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Digital twins and 4D visualization to cut through optimism bias and other unconscious biases on Mega Projects

Abhi Datta
Associate Director, Turner & Townsend

Turner & Townsend

Project Controls EXPO London, UK

About the Speaker

Abhi Datta – Associate Director; Turner & Townsend

As an engineering professional with a strategic insight, Abhi has worked at an operational and strategy level, helping in "mega" project set up which is very different and unique from regular project setup or management

He has ensured establishment of project controls and management best practices across the Infrastructure, Oil & Gas, Industry and Mining sectors. He has completed successful engagements in US, Middle East, India, China, Indonesia, Singapore, Philippines, Australia and currently based in Europe (Netherlands). Having working in management consulting, he has overseen quick and sustainable business turnarounds.

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About the Topic

Megaprojects suffer from optimism bias as its project team consistently underestimate costs and overestimate benefits. They fail to learn from their mistakes in spite of the practitioners knowing the presence of optimism bias leading to a 'performance paradox.' Thus, megaprojects are an example of the knowing-doing gap similar to other industries. We explore how megaprojects use innovative ways to address this knowledge-doing gap by managing risks that would arise during construction and operational readiness. For this, we used the case study of megaprojects in Netherlands and Australia .

Digital twins and 4D visualization to cut through optimism bias and other unconscious biases on Mega Projects

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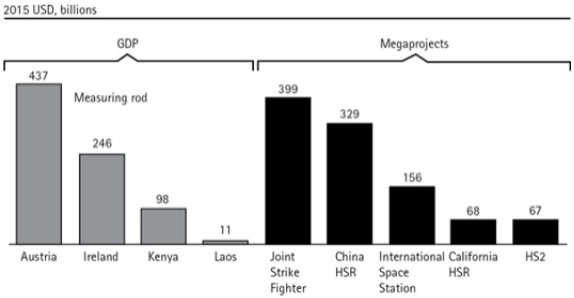
Mega Projects	Optimism Bias	Knowing Doing Gap
Systemic Risks	Case Study	Stakeholders
Digital Twins	Hidden Innovation	

Mega Projects

Megaprojects are a different breed of projects due to their complex characteristics. They are not just larger projects. Mega projects are large-scale, complex ventures that typically cost $1billion or more, take many years to develop and build, involve multiple public and private stakeholders, transformational, and impact millions of people

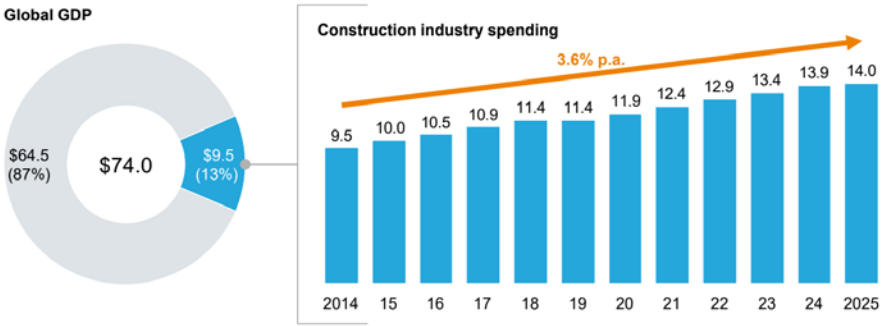
Mega Projects vs GDPs



Why Mega Projects matter?

Construction matters: Construction-related spending accounts for 13 percent of global GDP

$ trillion

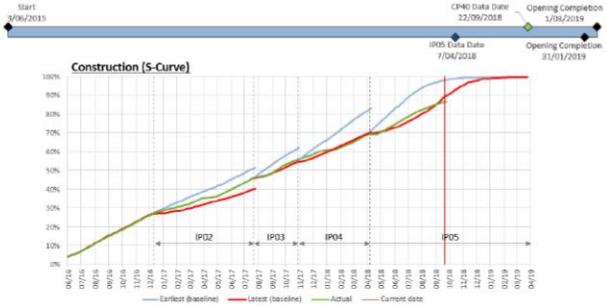


SOURCE: World Bank; IHS; ISSA; McKinsey Global Institute analysis

Optimism Bias or Strategic misrepresentation

Megaprojects suffer from optimism bias as its project team consistently underestimate costs and overestimates benefits.

They fail to learn from their mistakes despite the increased number of projects and researchers claiming the presence of optimism bias leading to a 'performance paradox.'



Optimism Bias and other fallacies

Misconceptions of chance

▶ HHHTTT or HTHTTH ?

- **The Conjunction Fallacy**

▶ Air travel insurance covering terrorism only closer to a flight vs insurance of all sorts including terrorism

- **Disregarding variance in a small sample**

▶ Likelihood of an average of 6 feet being the average height of 10 randomly selected people vs 1000 randomly selected people

- **Insensitivity to prior probabilities**

▶ A 99% reliable test gave you a positive result on a rare medical condition (1 in 1000 have the condition)

Is the Definition of Project a detriment to projects? "Uniqueness bias" is the tendency of planners and managers to see their projects as singular. This particular bias stems from the fact that new projects often use non-standard technologies and designs, leading managers to think their project is more different from other projects than it actually is. Uniqueness bias impedes managers' learning, because they think they have nothing to learn from other projects as their project is unique.

Optimism Bias

- One way to deal with the effects of optimism bias is to innovate during the project to manage overruns and preserve benefits
- For this we need to increase the capability of client and contractors and provide opportunities for innovation One way to increase the capability of the client is to be able to predict issues before they arise and be able to mitigate those risks.
- In complex projects risk tend to grow exponentially due to the interactions of the various parties involved if their efforts are not coordinated

Optimism bias – a political reality

System engineering and technical complexity are well understood, but uncertainty and stakeholder complexity are still big challenges for mega projects.

Three reasons for failure of Mega Project

- Underestimation or refusal to acknowledge uncertainty
- Stakeholder neglect or mismanagement
- Inflexible contractor management

Knowing Doing Gap – Knowledge to Action

Gap between Knowing and doing is greater than the gap between ignorance and knowledge.

This emphasizes the importance of measuring performance at each project stage

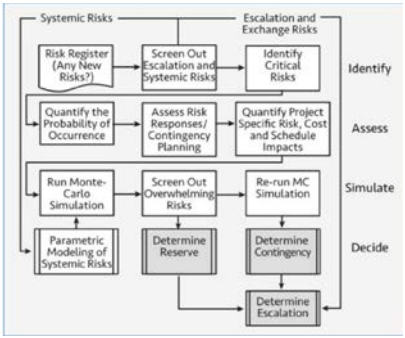
The first step towards addressing the knowing-doing gap is to acknowledge that the gap is real. The knowledge-doing gap is evident in the case of megaprojects as they suffer from a performance paradox where the project team fails to learn despite many opportunities to do so.

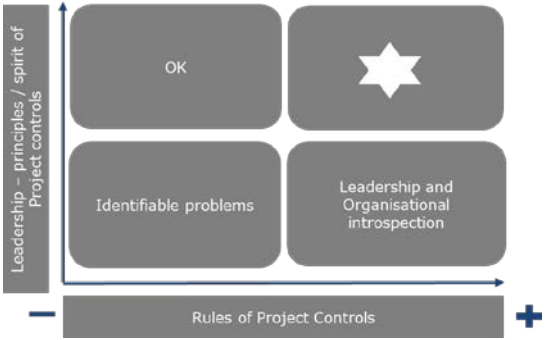
Systemic Risks and its importance

- Why most currently used standard probabilistic (Monte Carlo) methodologies are relevant to 'strong teams' only? – Weak team doesn't point to the individuals but to the team dynamics as is defined below
- The term systemic implies that the risk is an artefact of the project system, culture, business strategy, process system complexity, technology, and so on. Systemic risks are dominant for poorly defined projects, and their nature, behaviour and impacts are not reasonably quantifiable using traditional brainstorming workshop input. (Hollman, 2016)
- Introduction of a non-linear probabilistic (Monte Carlo) methodology to define adequate cost contingencies for projects managed by 'weak teams'?

Risk Identification

- Risk identification is the most important phase in risk management and the advantages of risk management hinges to a large extent on the approach used for risk identification





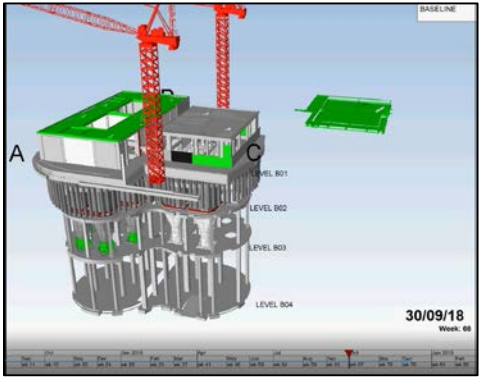
Road Ventilation Facility – July 2018

Road Ventilation Facility (RVF)

- 4D modelling used by client to track contractor methodology and program. Synchro© for clash detection.
- Contractor using full 3D Revit model of RVF for building structure and M&E installation.

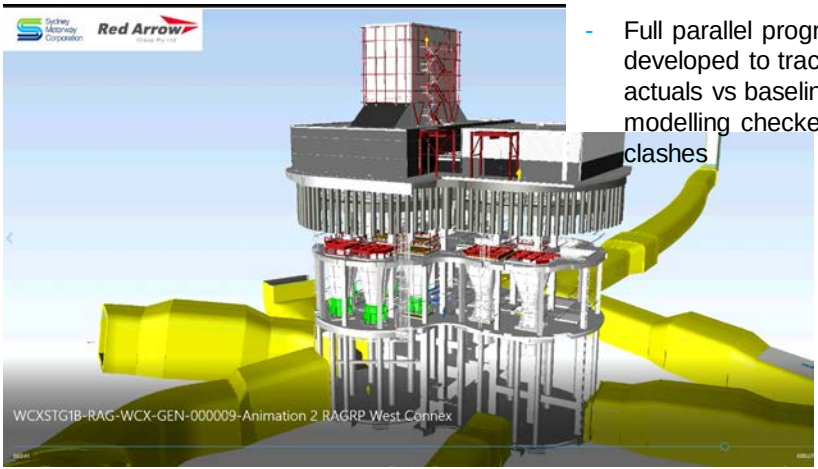
Road Ventilation Facility – July 2018

- Full parallel program developed to provide certainty in Contractor's program using more conservative program assumptions and sequencing



80 / 20 Rule

RVF final configuration – 6 vent tunnel openings into shaft



- Full parallel program developed to track actuals vs baseline. 4D modelling checked for clashes

RVF excavation

- 45m deep clover-leaf shaft, 80,000 m3 rock removed

RVF Temporary Props

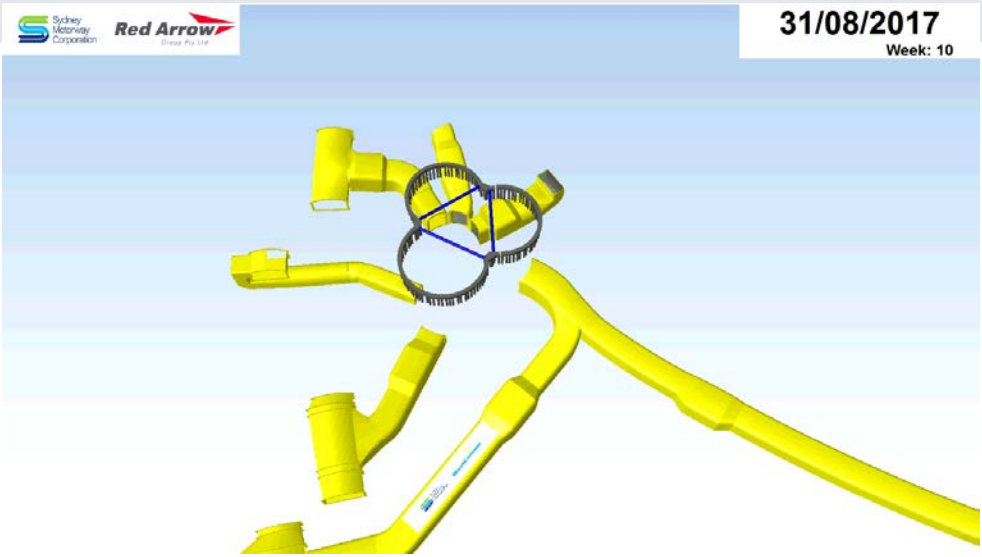
- Props to support capping beam during excavation

Sydney Motorway Corporation

Red Arrow Group Pty Ltd

31/08/2017

Week: 10



Bias with stakeholders

Project

Supervisor

Parking

Real-estate

Security

Finance

Digital Twins – Why?

- A digital twin is the virtual replica of a physical asset , process, place, system or device. Essentially it is a computer program, it uses data as the input and produces simulations of how its assets or processes will be affected by these inputs. Such real-time analysis and predictive modelling offer up 'what if' scenarios that are both faster and cheaper than real world testing creating insights into how to improve operations and increase efficiency.

- Most common uses at Schiphol are people flow analysis at peak times, fire safety analysis and prediction of flow when large airplanes arrive.

- Digital twins are created for new construction projects to provide a lifelike look of the design and amenities to facilitate better planning and design requirements. The BIM model in this case is not only linked to the time phasing plan but also to the operational data from airports asset management system, which is integrated with a GIS map to create the static digital twin. To make this digital twin alive, the model is fed with real time data from IoT devices deployed throughout the airport. This is coupled with simulation tools.

Digital Twins – How ?

- The next step is to start making recommendations based on what the predictive analysis will show the airport can then set its own rules about how those recommendations are actioned

- Ultimately recommendations made by digital twin technology will help inform that decision making. The technology will learn which recommendations are typically accepted and suggest a new rule to make the process even more efficient.

- Any such project must identify the end user and the intended use of the digital twin. They should also know what problem they are attempting to solve. This will lead to what types of maps, models, drawings and engineering data should be collected and how it should be presented.

Hidden Innovation in construction

- ## Sector-level innovation

Sector-level innovation is very visible and often produces radical or step change. It takes two principal forms. First, regulations and standards which prescribe new sector-wide product or material attributes (for example, structural integrity) or new behaviours (for example, health and safety regulation) forces 'compliance'

- ## Business-level innovation

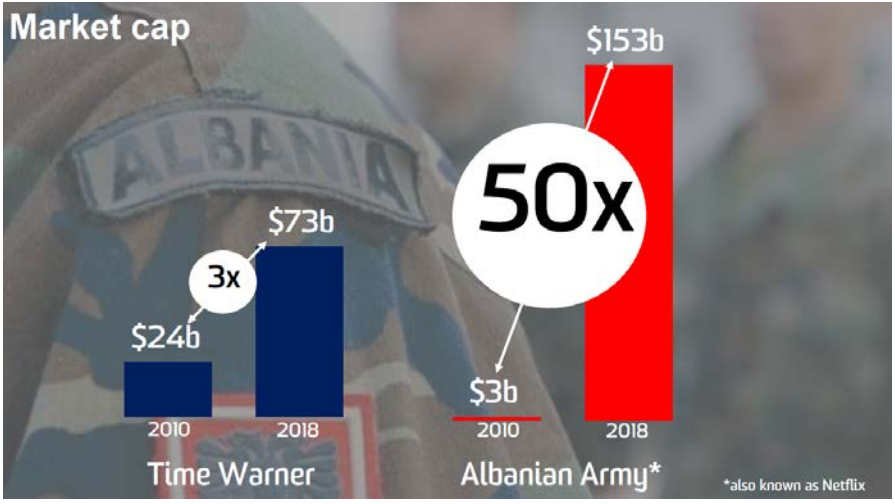
Business-level innovation tends to be more obscure than sector-level, and can produce either radical or incremental innovation. The innovation focus is on general resource and capability development, rather than being project specific

- ## Project-level innovation

Project-level innovation activity is the most hidden, but arguably has the greatest impact on sector performance, and is generally incremental in nature.

Catastrophic Overconfidence

Catastrophic Overconfidence



Thank you

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