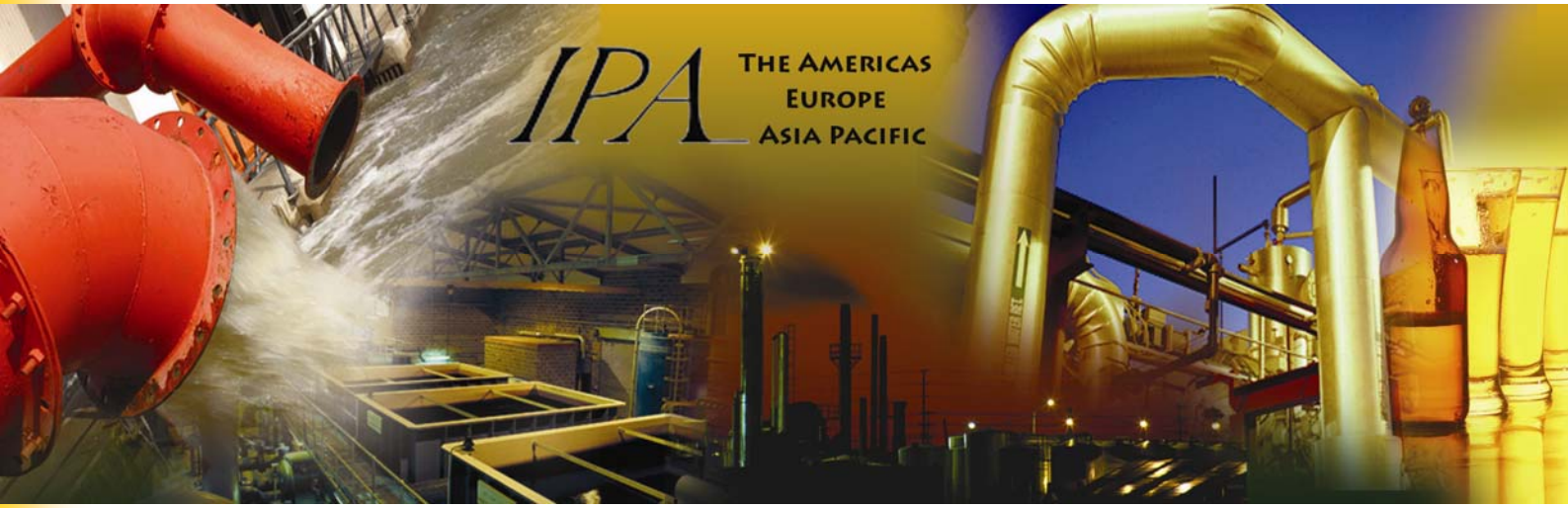
Independent Project Analysis, Inc. (IPA)

USA ~ Europe ~ Australia ~ Singapore ~ Brazil ~ China



Performance of Capital Projects in Australian Processing Industries

Joseph O'Brien, IPA Asia-Pacific

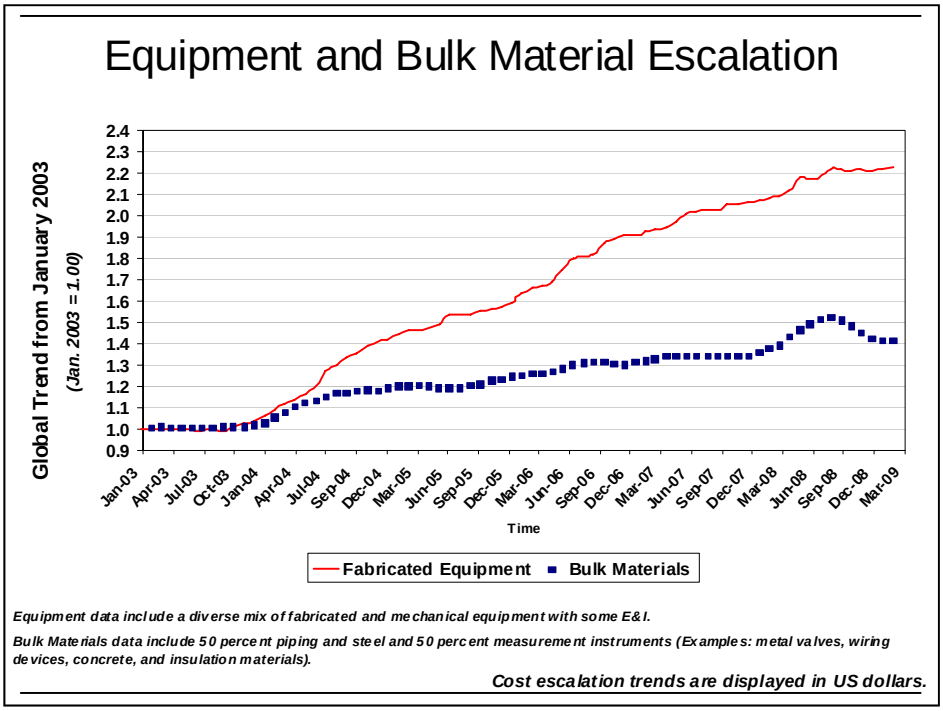
June 2009

Performance of Capital Projects in Australian Processing Industries

In the current economic downturn, capital funds are scarce. In most organisations, growth projects have stopped and capital expenditure is only being spent on sustaining or stay-in-business (SIB)-type projects. Data show that over the previous 10 years, with the exception of a few pockets of excellence, Australian SIB projects have underperformed in terms of safety, cost, and schedule performance compared with similar North American and European projects. The fundamental driver of the poor performance has been a lack of focus on capital effectiveness by the owner organisation. This, in turn, has led to business' willingness to approve projects without an understanding of the effects that inefficient execution may have on net present value (NPV) and the internal rate of return (IRR). A more thorough understanding of the risks associated with these projects may help Australian projects be more competitive with their overseas peers.

1 Introduction

The 2004 to 2008 time period was one of the most active in terms of capital projects, with almost all capital-intensive industries increasing capital spending during this time. However, in the past year, IPA has witnessed a dramatic downturn in the global project marketplace. Growth and expansion projects have dried up, with some organisations halting projects midway through construction. Further, prices for bulk materials have flattened and in some cases are coming down, whilst major fabricated equipment costs are stable for the first time in 5 years. The precipice for these changes has been the downturn in the global financial markets and the knock-on effect on commodity prices. Given these factors, the business case for large growth and expansion projects is no longer evident. Nevertheless, the requirement for funding sustaining capital projects is still critical to business success.



The performance of sustaining capital projects in the processing industries has been a key area of IPA research since its founding over 20 years ago. IPA has assessed over 6,000 sustaining capital projects globally. Over the past 10 years, we have evaluated hundreds of these projects in Australia across a range of organisations. These clients represent a range of different industries, but principally in the oil and mineral

processing sectors. Regardless of the industry or organisation, the performance of these projects has typically been poor compared with that of similar projects executed in Europe and North America. In fact, during the 10-year period, we have found that, on average, the Australian projects are less predictable and less effective in terms of cost and schedule than projects executed in North America and Europe. In addition, their safety performance was also much worse. Based on these studies, it appears that Australian businesses have a chronic problem with the efficient delivery of its capital projects. Given the current market, this is a key issue for organisations executing projects in Australia. From insights into projects conducted by government organisations, our perception is that performance of these projects is worse than the private sector. Given the recent injection of funds to support government infrastructure projects, this is a key area in which project performance needs to dramatically improve to avoid public-funded disasters.

However, while for the most part the performance of Australian projects has been poor, it should be noted that the capital performance of a few sites in Australia is comparable with that of the best sites from around the world.

What Are Sustaining Capital Projects?

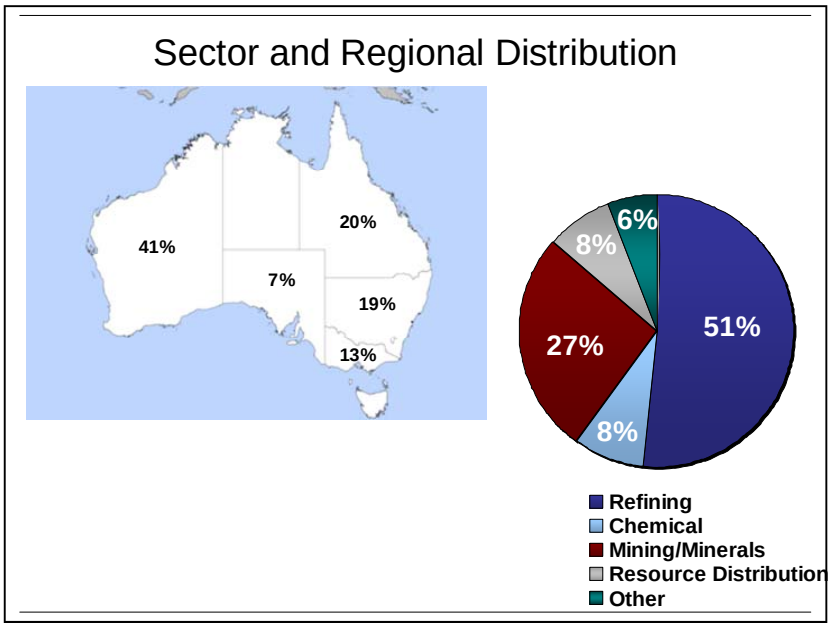
Sustaining capital project are sometimes referred to as stay-in-business (SIB) projects. These projects are typically executed at an operating site and aimed at maintaining a site's ability to operate effectively. The projects can range from process improvement or cost-saving projects with high returns to low-return maintenance or regulatory compliance projects. Typical SIB projects cost less than $15 million but, depending on the organisation, hundreds of millions can be spent on SIB projects, even in a downturn.

What Is Industry?

The term Industry refers to all projects in the database. The average performance of this set of projects is the "industry average." Therefore, industry average is the denominator by which we can compare individual project performance.

2 The Data

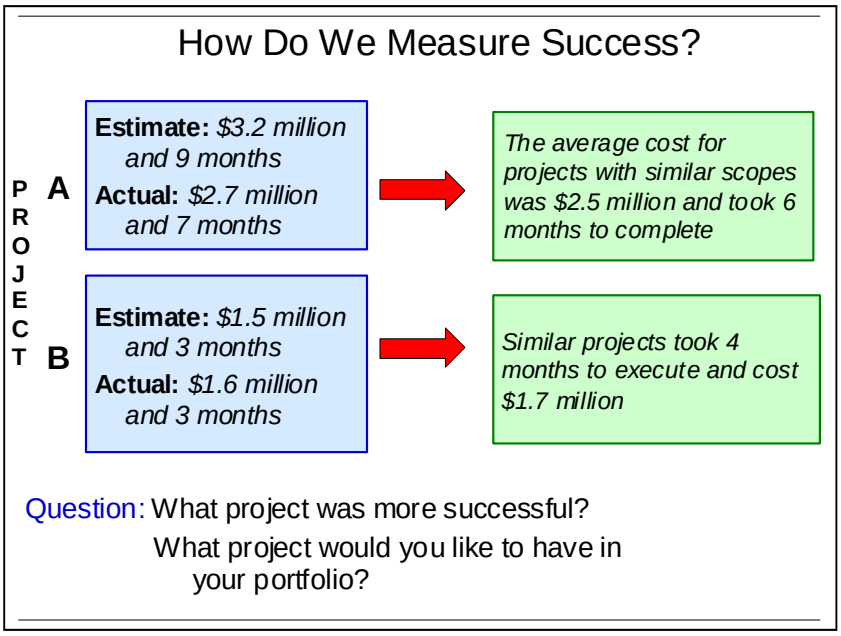
The data used in this study are primarily drawn from IPA's Downstream Database, which contains close to 12,000 detailed observations of projects executed globally over the past 20 years. Close to 6,000 of these projects are classified as sustaining capital projects, with the remainder being larger growth and expansion-type projects. This paper deals exclusively with these smaller, sustaining-type projects. The Australian dataset includes 282 of these types of projects that have been executed across 25 individual operating facilities by 15 separate organisations. The majority of these Australian projects are from the oil refining and mineral processing sectors, but there is also good representation from distribution (pipelines and terminals), and the chemical industry. The European and North American sample contains 4,252 individual projects. Of these, 75 percent are from the U.S. and



Canada, with the remaining 25 percent from Europe. It is important to note that all costs are normalised to take into account location and time differences. Thus, we have adjusted engineering rates, construction wages, and bulk materials (i.e., steel and concrete) and equipment (i.e., compressors and pumps) pricing for the price escalations experienced during the boom from 2004 to 2008, which is done by tracking prices and cost trends across a range of cost accounts. In addition, all costs are de-escalated to a common location and time.

3 Defining Success

IPA uses a range of measures to define a project's success or failure. An important measure is whether a project achieves its original cost and schedule targets, which is referred to as predictability. However, measuring only predictability fails to determine if a team spent more or less or took more or less time to construct a project compared to other similar projects. This is referred to as effectiveness. Cost effectiveness is essentially a measure of whether a project was cheaper or more expensive than a similar project. Likewise, schedule effectiveness is a measure of whether a project is faster or slower than a similar project. Provided a project is also safe and functions as planned, a project can only be considered successful when we examine both predictability and effectiveness. In the figure to the left, IPA would ascertain that Project B was more successful than Project A. Although Project A cost less than its estimate and was faster than planned, it was 8 percent more expensive and took 1 month longer to complete than similar projects. On the other hand, Project B had cost growth, but it was cheaper and quicker than similar projects. What this means is that as an industry we need to be careful in how we view outcomes. Having a predictable cost and schedule does not mean that a company is executing projects better than a competitor and is adding value to the asset. In fact, capital cost is the key driver of most NPV/IRR calculations. In summary, we can set conservative targets to ensure we can achieve them, or we can set aggressive targets to add further value to the business.

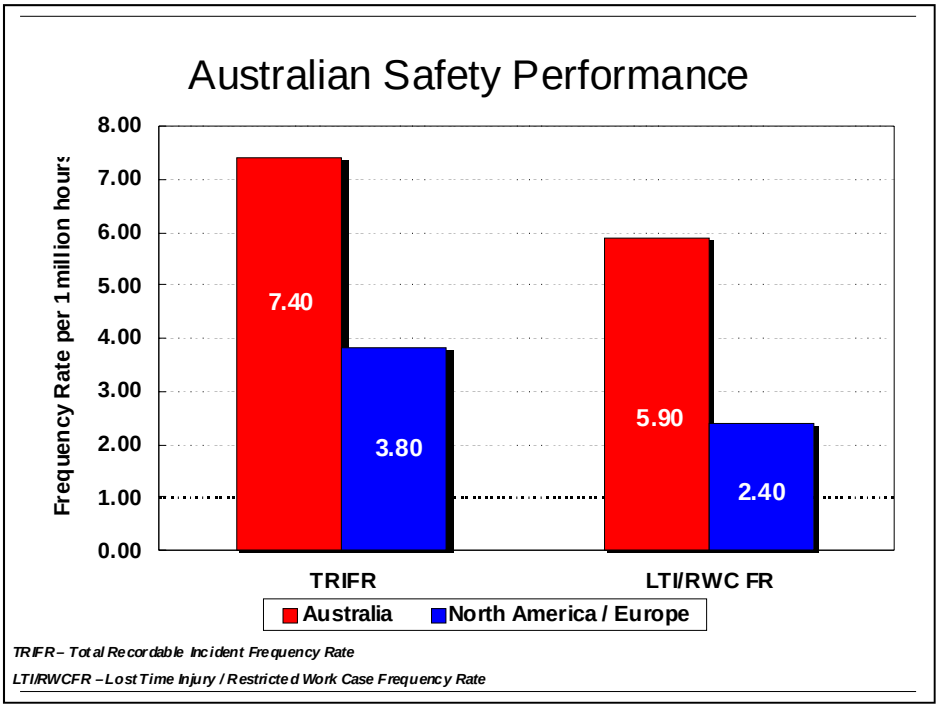


4 Performance Trends

Across the previously discussed sectors, IPA has found that Australian companies consistently lag their international peers with respect to cost, schedule, functionality, and safety performance in capital projects.

4a Safety

The key objective for all projects is safe execution. Even if companies are not interested in delivering cost-effective or schedule-effective projects, they still have a moral accountability to execute projects safely. Not only is it the right thing to do, construction safety results affect the overall image and reputation of an organisation. In addition, construction injuries and illnesses have a negative effect on project costs and schedule. Statistics released by the Australian Safety and Compensation Council[1] show that the median time lost from work in Australia was 3.8 working weeks and the median payment was $6,000 per incident. IPA's clients are industry leaders in the various processing industries and, on average conduct projects significantly more safely than the general construction industry. However, compared to equivalent sites in Europe and North America, IPA data[2] show that the total recordable incident frequency rate (TRIFR) for Australian projects is almost 100 percent higher. For more serious lost time, restricted work case incidents, safety performance was almost three times worse in Australia than in North America and Europe.



4b Cost

As discussed in the *Defining Success* section of this paper, there are two key cost measures at the heart of our analysis—cost predictability and cost effectiveness. If we examine predictability, Australian projects on average overrun their project estimates by almost 5 percent, as shown in the table above. Similar North American and European projects actually marginally underrun their estimates. Thus, are these North American and European projects setting and meeting conservative targets, whilst the Australian projects are setting and overrunning aggressive targets? The only way to answer this question is to examine the cost effectiveness of the two sets of data.

	North America/Europe	Australia
Cost Growth	- 0.4%	+ 4.7%

To allow comparison of different scoped projects, cost effectiveness is presented as an index with 1.00 fixed

[1] Australian Safety and Compensation Council, Compendium of Workers' Compensation Statistics Australia 2006-07, March 2007.
[2] Safety data has been normalised to account for regional safety definitions and measures

as the industry average. As shown in the table to the left, the data show that Australian projects are around 17 percent more expensive than Industry. In other words, Australia project teams are paying $1.17 million for a $1 million project. Multiplying that same index across the 282 Australian projects in the set (considering they are, on average, $1 million each), we can conclude that close to an extra $48 million is being wasted in the Australian sustaining capital environment based on just those projects IPA has analysed.

	North America/Europe	Australia
Cost Effectiveness Index (CEI)	1.06	1.17

As previously stated, project cost is one of the key drivers of an IRR model. An IRR model at its simplest is reflected by:

$$\text{IRR} = \frac{[(\text{present value of revenues}) - (\text{present value of costs})]}{(\text{value of capital investment})}$$ [3]

Therefore, cost predictably should not be used as a key measure of whether a project is adding any return on investment to a company. In fact, the only way to determine if a project is adding value is via a cost competitiveness measure.

However, the data also show an alarming trend: Australian projects are setting conservative (i.e., higher than average) targets, but are not achieving them.

4c Schedule

Schedule is another key performance indicator for project success. Meeting a planned schedule date is important as it ensures that commitments to customers are met and operational and business planning is effective. In fact, for some projects, schedule is the key driver over cost. This includes projects that require a temporary shutdown of the facilities operating assets, which effectively cuts off plant revenue for a period. Over the last 5 years, schedule overruns (slip) have increased dramatically. This is somewhat reflective of the recent heated global project market in which engineering and labour resources have been stretched and delivery times for major equipment and bulk materials have dramatically increased. Despite these factors, as shown in the table above, these results still indicate that Australian projects overrun their schedules more than North American/European projects. In real terms, given the average schedule overrun, a project in Australia planning to complete execution in 6 months would actually take just under 9 months.

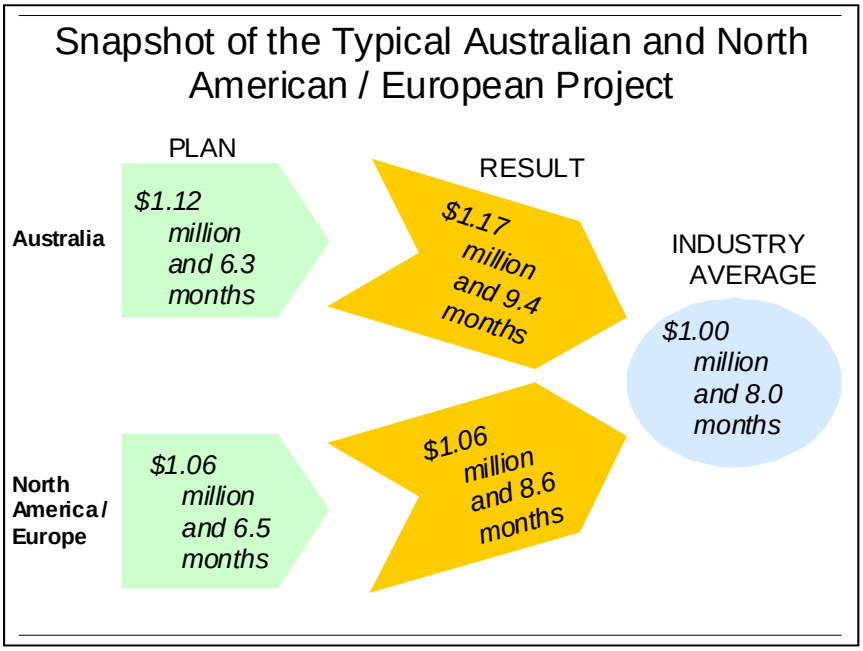
	North America/Europe	Australia
Schedule Slip	33%	48%

When we look at schedule effectiveness, we found that Australian projects deliver schedules that are 17 percent longer than Industry as shown in the table to the right. By contrast, North American and European projects are just 8 percent longer.

	North America/Europe	Australia
Schedule Effectiveness Index	1.08	1.17

[3] John K. Hollmann and Edward W. Merrow, "Controlling Project Costs," *Chemical Engineering Magazine*, November 2001.

As illustrated in the figure to the right, companies outside of Australia can typically execute projects in a cost-competitive fashion that are on budget, and with very good safety results. Although these projects tend to experience schedule overruns, they deliver ready-to-use assets in a competitive time frame. While the overwhelming majority of Australian projects are unsafe, expensive and have long schedules, there are pockets of excellent performance. The question is: What are these projects doing that the other projects are not?



5 Execution Strategies for Sustaining Projects

Even within a single organisation, various execution methodologies may be employed. At the highest level, there are two types of project management strategies: those controlled by a central and/or regional engineering group or those controlled by individual plant-based systems. However, contracting strategies can also differ across an organisation and sites. A range of contracting approaches was used by the organisations represented in this study. Several of the projects in used an alliance structure, whilst others used either reimbursable or lump-sum contracts for engineering and construction activities or a mix of the two. The data showed no correlation between the different contracting strategies used and the safety, cost, and schedule performance. Thus, we can conclude that effective execution and contracting methodologies are a second-order issue for projects. And although owner organisations typically blame contractors for any poor performing project, IPA research demonstrates that the root cause of project failure lies with the way owners set up projects. These inputs are what IPA refers to as “project drivers.”

Contracting Strategies

Alliance: Long-term contractual relationships between owners and contractors that aim to provide business benefits to both parties through improved efficiency

Lump-Sum: All execution work (detailed engineering and construction) is performed on a fixed price

Reimbursable: Execution work is completed on a reimbursable schedule of rates or unit rate basis

Mixed: Engineering and procurement activities are completed on a reimbursable basis with construction activities on a primarily fixed-price contract

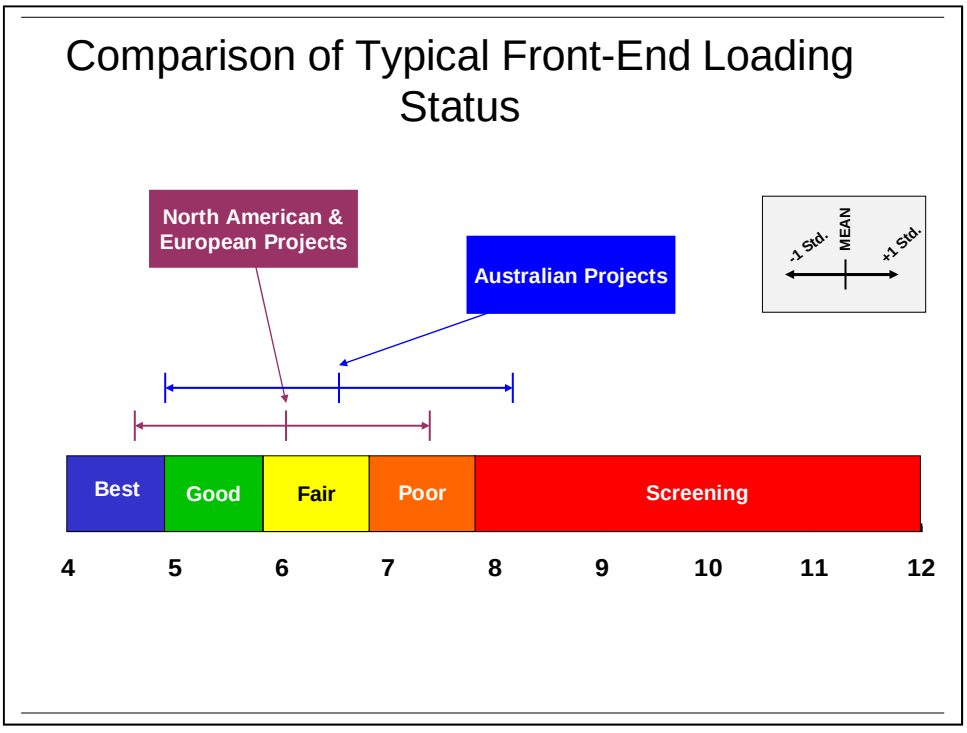
6 Drivers of Project Performance

So what are these key drivers of project performance? And what are the strategies that business leaders and managers can adopt to enable their projects to be executed safely, cheaply, and quickly? It should be no surprise that the better you understand an activity, the better that activity will be performed. The same can be said for capital projects. Thus, the level of definition for a project will drive the project’s actual

performance. To define this relationship, we need to measure how prepared a project is at a certain point. IPA does this using its Front-End Loading (FEL) Index, which evaluates a project's level of preparedness across several key factors, including knowledge of the existing asset/site conditions, level of engineering development, and level of planning for executing the project. An index of the project's level of definition and planning is generated, going from *Best (4.00 – 4.75)* to *Screening (7.75 – 12.00).* Although this may sound simple, the index assesses over 100 activities. A project's level of FEL can be measured at any time in the project life cycle, but the key point is the date of full-funds authorisation. At this point, the business has essentially handed the project over to the project team to be completed. Therefore, the FEL Index can be used to predict project performance. If business leaders do not require projects to achieve good levels of FEL, project teams typically will not achieve good levels of planning. To highlight the impact of the level of definition on project performance, we have evaluated the level of definition for the Australian set of projects and compared it with that of the North American and European projects. As shown in the figure, on average, the level of definition for Australian projects is worse than that of the North American/European projects. Specifically, the average FEL Index rating for the Australian projects is 6.49, while the North American/ European projects have an average rating of 6.03. Although both samples have ratings that fall within the *Fair* range of the FEL Index scale, the spread of FEL ratings helps explain the difference in performance between the two groups. In other words, the better defined projects (the North American/European projects) had performed better than the projects with worse definition (the Australian projects). Thus, we can clearly see that FEL, or level of project preparedness, is an accurate predictor of how successful (or not) a project will be.

Authorisation

Full funds authorisation is a term used to define the point in time when the business leaders give approval for a project to enter detailed engineering and construction (otherwise know as execution). Organisations have different nomenclature for this point; examples include request for authorisation, investment approval, or final approval. This point typically occurs after a period of study that is used to understand whether a project meets the business case of the organisation executing it. This can be referred to as FEL3, Phase 3, Feasibility Study or several other terms.



However, as stated earlier, some projects within the Australian sample had excellent performance. In fact, 38 projects (or 13 percent of the sample) from the sample had *Best* levels of FEL at full-funds authorisation. As shown in the table to the below, this good level of definition drove an 11 percent improvement in cost

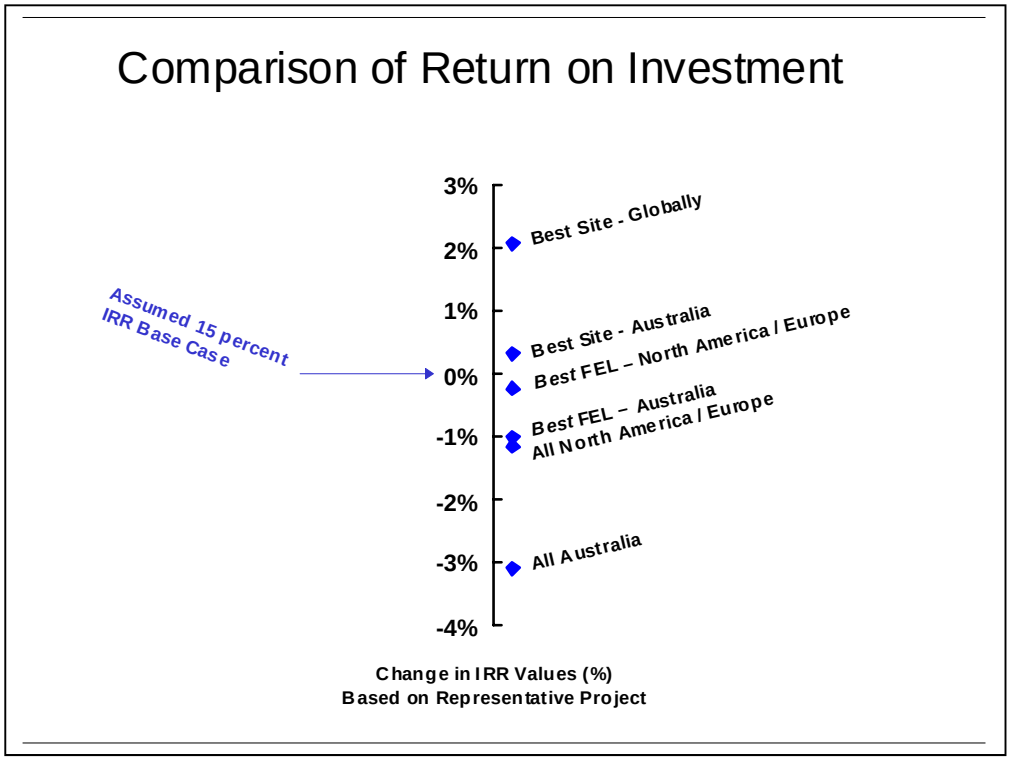
effectiveness for these projects. In addition, the gap in cost effectiveness between these projects and the North American/European projects was narrowed to 5 percent. Thus, we can conclude that FEL is still the key predictor of project performance.

	North America Europe	Australia
Average Cost Effectiveness Index	1.06	1.17
Average Cost Effectiveness Index With *Best* FEL	1.01	1.06

Further, the small set of companies that do achieve a level of FEL that is equal to or better than that of their North American and European counterparts achieve better cost and schedule predictability, reflecting a positive return on their investment in FEL. It should also come as no surprise that these projects had much better safety performance than the other projects in the sample. In fact, no recordable or lost time/restricted work case incidents were recorded by any of the *Best* Australian projects.

	Australia Projects With *Best* FEL	All Other Australia Projects
Cost Growth	–9 percent	7 percent
Schedule Slip	0 percent	55 percent

To further explore the affect of poor project performance on the bottom line of business, we examined the IRR of the different groups of projects examined in this paper. IRR is basically a measure of investment performance. All projects are essentially an investment in the future of the company or asset. Undertaking a simple IRR calculation using the average results from the study data and the assumed targeted IRR of 15 percent, we can see that the typical Australian project would erode the IRR of 15 percent by just over 3 percent. However, as shown in the figure above, all of the groups examined do not routinely provide a positive return over the 15 percent, but this is due mainly to the conservative cost and schedule target setting by companies globally over the last 5 years. However, the best global and best Australian performing sites both exhibit improved IRRs over the base case.



The data clearly show that organisations that drive the use of practices such as FEL see better cost, schedule, and safety performance and have a greater return on investment than those that do not. Further, business leaders that focus on predictability, whether it be cost or schedule, typically experience an erosion on the return on project investment.

7 Can Good Projects Be Consistently Executed in Australia?

As the data in this paper has shown, the majority of projects in Australia have poor results. However the encouraging sign is that some projects—and systems—are performing well. These few Australian sites have systematically and consistently executed projects that have provided outstanding returns on investment for their site and organisation. One consistent characteristic of these sites is that they have actively pursued a campaign, driven and supported by site leadership (i.e., refinery manager or higher in the business), of project improvement. Executing projects is viewed as a core part of the operations business and, as shown in the previous section, this focus helps to provide better returns on investment. Two sites in Australia with outstanding capital performance are owned by two different companies, have different capital delivery processes and use different contracting strategies (one has an alliance with an engineering, procurement, and construction management [EPCM] contractor, whilst the other relies on in-house engineering to help develop and manage projects), Points in common are that both sites have a high focus on capital effectiveness. Projects follow a capital delivery process in a disciplined manner and there is a focus on setting and achieving competitive cost and schedule targets. But most importantly, senior management views executing effective capital projects as an integral part of the business' operations and actively drive and pursue excellence within their project organisation—whether it be the performance of the contractor or owner.

Other Drivers of Project Performance

Although the level of FEL is the key driver for project performance, there are other significant enablers or disablers of success. These include the level of team development and the rigour of project reporting and controls in execution. Australian projects typically lag North American and European project across these drivers

8 Conclusions

As this study has highlighted, Australian project severely under perform against their overseas competitors. And while there are many factors that can make a project a success or failure, we have shown that the key to ongoing success is business taking responsibility for capital effectiveness and using a sound capital delivery process to set up projects for success. In other words, these senior managers must ensure that they develop a culture of excellence within their project organisations. This includes only approving well-defined projects and ensuring that cost and schedule targets are competitive. Thus, the organisations in Australia that remain focused on minimising cost and schedule overruns will continue to have poor cost and schedule effectiveness and will continue to erode the shareholder's (or taxpayer's) money.

Note

This paper has focused solely on sustaining capital projects as defined earlier in this paper. It is important to note that large project performance is also driven by an organisation's business leaders implementing and driving a successful project implementation process with FEL being the cornerstone of that process. Early results from a future paper to be published by IPA indicate that the poor performance of Australian projects also extends to the larger projects.

Acknowledgements

The data contained in this paper has been collecting from a range of global organisations over the last 10 years. The data and insights provided by the project professionals within these organsiations has been invaluable in advancing the knowledge of project management and drivers of project performance—the author would like to thank those countless individuals who have supplied data, and partaken in interviews over that time.

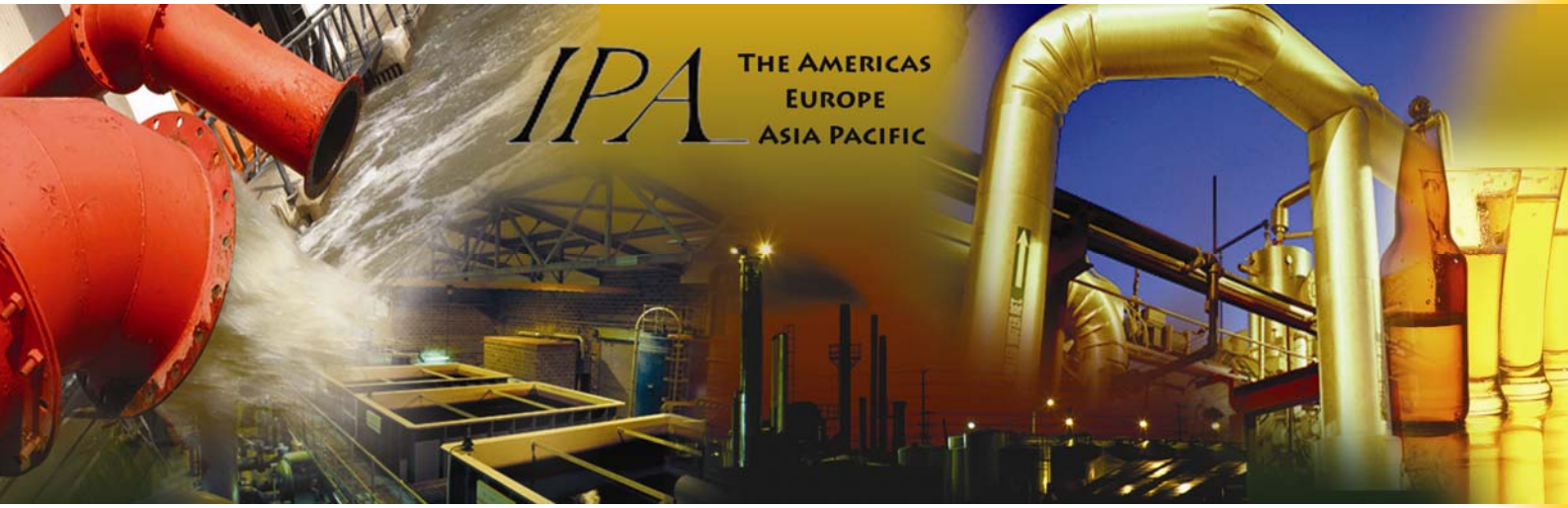
The author would also like to acknowledge the work of IPA analysts in analysing the some 5,000 projects referenced in this paper. Secondly to those colleagues, Petros Kapoulitsas and James Bukovsan, for compiling the data for this paper.

About IPA

Since its founding in 1987, IPA has rapidly evolved into the preeminent consultancy in project evaluation and in project system benchmarking, and has become the industry leader in quantitative analysis of project management systems. Our staff of 140 project and research analysis professionals at 7 offices on 5 continents serves hundreds of clients. The largest oil companies, chemical producers, pharmaceutical companies, minerals and mining companies, and consumer products manufacturers enhance their capital productivity using IPA's Project Evaluation System (PES®) and project system benchmarking services.

Further information can be found at http://www.ipaglobal.com or be contacting IPA's Asia-Pacific Regional Director Rob Young at +61 3 9458 7300 or ryoung@ipaglobal.com.

[4] PES is a registered trademark of IPA.



IPA Australia

Level 1, 56 Burgundy Street,
Heidelberg, Victoria, 3084
Ph: +61 3 9458 7300
Fax: +61 3 9458 7399

IPA North America

44426 Atwater Drive
Ashburn, VA 20147
Ph: +1 703 729 8300
Fax: +1 703 729 8301

IPA United Kingdom

Wellington House
First Floor
Worton Drive
Reading, RG2 0TG
Ph: +44 118 920 7800

IPA Latin America

Rua Pasteur, 463-salas
1201/1202
Curitiba, Paranà 80250-080
Brazil
Ph: +55 41 3028 9028
Fax: +55 41 3028 9024

IPA Singapore

#03-07 Creative Resource
31 International Business Park
Singapore 609921
Ph: +65 6567 2201
Fax: +65 6567 2231

IPA China

Beijing Mairuo Industry
Technical Consulting
Company
Room 9912B, Jingshi
Building
No. 19 Xinjiekouwai Street
Hai Dian District
Beijing
P.R. China 100875
Ph: +86 10 5880 1970
Fax: +86 10 5880 1957

IPA Netherlands

Prinsenhof Building, Prinses
Margrietplantsoen 32
2595 BR The Hague
The Netherlands
Ph: +31 70 335 0707
Fax: +31 70 335 0642

The IPA Institute

44426 Atwater Drive
Ashburn, VA 20147
Ph: +1 703 729 8300
Fax: +1 703 729 8301