Project Controls Expo, Australia – 26<sup>th</sup> November 2019

Melbourne Cricket Ground, Melbourne

#### Improving project predictability with AI

Alan McFadyen CEO & Founder, BitWinder







#### About the Speaker

Alan McFadyen, CEO & Founder, BitWinder

Alan is a chartered engineer with 25 years' experience in project management and engineering. His career began in Scotland where he studied artificial intelligence. His experience includes senior management roles on multibillion-dollar mining projects and the management of large project portfolios in excess of one billion dollars. Most recently he led a technology project delivery function for BHPs Coal business. Alan continued to maintain a keen interest in artificial intelligence, leading him to identify an opportunity in project management. The result was BitWinder, the company which Alan founded to innovate with AI in project management.



#### About the Topic

Poor predictability in projects is destroying value unnecessarily. With poor predictability, we blindly follow our forecasts until the evidence suggests otherwise. Yet, improved predictability allows our project teams to take early corrective action, when its least expensive and when options are plentiful. Artificial intelligence can significantly improve upon the current situation. Unlike us, artificial intelligence can learn from huge datasets giving it thousands of years of experience from which to draw upon when making forecasts. In this presentation, Alan McFadyen shares the results and new possibilities of using artificial intelligence to make projects more predictable.



#### What's the problem?



#### \$US15bn blowout sets off alarms

# ...needs another \$20 billion of public money to finish rollout

#### ... builders battle claimed \$2bn blowout





## The problem with projects

#### **McKinsey**

"On average, projects with budgets above \$1 billion are delivered one year behind schedule, and run 30 percent over budget.",

Asvadurov et al., 2017, The art of project leadership: Delivering the world's largest projects, McKinsey





## The problem with projects

# EY

Of 365 oil and gas projects:

- 64% in cost overrun
- 73% in schedule delay

2014, Spotlight on oil and gas megaprojects, EY





## Australian research

Grattan Institute conducted largest study into Australian transport infrastructure projects (836 projects, 15 years)

Projects > \$20M

34% of projects overrun their budget

The average overrun is 24% - 43%

Projects > \$100M

65% of projects overrun their budget

The average overrun is 52%

Average P90 – P50 estimate difference in samples of large projects was 9.2%, reality is 26%

## Findings of research relevant to AI

Reference class forecasting from similar historical projects could help inform future project estimates

Incorporates likely unknowns

# Does not suffer from optimism bias



















Still late









Spent budget - Late projects in underrun lent to overruns











## Real data example

Program of 43 projects: 2017 - 2018





- Large spread of variance indicating low forecast accuracy
- 8 projects from 43 are within +/-10% of approved spend for 2017/18



## Real data example

#### 43 projects: 2017 - 2018

Project performance analysis



Overruns and underruns don't cancel each other out because they destroy value differently:

- 1. Overruns deliver the same value for a higher price than expected.
- Underruns usually mean less value is being delivered than planned, which leads to extension costs. They are often future overruns in the making

#### Notes:

- · Cost overrun actual spend above approved spend which corresponds with an increase in total project estimated cost
- Late actual spend below approved spend which doesn't correspond with a reduction in total project estimated cost
- Cost overrun & late cost below approved spend which corresponds with an increase in total project estimated cost



## The problem



## What happens when you learn?

#### Mapping applications

Predicts journey time and route

.....

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Learns from previous journeys

Predictive modelling



Measured average error of 6%

#### Project software

Forecasts time and cost

Doesn't consider previous projects

Schedule based forecast

Measured average error of 34% (>\$100m)



#### Artificial intelligence – a few basics



## Artificial intelligence – why now?

#### Artificial Intelligence

Any technique which attempts to replicate a task requiring human intelligence. For instance, playing chess (1950s).

1960s

1970s

1980s

1950s

#### Machine Learning

Requires strict data structuring and data preparation. Well understood problems.

2000s

2010s

1990s

#### Deep Learning

Feature extraction and selection. Can solve difficult problems.



## The machine learning pipeline



#### A journey into using AI in projects



# First steps in AI for project management (classification)

Can we learn from historical data and determine if projects in execution will end "good" or "bad"?





## What is a good or bad project?

Good – at completion:

- Cost is within +/- 10%
- Schedule is within +/- 10%



## **Classification of projects**





# Training (learning) the neural network



Raw cost charts



Feature engineering

Deep learning Image classifier





# 12 month project, on budget, one month late reporting period 5



## Bad, we've learned how this usually ends

#### 12 month project, 43% over budget, 5 months late, project complete





## The overall classification result

Correct classification with under 10% error over sample of 80 projects



# Next step, can we predict periodic costs? (regression)

Can we learn from historical cost data and generate a more accurate predicted forecast for projects in execution?





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## Training a regression neural network



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Historical cost & meta data

Feature engineering

Deep learning regressor



## Forecast prediction with AI



in execution

learning regressor



#### So how well does Al perform?



## Validating performance – test data setup

38,000 project snapshots at progress mark: 20%, 30%, 40% Unique combination of plan type, total cost and duration,

Unique combination of CPI, SPI and forecast variance



## Summary of results at 20% progress



Prediction error of 7.55% on cost & 4.70% on time



81.15% of predictions are more accurate than the forecast



Prediction better on average by 15.32% over forecast error





#### How can we apply this in the real world?



## 12 month project - 2 months remaining





## 2 months to remaining, 6 months overrun





## 8 months remaining - 6 months overrun





## **Dashboard - predictive analytics**





#### In **conclusion**



## Challenges







## Where to from here?

Improve explainability & the drivers behind the why

Schedule, risk and 2 contract deliverables



Bring AI into the visualisation





Project Controls Expo, Australia – 26<sup>th</sup> November 2019

Melbourne Cricket Ground, Melbourne

#### **Questions?**

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