Does a lack of trust contribute to cost blowouts?

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As projects grow, trust diminishes

Australia's mining sector should be performing better than it currently is, but amid uncertain global markets institutional financiers remain doggedly conservative in their approach to funding major capital projects.

One look at the analysis of how large projects perform and we can hardly blame them for that conservatism. According to Independent Project Analysis, one in eight large capital projects around the world is a failure, with significant deviation from plan on budget, schedule and/or performance. In 2011, they observed that 65% of projects with a capital budget of greater $1 B fail to meet their business objectives.

In 2019, McKinsey stated , *"The bigger the project, the bigger the problems* is an apt description for infrastructure megaprojects and that these projects have a history of failed delivery due to poor planning and execution. Their increasing size, complexity, and risk are frequently exacerbated by disconnected project teams, inefficient processes, and siloed data. The result is schedule delays, cost overruns, and quality issues."

In contrast, small teams can deliver small minerals processing projects with greater certainty than large projects. Project cost, quality and schedule targets are also easier to achieve with small projects when compared with large projects.

Our challenge then, is to apply lessons learnt in the successful delivery of smaller projects to larger ones, simplifying the execution strategy and reducing risk. As projects get larger, the number of people and interfaces increase, and managers need to focus on how information is communicated and decisions (including approvals) are made in a timely manner.

The ability to do this is dependent on numerous factors but most significantly those associated with successful small projects are:

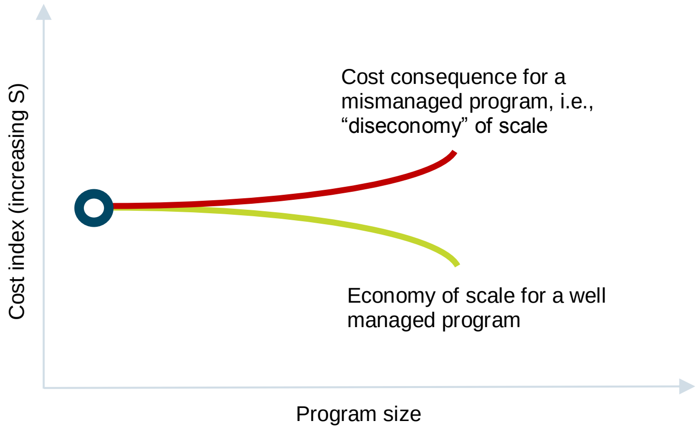
- Knowing what good looks like
- The ability to make fast decisions
- A culture based on trust.

To understand why, let's consider what happens as projects get larger in terms of:

- Complexity
- Associated infrastructure
- Decision-making
- Bulk materials quantities.

Complexity

Most of us are familiar with the concept of ‘economy of scale’ but Westney (2003) has also pointed out the “diseconomy” of scale that emerges alongside inefficiencies in project delivery (figure 1).



“As projects become larger, the risks of inefficiencies resulting in “diseconomy of scale” balance the opportunity to achieve significant savings through economy of scale.”

Figure 1 — The diseconomy of scale (from Westney, 2003)

In part, this diseconomy of scale can be attributed to the increase in project complexity as projects increase in size.

For example, even though the overarching flowsheet for a large project may remain similar to a smaller project (e.g. crush, grind, flotation, concentrate handling and tailings handling), the number of mechanical equipment and fabricated platework items increases dramatically.

Not only does the number of items increase, but the complexity of the systems (motors, gears, belts, etc.) also increases, particularly if equipment size/scale is increased above that in common use at the time.

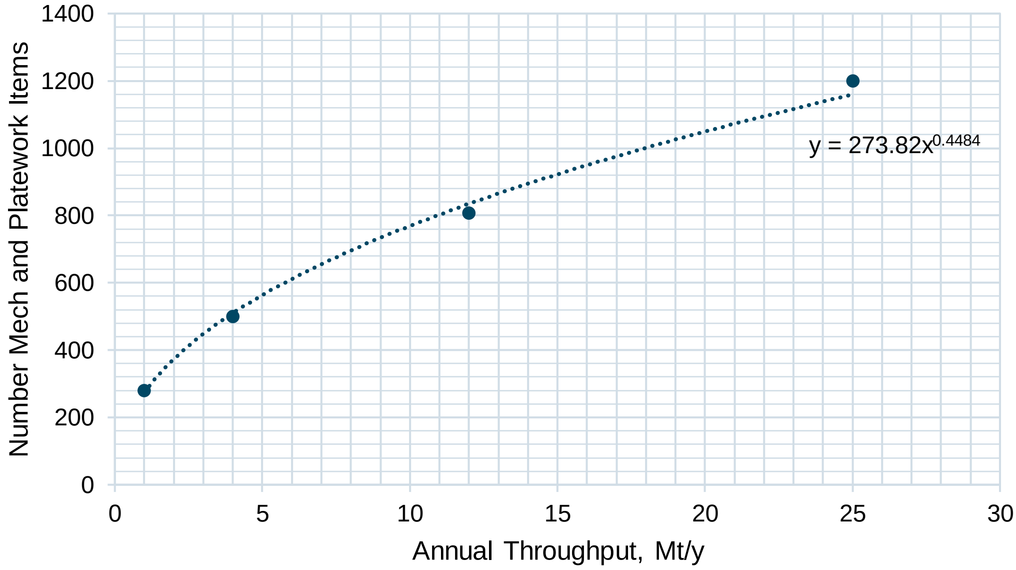


Figure 2 — Complexity of project as a function of annual throughput

Associated infrastructure

Large projects require large scale infrastructure in terms of ports, access roads, power supply and water supply. Due to the relationship between the process and service requirements the power and water requirement increase linearly with project throughput unless the process route is altered to optimise the outcome. However, large projects requiring the installation of ports, new power lines, water supplies and pipelines also involve broad consultation with landowners and government authorities that can be more complex than the equivalent discussions for the mine and plant.

Whilst the plant capital cost gets a lot of attention, the infrastructure and services associated with the project can cost more than the processing plant and, as a result, necessitate more effort to provide project surety through permitting and land access requirements.

Decision making

As project scale increases, the impact of decisions increases in cost/benefit and projects can afford to seek multiple opinions and inputs on all aspects of the project. However, the time to make a decision is proportional to the number of decision by the number of people required to make them (i.e. not linearly proportional to project capital cost, but increasing in proportion to the other factors such as the amount of new technology or the complexity of the social and environmental issues). As a result, the probability of optimal outcome is a function of not the number of inputs, but the quality of the inputs.

The ability to make good decisions at the lowest cost level of a business is fundamental to good business management. Contrary to this, large projects often require multiple functional manager signoffs as part of their governance process rather than holding people accountable. With small projects a project manager is accountable for staying within budget and making good decisions. It is entirely reasonable that larger levels of expenditure on major contracts that may be worth >$100 M are scrutinised, but equipment purchase, for example, once budgeted requires expeditious approval.

Bulk material quantities

Ausenco has identified that typically ~60% of a project's costs come from bulk materials (and associated labour and indirect costs). By reducing a project's layout and installation height, we are routinely able to reduce:

- Steel
- Concrete
- Piping
- Cabling
- The amount of power required for grinding,
- The amount of water required.

Our designs also frequently increased safety in construction and operation.

The ratio between installed equipment cost and total direct costs remains very similar across a wide range of throughputs. Similarly, the ratio between bulk materials quantities and equipment costs tends to be linear.

Put simply, reducing bulk materials on a project reduces both project cost and project execution time.

The better way

If we are to mitigate the risk of inefficiency on large projects, we must foster the cultures and behaviours associated with successful small projects.

So, what can we learn from smaller projects?

1. As a manager, you (and your team) need to know what good looks like so you recognise when red flags are on the horizon.
2. The trust that exists in many small teams needs to prevail on large projects to simplify decision making.
3. Look for ways to make processes as simple as possible by reducing interfaces and simplifying processes.
4. From a technical perspective, good layout and bulk materials quantities are scalable. Large throughputs do not mean that cost-effective design principles should be abandoned.

The outcome

A comparison of large grinding circuits

Grinding circuits for large copper concentrators in the USA and South America typically used about 0.4 m^3 concrete per kW of motor power installed and about 0.07 t steel per kW installed (Figure 3). Some of the South American projects in Figure 3 are in high seismic zones and all have the grinding circuit in buildings.

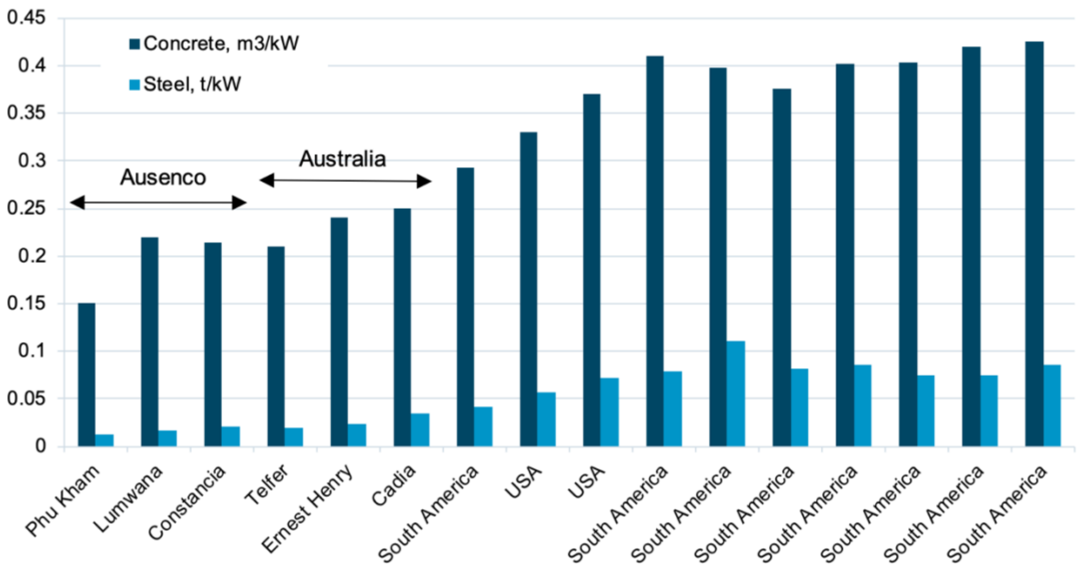


Figure 3 — Concrete and steel quantities for medium to large Cu concentrators

The typical small Australian grinding circuit had about 0.15 m^3 concrete per kW of motor power installed and about 0.015 t steel per kW installed. The markedly lower steel specific consumption is due in part to the lack of buildings for grinding circuits for most Australian projects. For comparison Century Zinc had a grinding circuit in an open sided building and used 0.27 m^3 concrete per kW of motor power installed and about 0.064 t steel per kW installed, lower than the American norm.

Optimising grinding circuit design

Phu Kham, Lumwana and Constancia were constructed by Ausenco using the same design principles that Ausenco used for designing smaller 1 to 2 Mt/y grinding circuits. This resulted in a substantial reduction in concrete quantities, from 0.4 m^3 concrete per kW to 0.15 and 0.21 m^3 concrete per kW for Phu Kham and Constancia, respectively. Constancia was constructed in a high seismic zone in Peru and Phu Kham in a moderate seismic zone in Laos.

The large reduction (50%) in concrete is a result of a significant reduction in grinding mill footprint and the application of smart design and layout principles developed in designing small plants.

All of which was underpinned by a culture based on trust, in which project managers had demonstrated that they knew what good looked like and were empowered to make fast decisions.

How can we ask institutional investors to trust us with their capital, if we are unable to produce execution strategies that demonstrate trust in our own decision-makers?