A Systems Thinking approach for understanding the complexity of cost overruns in transportation megaprojects

Gimhan Godawatte

Assistant Professor in Quantity Surveying
Heriot-Watt University

G.Godawatte@hw.ac.uk

Transportation megaprojects and Cost overruns

- Megaprojects (also known as major programmes) are large-scale, complex infrastructure projects.

- Cost threshold: over US$ 1.0 billion

- Cost overrun = Estimated cost < Cost at completion

- E.g. the Channel tunnel (1994), Denver International Airport (1995), Boston's Big Dig (2007)

Theoretical explanations for cost overruns – the schools of thought

- **The Psycho-Strategists** – Cost overruns happen due to psychological (cognitive) biases of decision-makers and political influence to initiate 'wrong' projects.

- **Evolution theorists** – Cost overruns are a result of accumulated costs caused by changes to the project due to errors made by key decision-makers.

Gaps in research

- Research on cost overruns in construction projects dates back to 1960s.
- Both schools of thought agree that cost overruns is a 'complex problem'.
- Current research on cost overruns rely on reductionist approaches. i.e. ranking the factors causing cost overruns
- Lack of 'holistic approaches'. i.e. systems thinking etc.

Research approach

- A qualitative model building approach based on grounded theory and systems thinking using data from a case study

- Case study – California high-speed rail project

The California high-speed rail project

- Approved in 2008 by the voters

- 800 miles

- Connecting the main cities of Sacramento, San Francisco, Los Angeles, San Diego

- Estimated completion: 2020

- Current estimated completion: 2030

- Estimated cost: $45 billion (2008)

- Current estimate: $80 billion (2020)

- Major issues: lawsuits, construction delays, inadequate funding, lack of expertise to plan megaprojects, polarized politics

Data collection

- 23 interviews

- 67 newspaper articles

- 12 board meeting transcripts

- 10 audit reports

- 06 US Government Accountability Office reports

- 04 contract documents

Grounded theory

- Grounded theory (GT) – a systematic qualitative data collection and analysis approach used to construct a substantive theory that is "grounded" in actual data.

- Ideal for research focused on causality
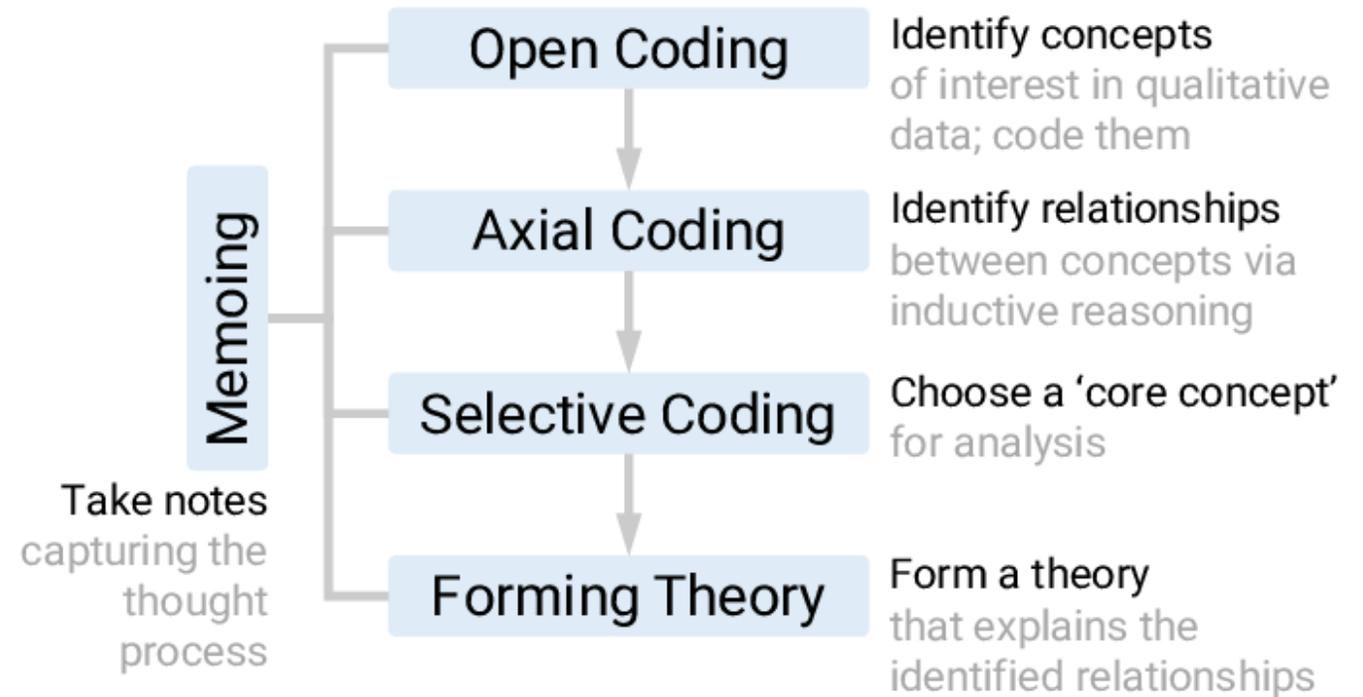
GT for Systems thinking as a theory building approach

Data analysis stage in GT	Description of the process	Input	Output
Open coding	Identifying variables, concepts and themes in the data	Raw data	A list of concepts and themes and corresponding codes
Axial coding	Identifying causal relationships between the concepts	List of concepts and main themes and their corresponding codes (NVivo)	A coding chart, Nodes tree on NVivo
Selective coding	Abstraction of the identified causal relationships	Coding chart, Nodes tree on NVivo	Causal maps for each core theme
Substantive theory	Formation of the theory that explains the identified causal relationships	Causal maps for each core theme	Final causal map

Analysis of data – open coding example

Political polarisation?

"*Part of the issue is the controversy and the political polarisation of a high-speed rail project in the United States.* It's very unique in terms of polarised politics. *And you're seeing that play out between the Trump administration and the California governments.* The intent behind this project was always at some point to enter into a public-private partnership. And have a concessionaire became principally the project and manage it. *And so, there is a funding gap and that's probably the biggest risk right now to the project, getting it to a point where a concessionaire or a public-private partnership get into an agreement to go forward. Given all the controversies surrounding the project, funding is at risk*" (Int 22).

Funding availability?

Support from the Legislature?

"*And in delivering this project, I think another major issue for us is, as a brand-new project we didn't receive any support from the Legislature.* And so, everything we do just about that affects a third party, we had to negotiate. Well, I could take the comparison when I came from as I mentioned Caltrans six years ago. And you know the state highway system has been around for many decades. Caltrans has been delivering projects for well over 100 years. And so, for them everything is established. It's like hey if we need to go to construction and this utility needs to be moved you contact the utility company and Caltrans has the legal right for the utility company to have to come in and move and pay for it. And so, we couldn't do that. *We didn't have direct control over of them*" (Int 15).

Analysis of data – axial and selective coding

- The process of labeling and organizing qualitative data to identify different themes and relationships.

- 04 main themes identified

The substantive theory – causal map
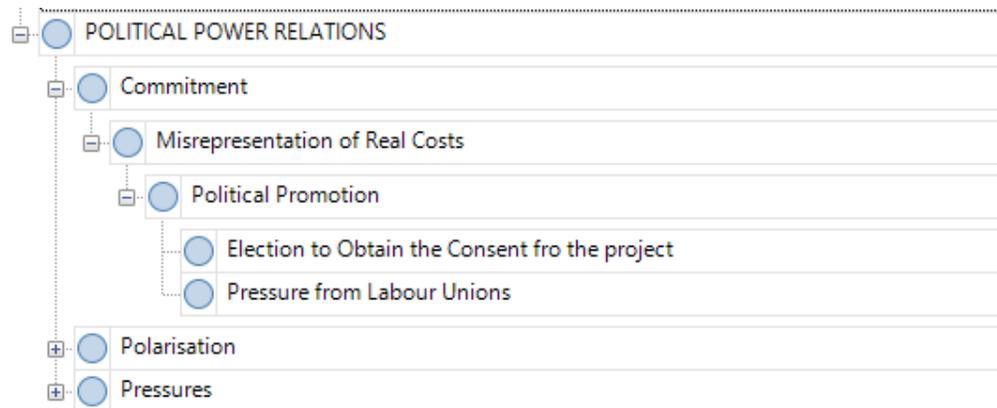
Research limitations and future work

- Model based on data from one case study

- Complete the stock and flows and SD simulation

Thank you!

Questions???