Quantification of Infrastructure Downtime in Earthquake Reconstruction

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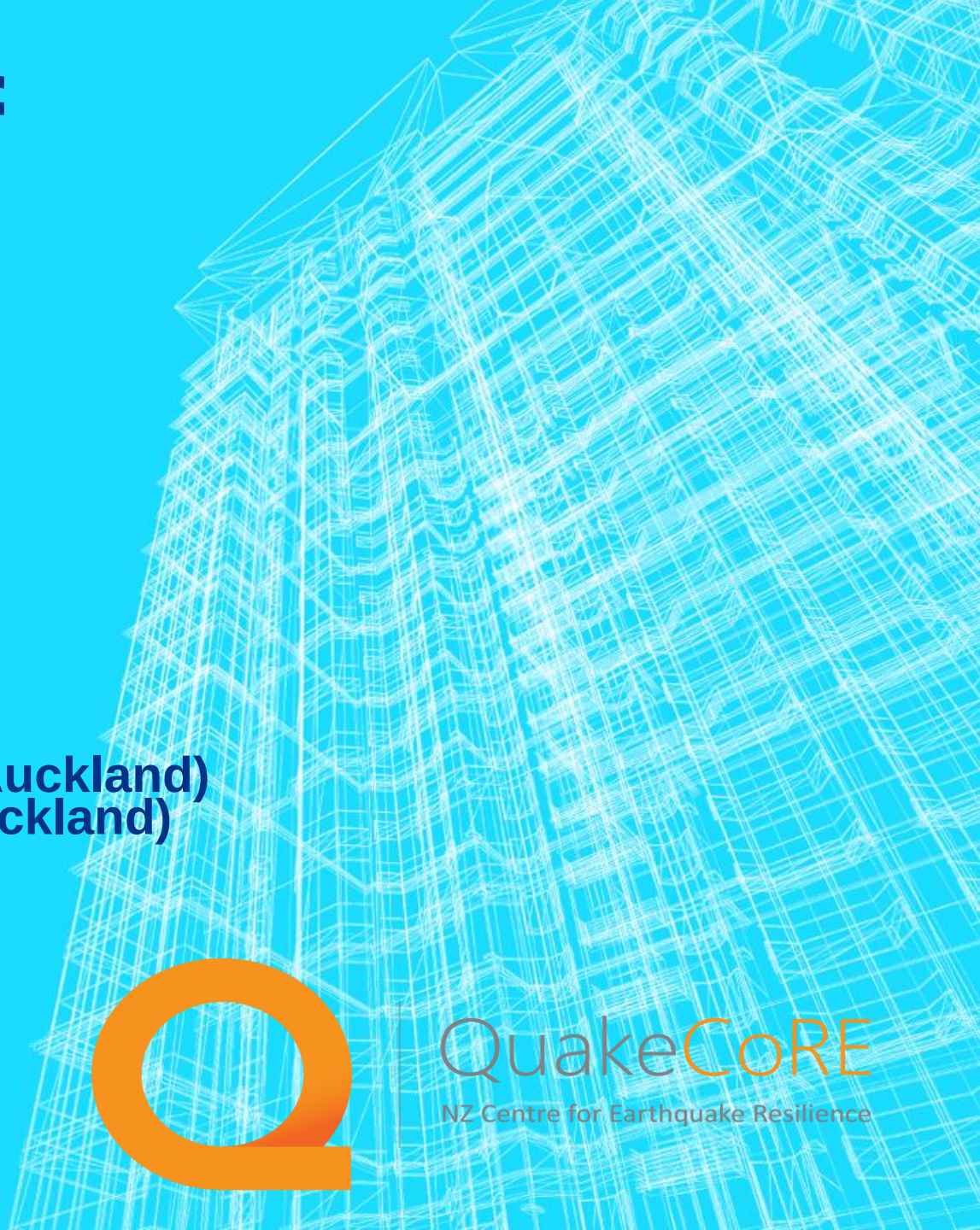

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

QuakeCoRE
NZ Centre for Earthquake Resilience

SYSTEM DYNAMICS MODEL OF CRITICAL MECHANISMS AFFECTING REBUILD TIME

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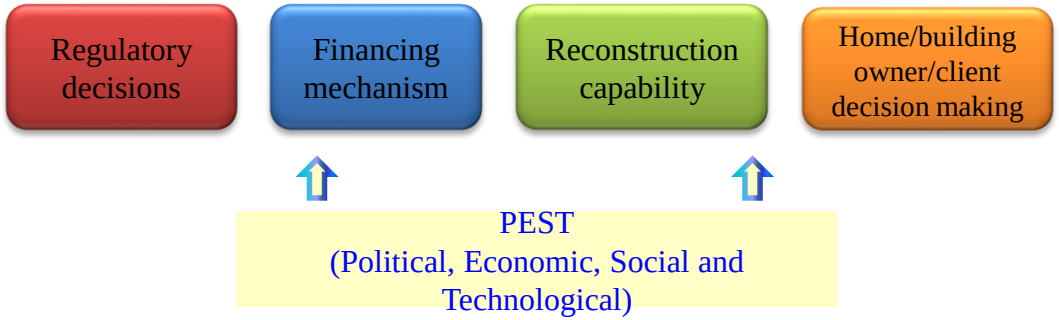
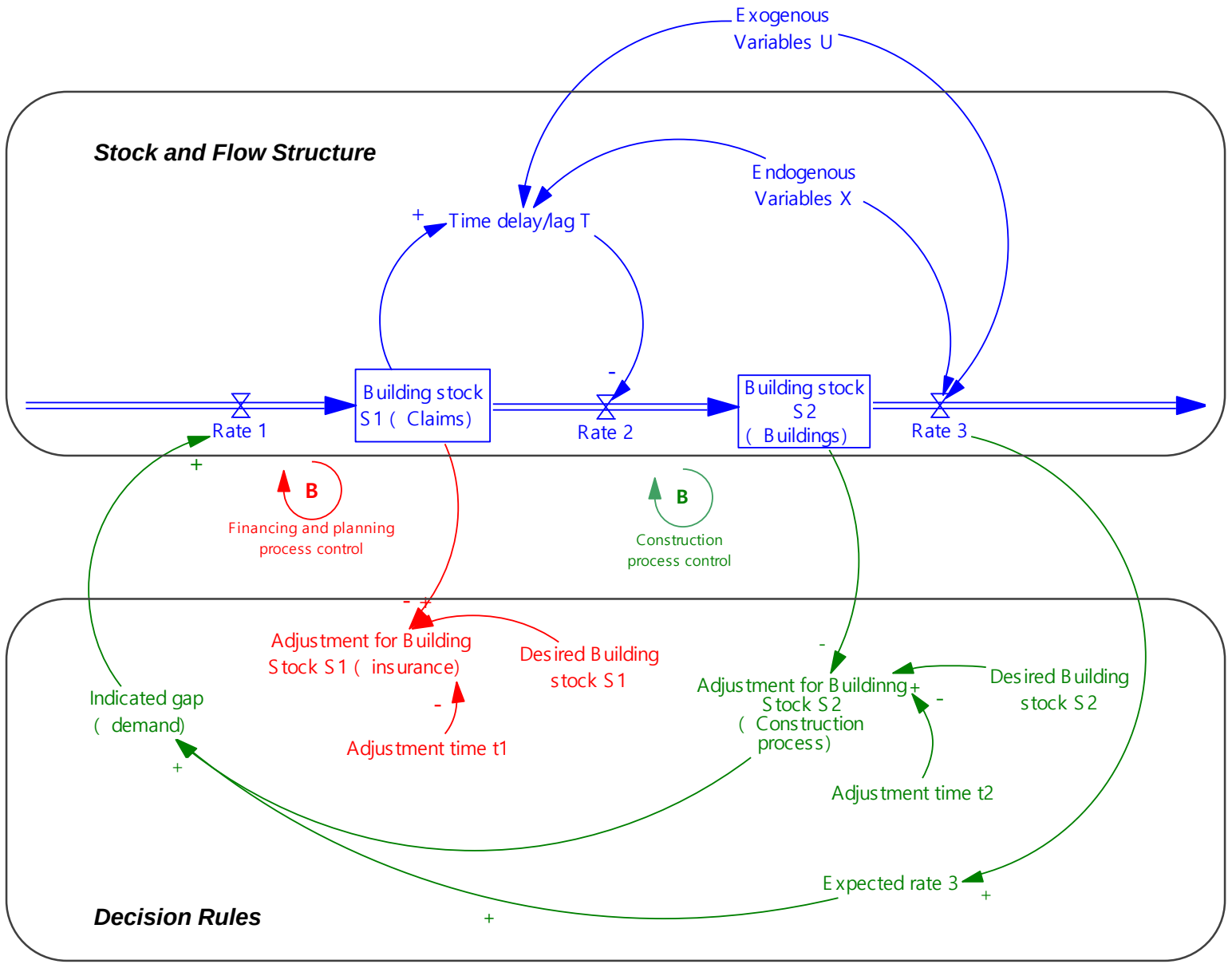
The mechanisms that affect the time-path of post-earthquake reconstruction fall into four categories

- Planning and regulatory environment
- Capability of engineering and construction sector
- Financing mechanism (e.g. insurance settlement)
- Decision making and actions of facility owners



Time delay (Dependent variable)	Critical contributing factor (Independent variable)
Inspecting and assessing time (Time needed for concluding damage results)	Technical capability of engineering professionals
	Speed of engineer mobilisation
	Availability of engineers
	Fatigue of engineering assessors
	Frequency of ongoing after shocks
	Existence of a robust building inspection methodology
Decision making time (Time needed for achieving recovery strategies)	Changes to the building code
	Land zoning decisions
	Consenting and permitting process
	Insurance claim apportionment process/process of securing finance
	Mechanisms of recovery governance
	Coordination with other sectors
Financing time/Claim settlement time (Time needed for securing financing or settling insurance claims)	Availability of loss adjusters/quantity surveyors
	Productivity of quantity surveying
	Work hours of loss adjusters/quantity surveyors
	Pace of decision making of policy holder
Adjustment time (Time needed for mobilisation of construction resources)	Capacity of construction businesses
	Availability of construction manpower
	Economic conditions in the region
	Economic conditions elsewhere
	Availability of temporary accommodation
	Needs perception delays (Flow of information on reconstruction work pipeline)
Completion time (Time needed for undertaking construction work)	Repair/rebuild procurement method
	Repair scope variations
	Extent of demand surge (labour wage inflation)
	Productivity of construction labour
	Long lead time components
	Speed of design process
Rework time (Time for discovery of repair defects and rework)	Treated as a constant

SYSTEM DYNAMICS MODEL



RESEARCH METHODOLOGY

1. **Systematic Review of Literature**
   Review of factors affecting the recovery efforts on infrastructure in disaster reconstruction

2. **Semi-structured Interview**
   Interview with stakeholders associated with local earthquake recovery agencies
   Christchurch - SCIRT
   Kaikōura – NCTIR

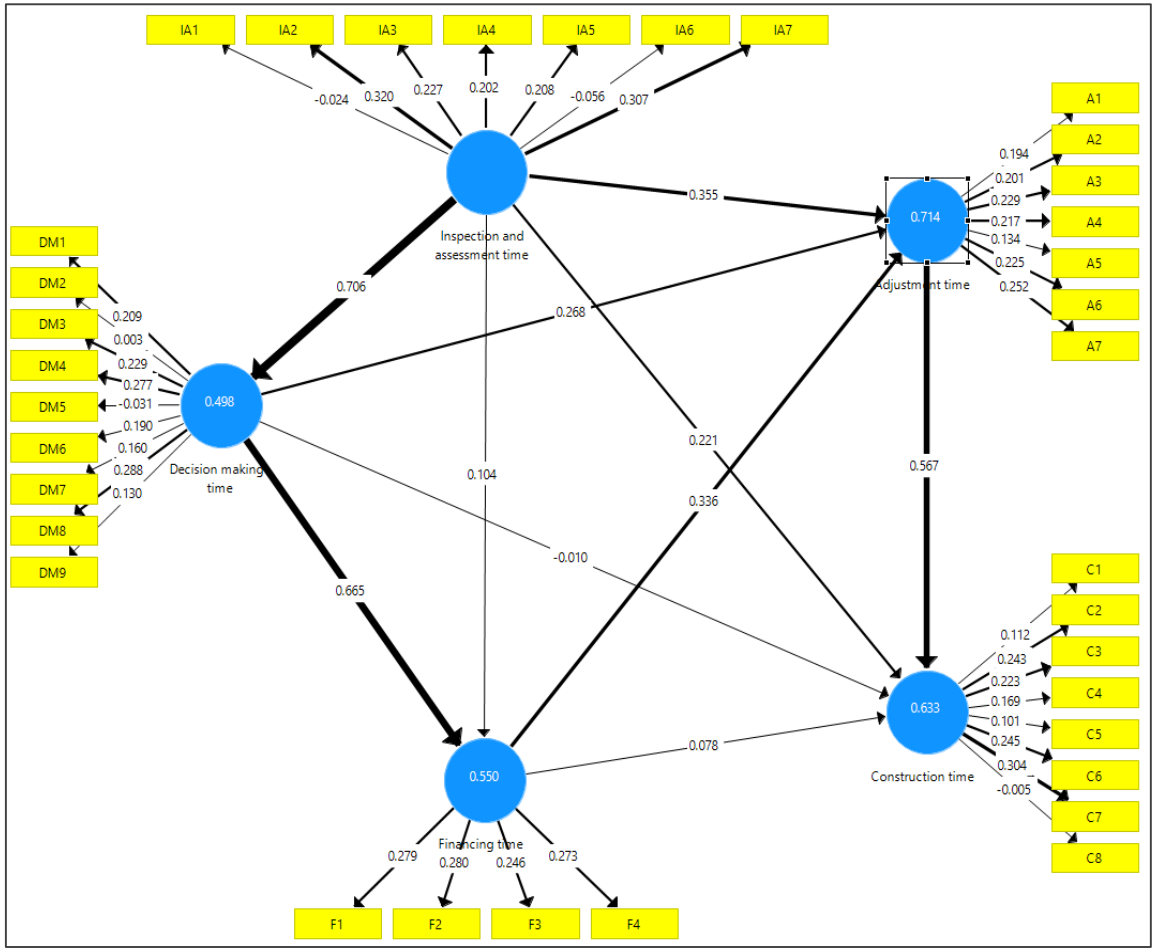
3. **Questionnaire Survey**
   Investigate the infrastructure recovery pathways in Christchurch by understanding the impact of critical factors on the recovery efforts

4. **Structural Equation Modelling (SEM)**
   Observe of strength of relationships between recovery stages
   Quantify the impact of critical variables specific to the recovery phase

RESULTS

Inspection and Assessment	Decision Making	Financing	Adjustment	Construction
Technical capability of engineering professionals	Changes to building standards and practices	Availability of loss adjusters/quantity surveyors	Financial capacity of construction businesses to take on further work	Repair/rebuild procurement method (Form of contractual agreement)
Access to site due to safety concerns	Information management (database information)	Productivity of quantity surveying	Availability of construction manpower	Repair scope variations incurred through construction
Speed of engineer mobilisation and assessment	Incorporation of resilience and performance-based systems	Work hours of loss adjusters/quantity surveyors	The state of the economic system in Christchurch	Clarity in scope of the works
Availability of engineers	Land zoning decisions	Pace of decision making of policy holder	Economic conditions elsewhere	Extent of demand surge (labour wage inflation)
Fatigue of engineering assessors	Consenting and permitting process		Availability of temporary accommodation for staff	Competency and productivity of Contractors involved
Frequency of ongoing after shocks	Insurance claim apportionment process/process of securing finance		Availability of construction materials	Long lead time components and supply chain issues (logistics)
Existence of a robust inspection methodology	Mechanisms of recovery governance		Needs perception delays	Speed of design process
	Coordination with other sectors			Rework time such as repairing defects
	Community engagement in decision making			

Critical factors in the infrastructure recovery process



Structural Equation Model of the infrastructure recovery process from Questionnaire Survey Responses

THANK YOU - QUESTIONS

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