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# Major Engineering Project Performance

## Other reasons to explain over-budget and delay

As you know, people can be biased in a number of ways. They are over-optimistic when underestimating cost, and overestimating benefit. They can also display opportunistic behaviours,that can be as extreme as paying bribes to build an unnecessary infrastructure. A key point is that all these factors together along with the complexity of major projects, explain why projects encounter delay and they run over budget. In general, there is a never a single reason to explain why projects go over budget. But rather, a long list of factors that every time may have contributed more or less to the project going over budget. Now, let me ask you a question. Let's pretend that the world in the future will be dominated by robots. These robots do not have human bias. They are emotionless, and cannot behave opportunistically. Do you think that the projects made by these robots will still run over budget, and will be delivered late? Hit pause, and try to think about this. What do you think? Well, the answer is yes. Even in a robotic society following our rules, projects will be delivered over budget, and late. There are three reasons for this.

The first reason is that projects are usually awarded to what is described as the best deal. For instance, the company providing the lower quoted cost for certain specifications. This can be seen as a form of auction. In auction literature, there is a famous phenomenon known as the winner's curse. The name comes from sealed-bid, common-value auctions, where a number of bidders bid for an item of uncertain value, a value which is the same for all bidders. All bidders guess the true value of the item, make sealed bids according to these guesses, and the highest bidder gets to purchase the item. It's clear that on average, the result will be that the winner ends up paying more than the actual value of the item, hence the name winner's curse. So, we're thinking back to the robots. If 10 robots need to provide a cost estimation they will work with different models and data, and generate 10 different offers for a certain service, or product. The decision robot will select the best value deal. For instance, the one offering the lower cost and therefore, again the most optimistic price.

The second reason why projects run over budget is what is known as regression to the mean. This describes a well-known statistical trap caused by selection. If participants in an experiment are

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selected based on some characteristic with random variation, say, having a high result on a test, then follow-up measurements of that particular characteristic, a repeated test say, will show that the selected group is becoming more similar to the control group. That's to say, the difference will be smaller. This trap can lead to false inferences being made. Let's consider an example. 500 robots are doing a closed answer test. With 100 questions, each with five closed answers where only one answer is right. Some robots are very knowledgeable while the others are quite ignorant. Anyway, they need to answer all the questions. So, any answer they don't know they will guess a response. We then look at who were the best, and the worst performers on the test. The five best performing robots scored on average 95 points. The five poor performing robots scored on average 22 points. Now, you want to carry out the test again with only the best and worst performing robots taking the test. What do you think will happen? Let's say that in the original test, the most knowledgeable robots knew 80 answers, and they guessed the other 20. Their score should therefore be 80 plus 20 divided by five equal 84. But they were lucky first time round, and scored 95. Taking the test again, they will still know 80 answers, but there is no reason to think that they will be lucky again. So they will score 84. The worst performing robots knew 10 answers and guessed on 90 questions. Their score first time round should have been 10 plus 90 divided by five which is 10 plus 18 equalling 28. However, that time they were unlucky so they got 22. Taking the test again, they will still know 10. But there is no reason to think that they would be unlucky again, so they will score 28. As we can see, the best performance average score decreased while the worst performance score increased. This is an example of the regression to average. So in a major project, if you're hiring the best performing company or service provider, be mindful that there are some random elements which affected their past performance that might not be there in their future performances.

The third reason for projects running over budget is a form of selection bias presented in the figure shown here. Black dots are the true unobserved payoff of a number of project suggestions. For the purpose of illustration, we assume that the true payoffs are the same for all projects. These payoffs are unobserved, meaning that nobody knows about them for certain, neither the robots proposing the projects nor the robot selecting the projects. However, robots are honest, and sometimes they underestimate the payoffs, shown here as the white dots below the black ones, and sometimes they overestimate payoffs, shown here as the white dots above the black dots. A robot decision maker observes forecast payoffs illustrated by circles, and only projects above some selection threshold are

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realised. The true payoffs are revealed once the projects have been realised. It is obvious the true payoffs will on average be lower than the forecast for the selected projects, even if forecasts were unbiased for all projects. In other words, the selection process will mean that on average, the decision maker will be disappointed by the true payoffs of the selected projects. This is the case even if the forecast errors for all projects that they had to choose from were zero on average. It's also obvious that the more competitive the selection process is, the higher the threshold. There will be a greater difference between the estimated payoffs, and the true ones. So, to summarise, here we have learned that besides the human bias, there are several other reasons to explain why projects go over budget, come in with delay and a worse cost benefit than expected. You can now be mindful of these factors next time you carry out a project.

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