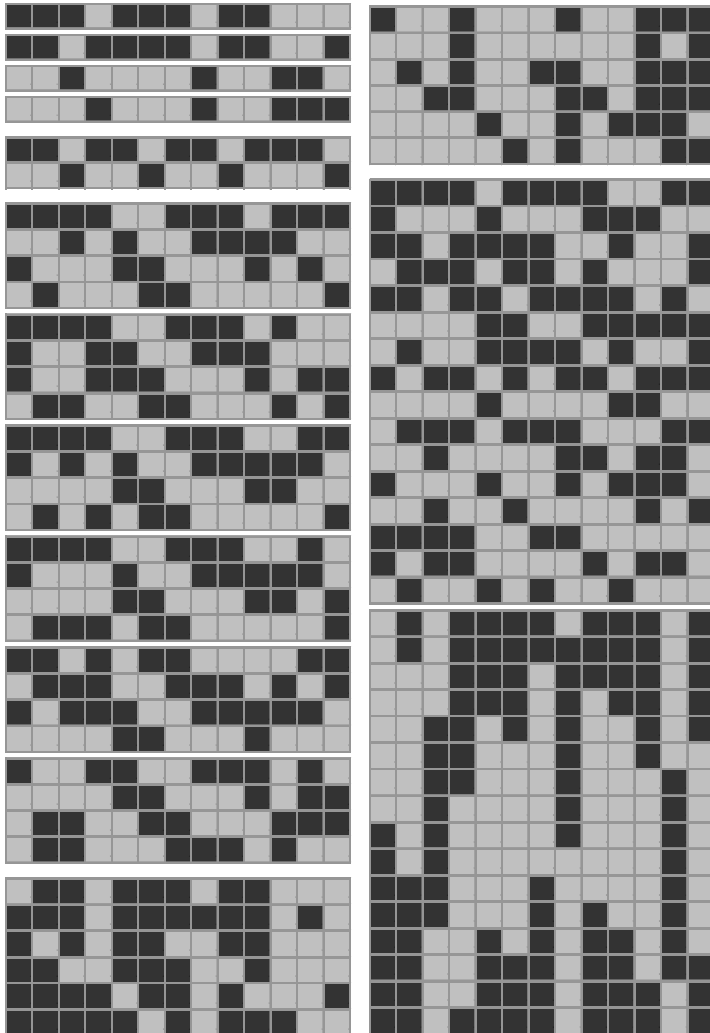


\\ Model simulation and results

- 2-state, 13 indicators, 360 rule-tables, ~3million cellular automata
- Computations
 - Job-split parallel computations
 - 18 PCs and ~30hrs each
- Outcomes
 - Patterns
- Distributions



\\ Scenarios



Pattern_01

Pattern_02

Pattern_03

Pattern_04

Pattern_05

Pattern_06

Pattern_07

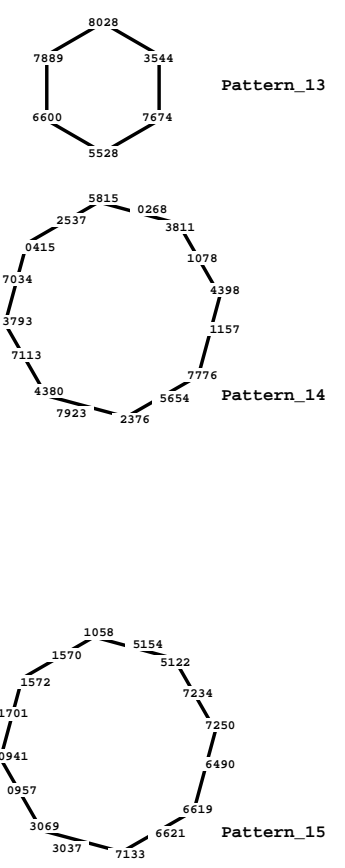
Pattern_08

Pattern_09

Pattern_10

Pattern_11

Pattern_12



Pattern_13

Pattern_14

Pattern_15

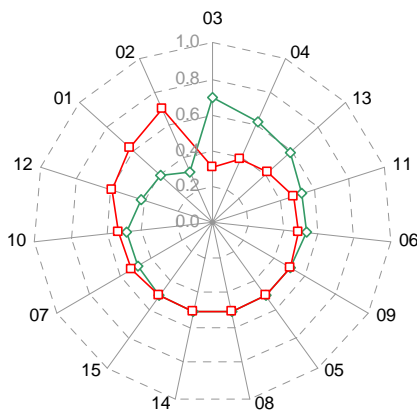
\\ Assess scenarios (quantitative)

- Measures of characteristics

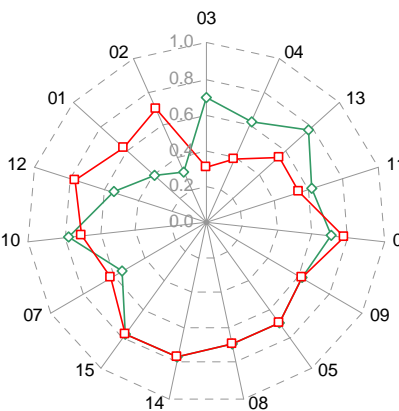
$$\frac{1}{r} \left(\sum_{i=1}^r \sum_{j=1}^p \mathbf{w}_j \mathbf{G}_{ij} \right)$$

$$\frac{1}{r} \left(\sum_{i=1}^r \sum_{j=1}^p \mathbf{w}_j \mathbf{R}_{ij} \right)$$

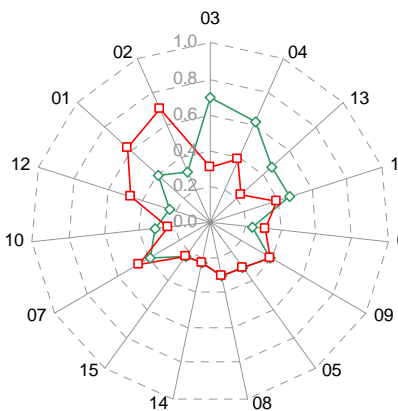
Average Score



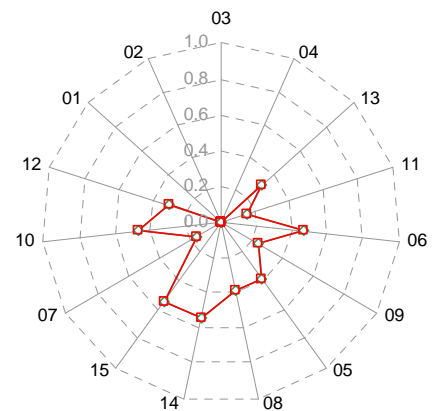
Maximum Score



Minimum Score

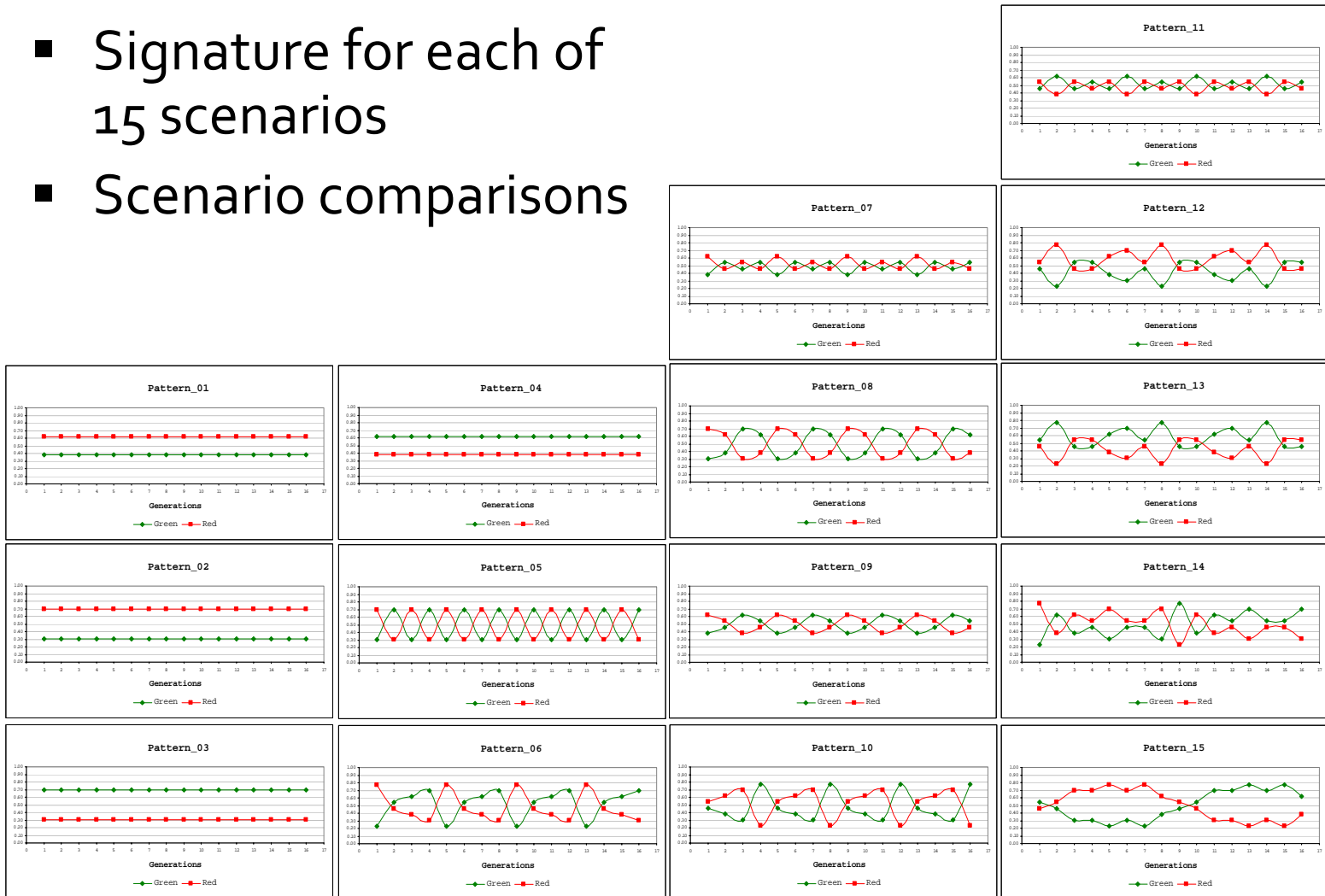


Range Score



\\ Assess scenarios (qualitative)

- Signature for each of 15 scenarios
- Scenario comparisons





>> Evaluation and knowledge

- The model system suggest no scenario with improvements for all the performance indicators
- Performance knowledge-base for system behaviours; accounts interactions and dynamics based on various interactions.
- Performance management strategies
 - Scenario planning for local units
 - Positioning
 - Shifting scenarios
 - Proactive policy participation

Specifications and limitations

- SEM used for structural analysis
 - Influences mapped based on linear relationships
- Cellular automata based simulations
 - Parallel calculations (job-split): 18 PCs approximately 30hrs each for ~3million evolutions calculated
 - Limited information utilised from the path diagram
 - Binary cells
 - Cellular automata with k-state; rule-tables
- Dynamic or random graphs
 - Static but statistically significant graph based simulation
 - Dynamic graphs can incorporate non-linear dynamics but practically limited due to data availability for most of the high-level frameworks



Summary

- Statistical technique provided basis for deriving knowledge based on performance information
 - Knowledge-base for prescriptions based on the performance information are what makes information relevant for decision-making
- Simulation based knowledge about the model system can be useful for formative evaluation.



References & Bibliography

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over to attend your queries...



- Where is the problem?



I saw the angel in the marble and
~~carved~~ until I set him free.

carving

Thanks to you, Michelangelo



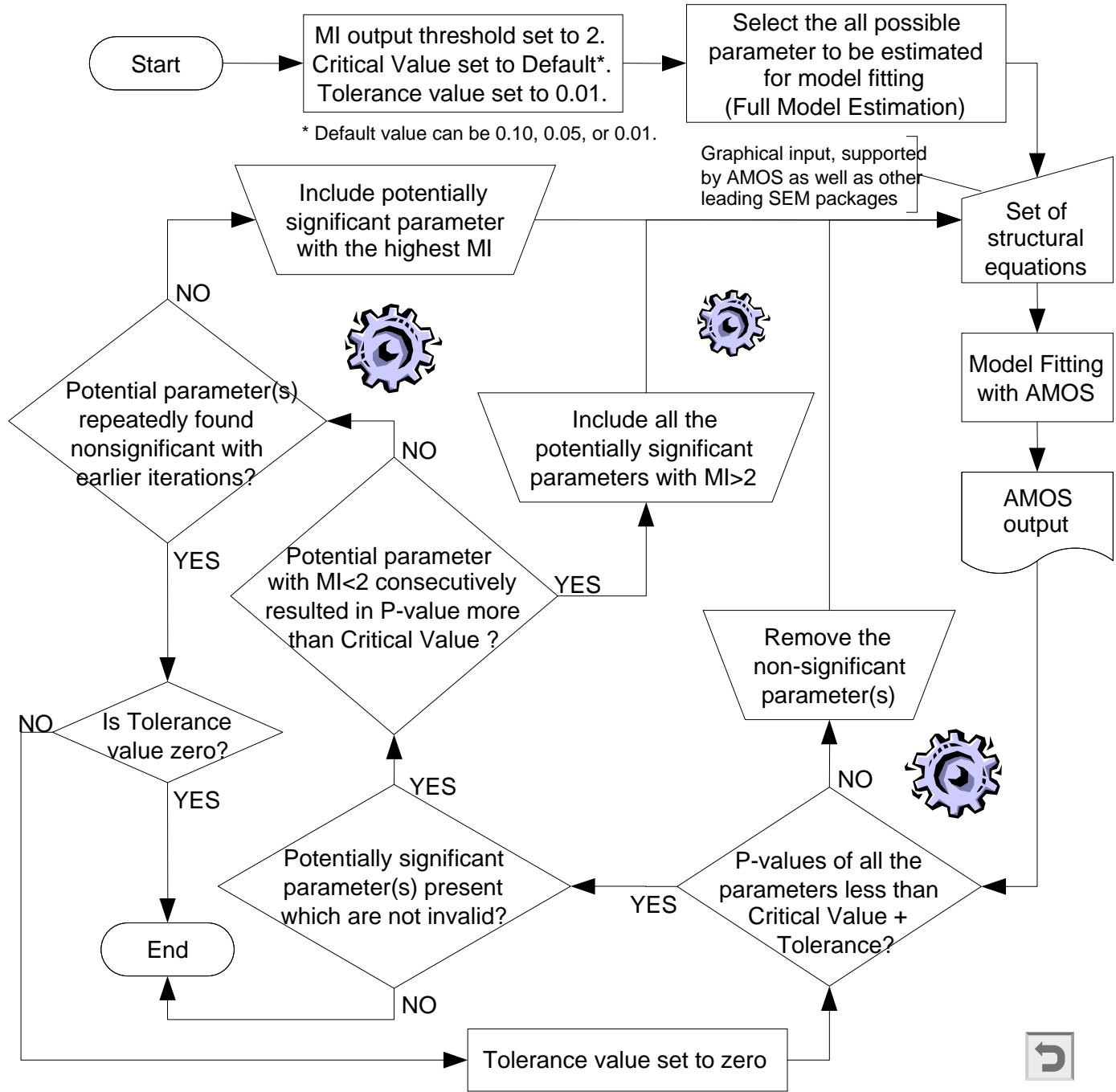
A view on the NHS Plan

- A change programme (planned) to achieve reform
- If we look on implementations to-date from organisational change perspective, then
 - Star Ratings and (observed) and others (follow-up programmes etc) are implementation tools, and
 - Role for change programme, monitoring and communications
- Performance measurement system and the NHS Plan
 - Performance Ratings and Annual Health Check as strategic choices
- Formative evaluation?
 - Reduced complexity with simple structure
 - Performance Ratings and Balanced Scorecard based performance indicators



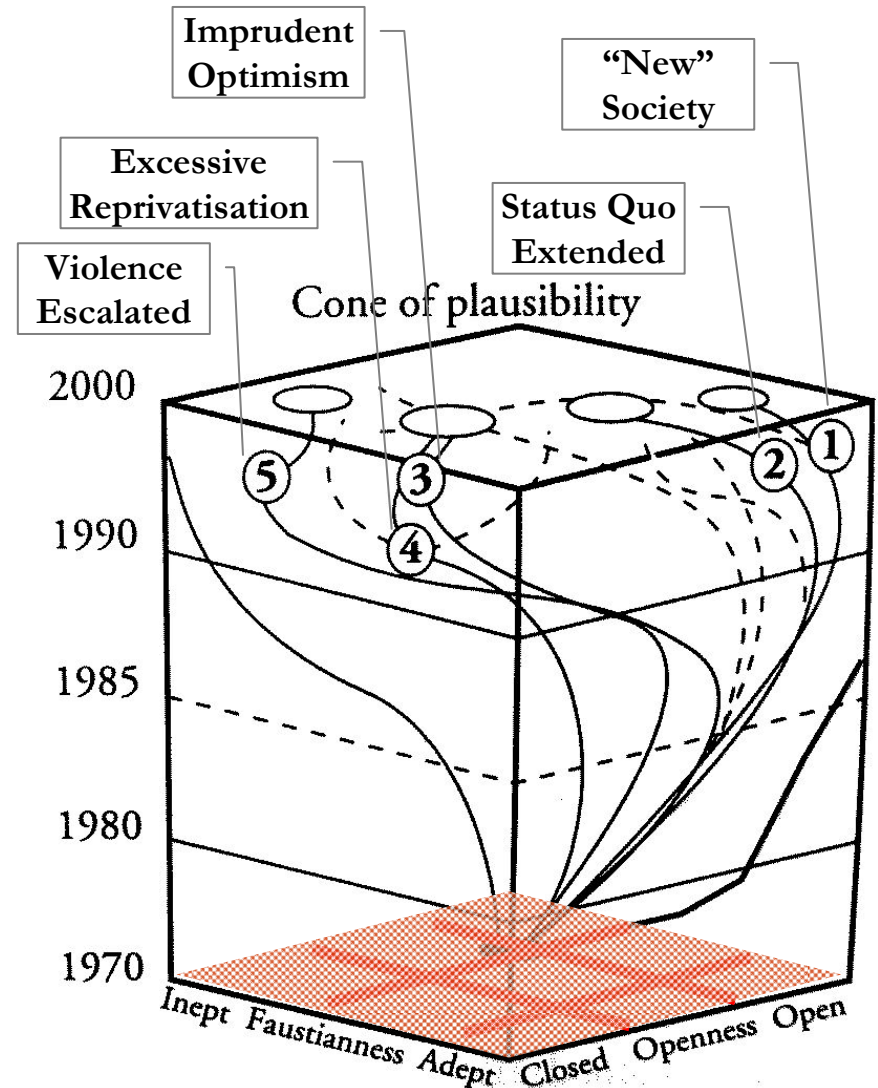
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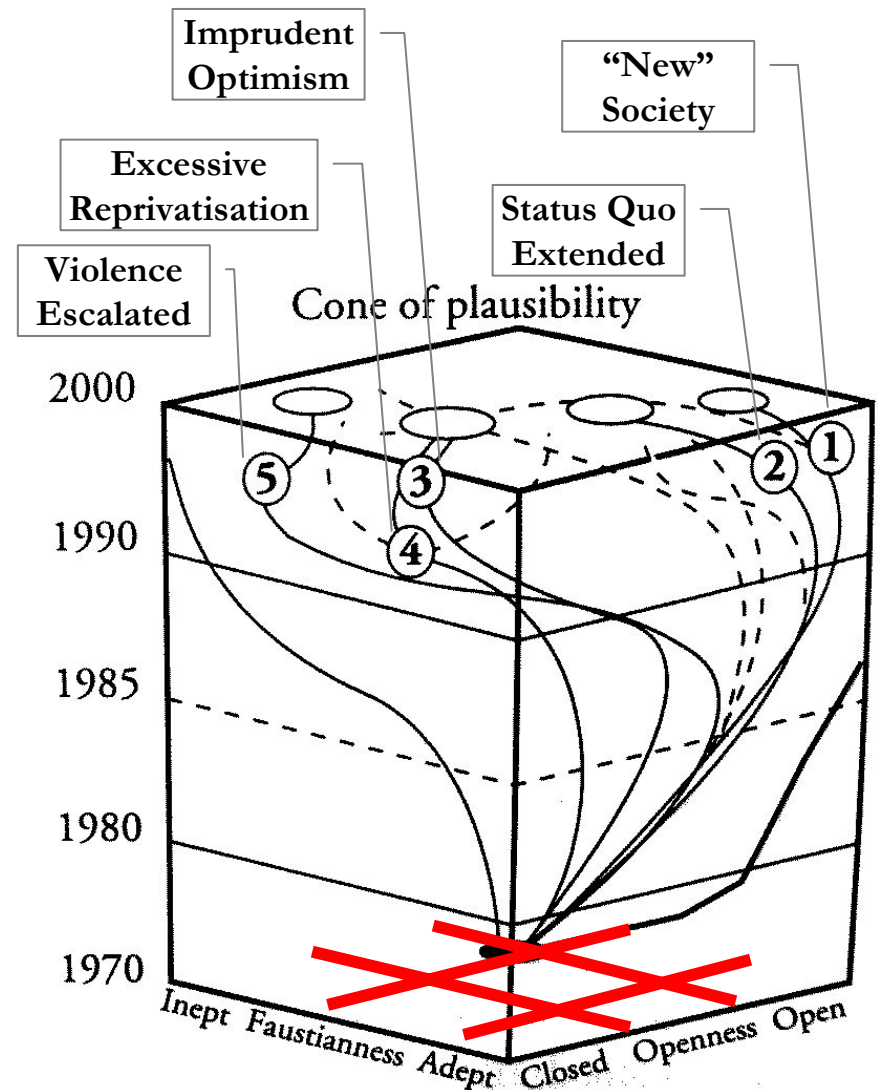
Evolution – a basis for evaluation

- Evolution of a modelled non-physical systems
- Future of American Society: a case of two questions (issues)
- $3 \times 3 = 9$ possibilities
 - Only 5 considered
 - 4 not congruent with structural relationship of the system
- Complexity
 - If issues measured and modelled as continuous or interval measure
 - Enumerated cone of plausibility: $N \times N$ or $R \times R$
 - More than two issues!



Evolution – a basis for evaluation and planning

- Evolution of a modelled non-physical systems
- Future of American Society: a case of two questions (issues)
- $3 \times 3 = 9$ possibilities
 - Only 5 considered
 - 4 not congruent with structural relationship of the system
- Complexity
 - More than two issues!



Source: Kleiner, 1996

\\ Performance indicators

- Performance Ratings and Balanced Scorecard based performance indicators

Patient Focus (PF)
6 months Inpatient Waits (P1)
Total Inpatient Waits – percentage of Plan (P2)
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Data Quality (CC1)
Staff Satisfaction Survey (CC2)
Junior Doctors' Hours (CC3)
Sickness Absence Rate (CC4)
Information Governance (CC5)

Indicators	2001/02	2002/03
A&E emergency admission rate (A101)	✓	✓
Beds in hospital	✓	✓
Best cancer treatment within a month	✓	✓
Cancelled operations	✓	✓
Day case booking	✓	✓
Delayed transfers of care	✓	✓
13 weeks inpatient waits	✓	✓
Outpatient A&E emergency admission	✓	✓
Outpatient A&E emergency admission, more close	✓	✓
Outpatient A&E emergency admission	✓	✓
Outpatient A&E emergency admission, 1st admission to be	✓	✓
Outpatient A&E emergency admission, 1st admission to be	✓	✓
Paediatric outpatients admission rate	✓	✓
Patient complaints procedure	✓	✓
Planned activity	✓	✓
Six month inpatient waits	✓	✓
Three month outpatients waits	✓	✓
Total inpatient waits	✓	✓
Waiting times for Rapid Access Chest Pain Clinic	✓	✓
Clinical Negligence	✓	✓
Deaths within 30 days of a heart bypass operation*	✓	✓
Deaths within 30 days of a locked spinal procedure*	✓	✓
Emergency readmissions to hospital following discharge	✓	✓
Emergency readmissions to hospital following discharge for stroke	✓	✓
Emergency readmissions to hospital following treatment for a fractured hip	✓	✓
Emergency readmissions to hospital following treatment for a stroke	✓	✓
Referring home following hospital treatment for fractured hip	✓	✓
Referring home following hospital treatment for stroke	✓	✓
Infected spinal procedures	✓	✓
Met HHS Risk Stratification Hygiene Awareness (MRS) back team in improvement score	✓	✓
Trombolysis treatment time	✓	✓
Consent approval	✓	✓
Data quality	✓	✓
Fire, Health & Safety	✓	✓
Information Governance	✓	✓
Junior doctors' hours	✓	✓
Sickness absence rate	✓	✓
Staff satisfaction survey	✓	✓

* variables related to special practices or high proportion of missing information