The missing key

Unlocking high value infrastructure by design

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The missing key

Unlocking high value infrastructure by design

The problem

Infrastructure owners and developers face a sizable challenge in securing new investment and creating infrastructure that will meet the needs of Australia's evolving economy and society.

While the size of the task has been appreciated for some time, progress has been slow and piecemeal. Essentially, the problem is that deep-seated impediments to developing high-value infrastructure are not being effectively exposed and resolved. Often these impediments are grounded more in human and institutional dynamics than financial or technical issues.

The solution

'Intentional design' breaks the impasse, bringing a different mindset and approach to development.

Intentional design provides insights to human factors that are central to success. These factors relate to the value and functionality of infrastructure assets *and* the way they are conceived and delivered. These fresh insights enable new and better infrastructure outcomes to be delivered *by design*. Indeed, intentional design represents the next evolution in professional practice that's relevant to all players in infrastructure, whether government agencies, consultants, contractors or investors.

While novel in the context of infrastructure, intentional design is not new and complements existing planning, investment and delivery practices.

The benefits

Users of intentional design can achieve a rapid return on investment because it's quick to implement, low on cost and high on return. With a better understanding of the infrastructure 'problem', effort is also better allocated, solutions better conceived and risks better managed. Stronger investment cases and more bankable projects result.

With careful attention to the human factors that create high value projects and smooth delivery pathways, public and private investment can again begin to flow, so the quality and pace of infrastructure delivery can grow.

Indeed, heads of government, investors and the boards of private corporations should all be looking for evidence of this approach when making their next infrastructure investment.

Innergise

Nick Fleming is the author of this paper, the founder of Innergise and a business leader, performance partner, coach, writer and sought-after public speaker.

Nick's been sustainably developing regions and industries for over 20 years, leveraging his background in engineering, a PhD in sustainable infrastructure, and experience in business governance and executive leadership. He's worked internationally across industry sectors including water, transport, mining, defence, power and resources.

Nick has a unique aptitude for finding elegant solutions to complex problems. It's why he's engaged at Board, executive and program management levels to help shape pragmatic solutions to difficult business, project and community challenges.

He applies his sharp strategic insight, executive leadership experience, skills in facilitating innovation and design thinking, and insights from psychology to unleash and focus people's latent talents. Working alongside his clients, using proven collaborative design methods, Nick helps to focus effort on the right problems in a strategic and structured way. For Nick it's all about better placed effort, not more effort, to deliver immediate and lasting results.

As the managing director of Innergise, Nick partners to offer teams of seasoned, like-minded professionals to work with those special clients and leaders who embrace and shape change, aspire to better outcomes and support their people to learn and grow.

Productivity, progress, prosperity.

"Nick has a strong strategic mind and is adept at finding elegant solutions to complex problems."

David Singleton, Chairman,
Infrastructure Sustainability Council of Australia

"Nick is an exceptional strategic thinker with a very sharp mind and a passion for innovation. He is an excellent reader of people and has a special skill to engage those around him."

Cai Kajer, CEO, Swoop Analytics

"Nick is a great communicator and forward thinker. He has the rare skill to ask those 'why not?' questions to move forward into uncharted territory. And he doesn't leave you there – he helps find the answers based on evidence."

Dan O'Sullivan, Onshore Gas and Sustainability Advisor, CSIRO

The missing key

Unlocking high value infrastructure by design

Infrastructure owners and developers face a sizable challenge in securing new investment and creating the infrastructure assets that will meet the needs of Australia's evolving economy and society. While the size of the task has been appreciated for some time, progress has been slow and piecemeal. Yet a fresh approach – intentional design – can unlock better solutions, triggering the breakthrough sought by investors, developers, business and the community.

Practical experience locally and abroad demonstrates that conceptually simple and proven design methods can substantially improve the calibre and value of infrastructure with direct and immediate benefits.

This paper argues that 'intentional design' is the missing key to high value infrastructure, demonstrates how it can address contemporary infrastructure needs, and explains what it takes to realise the benefits.

Should you read any further?

Report after report describes Australia's infrastructure challenge, which mirrors that of many other developed countries (see Box 1). Despite these challenges and the promise of intentional design to deliver new, more valuable solutions, there's a question that needs to be asked: "Is this paper for you?"

Here's a few questions to test whether the practices explained in this paper can be of value to you and your organisation:

1. Are you in a position to influence how infrastructure needs are met, either for your organisation or your client's?
2. Do you believe that fresh thinking and new approaches are necessary to resolve contemporary infrastructure challenges?
3. Do you believe your people are open to adopting a new, performance-enhancing approach to their work?
4. Most importantly, are you *genuinely* motivated to embrace and lead a shift in practice? (Think about this carefully.)

Box 1. National Infrastructure Audit

In 2015, Infrastructure Australia concluded the first major, independent review of the condition Australia's infrastructure [1]. It concluded that major reforms are needed to improve the way Australians plan, finance, construct, maintain and operate infrastructure. The challenges identified included:

- Avoidance of investment in poorly conceived projects, targeting investment to productivity-enhancing infrastructure.
- More integrated infrastructure planning and delivery.
- Greater attention to be paid to the levels of service people need.
- Greater community engagement to better meet their needs and reduce objections to new projects.
- Higher quality urban development to engender greater community support for higher density cities.
- Private sector investment to overcome unsustainable levels of public investment, particularly in transport infrastructure.

If you have answered "yes" to these four questions, then it's worth your time to read further. In the end, success using the fresh design methods that follow will come to those with the resolve to do what it takes to make it work.

"... mega-projects require a completely different perspective, level of stakeholder engagement, cultural environment and project leadership than that practiced at the moment".

John Flecker,
Australian Constructors Association,
CEO Brookfield Multiplex[15]

"Design thinking – the magic is in the mindset."

Mox Fo [13]

The key is design

At the heart of this paper is the notion of design. Not design in a visual, artistic sense, nor in the mode of detailed engineering. It's design as the process of meeting people's needs in appealing, elegant and enriching ways – enhancing the human experience. It's design as a deliberate, creative, persistent practice. When design is embraced as a mindset, then new behaviours, insights and opportunities flow.

It's not new, but now is the time

Today newspapers, business and industry magazines are all talking about 'design thinking'. Examples are often drawn from the private sector, highlighting products like Samsung's mobile phones and televisions [2], PepsiCo's products and customer experiences [3], or services like those provided in the telecommunications and finance sectors [4].

Interest is also emerging in the public sector, helping shape the way that services are delivered by the likes of the taxation, welfare and education departments and even hospitals [5, 14].

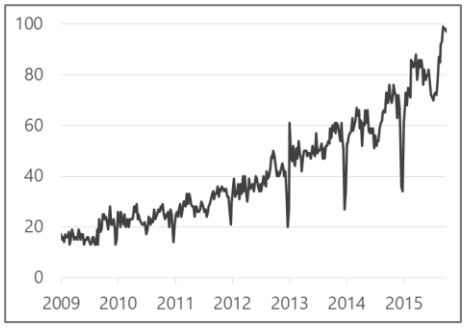


Figure 1. The past several years has witnessed a five-fold increase in internet-accessible citations of 'design thinking', reflecting strongly growing interest in the topic. (Source: Google Trends)

A healthy sceptic will ask "Is this just a fad or something genuinely useful? Is the hype warranted?" Direct experiences suggests there is real value to be gained on a number of levels.

Recent studies have also shown that design-driven companies have developed and maintained a significant performance edge. In the USA, companies embracing design thinking have gained a clear stock-market advantage, out-performing the S&P500 by an extraordinary 219 percent over the past 10 years [6].

Can these benefits be transferred to the big dollar, big impact world of public and private infrastructure? Yes. This fertile ground, as-yet largely untouched by design thinking, is all about to change.

Why 'intentional design'?

'Design thinking' is the name given to the user-centred approach to design that has been championed by US innovation consulting firm, IDEO. While the human-centred approach is replicated in this paper, the context of its application involves some material differences.

Four features stand out in relation to infrastructure: (a) typically the capital investments are very large, (b) the assets that are produced have long life spans, typically measured in decades, (c) the assets have flow-on consequences, shaping the form and function of other infrastructure, affecting industries and regions, and (d) it's a stakeholder rich and sometimes adversarial environment. It's the scale of investment and consequences associated with infrastructure that warrants very careful, purposeful attention to design and delivery. Hence the emphasis upon *intentionality* of design. Rather than offer up 'design thinking' as a novel idea that might attract passing attention, 'intentional design' better reflects the gravity and responsibility of its practice in the context of infrastructure.

The essence of intentional design

If design is about creating things that people want, then understanding people's needs is central. But what does this really mean in an infrastructure setting?

Take the situation of public transport. Would a user's need be described as simply being able to move between two places? Let's change the point of view. How would a passenger describe their needs? Perhaps moving safely between destinations, in comfort, at predictable times. But what would make for an utterly appealing, valuable experience? What would public transport look like for it to be loved, something that people promote to friends

and visitors with pride, something they want built, and something they want to pay for?

This is the first key departure of intentional design, from a functional, procedural activity to an *empathic* one. Intentional designers strengthen their focus on users' experiences, especially their emotional ones [2].

When empathy becomes an integral skill requirement of an infrastructure design and development team, it triggers a shift in emphasis and practice. Early and better definition of the desired user experience occurs, which subsequently influences the design and functional requirements. A richer, arguably more realistic, appreciation and expression of the design problem emerges. Important cause-and-effect relationships become more transparent. They also present greater complexity. Of course that complexity is reality. Now the task for the project team becomes one of integrating perspectives, skills and experiences across disciplines to find elegant solutions that transcend that complexity. The task is to create new, elegant pathways for progress. (See Box 2).

With greater complexity and subjectivity in measures of success (like user experience) a design team must engage more overtly with an uncomfortable (omnipresent but avoided) reality: that it's unlikely to create the right or best solution the first time. Thus *prototyping* is the second key departure from prevailing infrastructure design practice. Put plainly, this demands an open tolerance for failure. Indeed, people with a design mindset expect failure and recognise it as a critical ingredient in ultimate success. Persistence is the desirable bedfellow, constantly asking 'how' to resolve issues and overcome impediments in value-creating ways.

Of course, few organisations or leaders tolerate failure. Where large capital intensive projects are involved, sometimes providing essential public services, that aversion is only heightened. Yet sticking our heads in the sand doesn't change the reality of the situation. The constructive response is to embrace rapid, iterative learning or 'fail fast' practices.

Box 2. New angles unlock new solutions

How might a design-minded person approach contemporary infrastructure development challenges?

Take, for example, the development of alternative (coal seam) gas resources. Instead of tackling the challenge "Developing gas resources in the quickest, legally and technically feasible and commercially profitable way?" a design-minded person might focus on "Developing gas resources in a way that the community actively embraces."

Also consider the example of developing infrastructure to support water recovery from the Murray-Darling River systems to restore environmental values. Instead of answering the question "How much water can we afford to recover for the environment?" a design-minded person might have usefully reframed the challenge to "How can we help communities to prosper in a context of less water for irrigation?"

Both of these shifts of reference are likely to have yielded more effective responses, generating better outcomes and less financial, organisational, political and social pain.

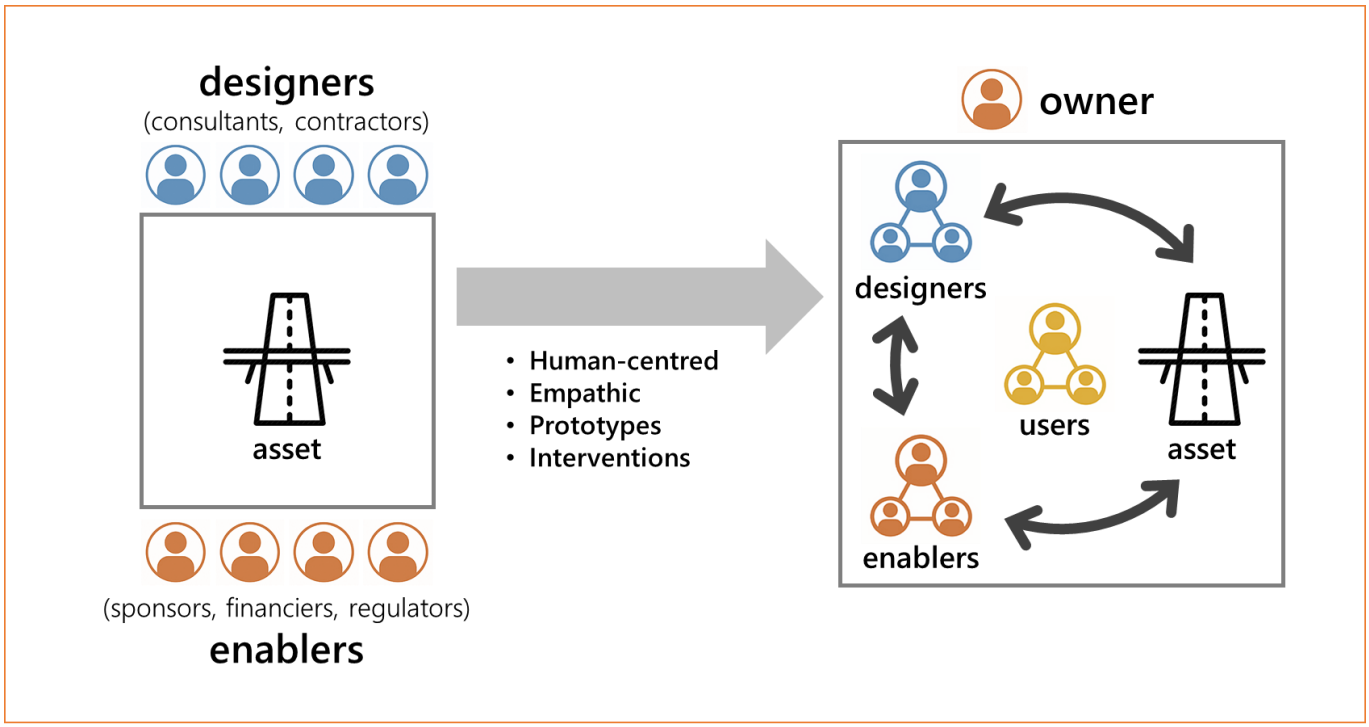
Prototyping and other shifts in design and delivery practices will create anxiety and discomfort within project teams and their sponsors. Fear is the root of all avoidant behaviour. So this is where empathy again emerges as a critical enabling factor, and it's where design and organisational strategy meet. Intentional design should not only be applied to creating assets but also to *the process* of their creation and adoption. Business and project leaders need to answer this question:

> *"How do we design the process of delivering innovative infrastructure solutions so that the people involved can test ideas, learn and flourish?"*

"While a few people hold authority, in practice many people are in control"

"We must focus beyond projects that are technically and financially feasible to design projects that are humanly possible."

Figure 2. At the heart of intentional design is a focus on the users of infrastructure assets, involving a shift in practice from a cooperative transaction to develop an asset to a collaborative design process to create high value experiences and outcomes, enabled by elegant, adaptable assets. But while more stakeholders actively participate, all voices are not equal. The risk of accepting a lowest common denominator solution is to be avoided. Asset owners must ultimately make, accept and deliver on their decisions.



FROM functional, high cost assets with residual long-run risk

TO appealing, high value, simplified, adaptable, de-risked assets

The practice shift

A reasonable question might be "Why haven't these practices already been implemented and the benefits gained?"

There are a host of reasons why tangible opportunities like intentional design are systemically overlooked. Some relate to the way people are professionally trained, others are linked to the inertia created around long-standing business and institutional practices. To some extent the industrial-isation of knowledge work to tasks and deliverables with an efficiency focus has caused separation and siloes that we now need to overcome. Personal and organisational dispositions toward risk are also a critical explanatory factor. (A separate discussion on this topic is provided in articles on the *Anatomy of Opportunity* [8] which will be the subject of a forthcoming paper).

It is, however, useful to name here the specific changes in behaviours that should occur to practice intentional design (see Table 1). Most fundamental is the shift of focus from assets to people – for whom and by whom assets are created.

Alongside a strong focus on empathy for clients, users and implementers is the disposition to thinking systemically, expanding the view beyond traditional, often hard boundaries of a problem.

It's this systems view that helps connect knowledge, expose new insights and trigger and link ideas. It also serves as a strong tool or platform for collaboration.

Collaboration extends to co-designing solutions with users and stakeholders. Indeed, designers may even proactively find ways to solve problems for people whose contribution and support will be central to a solution being adopted.

Implicit in this practice shift is an appreciation for the value of diversity. Diversity of mindsets, experiences and perspectives enriches the design insight and quality of decision making, particularly when focused in the constructive, outcome-oriented practice that is intentional design.

A rapid return on investment

Organisations that apply intentional design to their infrastructure challenges can achieve a rapid, substantial return on investment.

How can such a bold claim be made? There are several reasons, well substantiated by experience and case studies. Consider these facts:

- The investment required to practice intentional design is often very small in relation to overall capital and operating costs of new infrastructure assets.
- The efficiency dividend or cost savings required to offset the upfront investment is a very small, achievable percentage of the overall project costs.
- Intentional design doesn't require substantially more people, skills and effort than would otherwise have occurred. Rather it seeks to better align and use that effort.

> "Mindset and behaviour flaws are the root cause of 30% of major project failures."
>
> Schlumberger Business Consulting[16]

Table 1. Shifts in mindset and practice for intentional design of infrastructure

Conventional Practice	Intentional Design
Organisations tend to focus strongly on the technical aspects of creating assets. The utility, function and commercial aspects gain most attention. Stakeholder issues are left to be addressed by the initiating client or mitigated through formal consultation and approvals mechanisms. Cooperation prevails over collaboration.	Organisations exhibit a stronger focus on outcomes mindful that it's people who conceive, deliver and use them. They work more creatively and collaboratively, and blend emotional and technical language, recognising the emotional resonance of an asset intimately related to its utility [2].
– Tasks and outputs delivered cooperatively	– Outcomes and experiences achieved collaboratively
– Piecemeal, functional and project focus	– Systemic, user and network focus
– Problem solving tasks assigned by disciplines	– Thinking and testing creates an appealing solution
– Linear development process aiming to avoid failure	– Fast-iterating development embracing failure
– Thinking converges around a 'used' solution	– Co-creating solutions (stakeholder engagement)
– Marketing of projects ('design and defend')	– Sketches and models to share and refine ideas
– Formal plans and drawings to document plans	– Designers help solve other's problems

- When effort can be better placed, it infers that any prior allocation of effort was sub-optimal. That is, the effort would have been unproductive and incur cost unnecessarily.
- Risks to project delivery, particularly customer, social and stakeholder risks, can be eliminated by design. The result is a smoother passage for the project reducing time delays and costs that can often become a material proportion of total costs and even kill a project.
- Experience indicates that the scope of projects is often simplified. The footprint and resource costs can be reduced, not only reducing capital but also operating costs.

Indeed, **studies suggest that project cost savings in the order of 20 percent could be readily achieved** [9].

Consider also the benefits to revenue streams from infrastructure that users genuinely enjoy and gain value from using.

Reduced project costs and greater consumer willingness to pay with heightened revenue security all help to close the financial gap, while the saved capital can be productively deployed elsewhere. This is clearly an outcome sought by public and private investors alike.

Box 3. Well-designed projects create value in many tangible ways, including capital cost savings

Fleming & Marr [9] report that mitigating the impacts of poor design costs money, while smart design from the outset saves money. Equally, fragmented or *ad hoc* responses to inter-related risks equate to mismanagement, creating risk that inevitably impacts on the core measures of business value and project success (time, cost, quality). Poor design contributes to poor outcomes, and:

- Higher risk projects that attract higher risk premiums
- Waste of capital that could be invested more productively
- Misstated financial statements and inadequate public disclosures that erode investor confidence and stakeholder trust.

What does it look like in practice?

Intentional design is already being applied successfully in practice on diverse infrastructure projects in Australia and internationally. While the applications are few in comparison with the potential, case studies [11] provide good demonstration of the practicality of intentional design and the value that can be realised.

The phases of intentional design through which an infrastructure project would typically pass are illustrated in Figure 3 (see next page). A description of each phase is provided over the following pages, illustrated by a real case study.

While the case study focuses on a single, large capital project it is important to emphasise that **intentional design can be effectively applied to the design and delivery of networks of infrastructure, programs of work and business model evolution.**

Furthermore, because intentional design is a problem solving process it can be usefully applied at each stage of an infrastructure program or capital project life cycle (Figure 4). While the greatest benefit can surely be gained at the outset of a program or project, it would be false to think its benefits are limited only to those early phases.

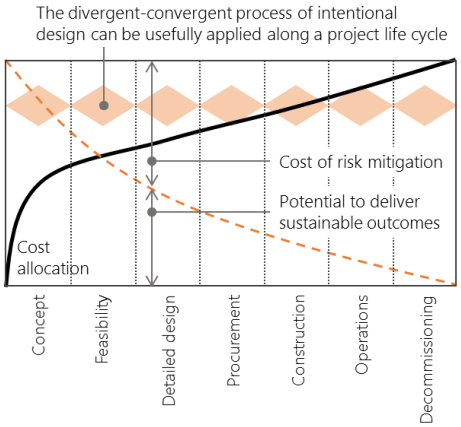
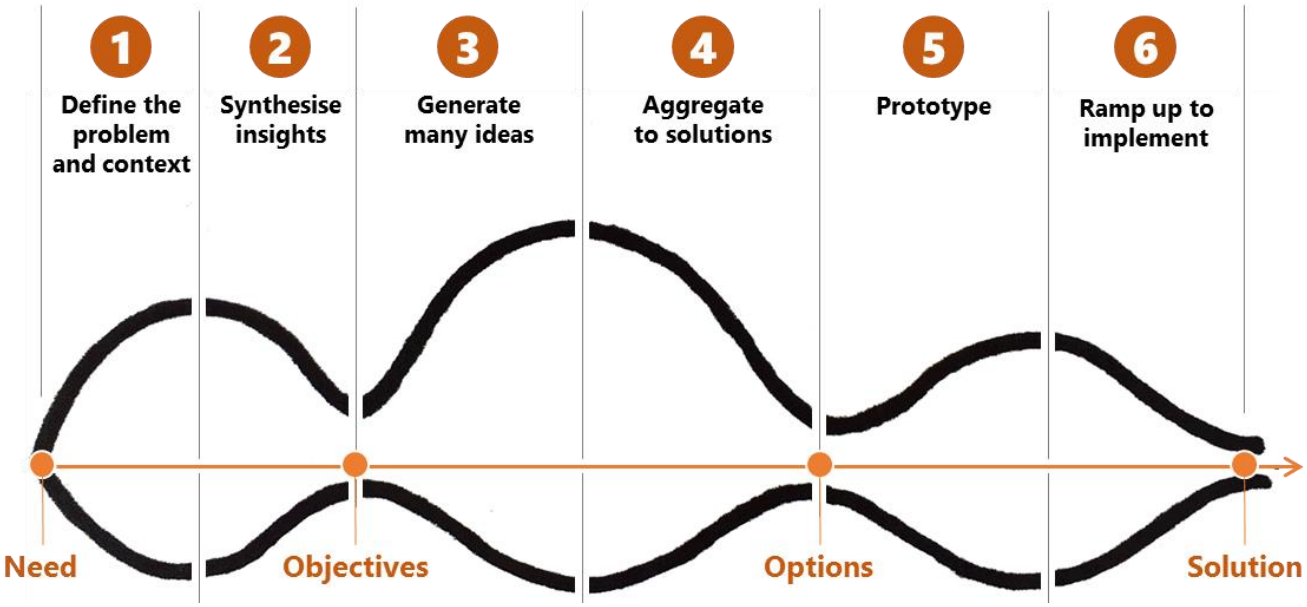


Figure 4. Intentional design is a creative, scalable problem solving process. It can be applied at any point along a project life cycle, focused on creating high value solutions and remedying any residual or emergent problems.

Figure 3. Phases, activities and tools enabling intentional design



1. Identify the opportunity or need 2. Broadly scope the project 3. Deeply analyse stakeholders 4. Examine the emerging operating context 5. Analyse strategic risks	6. Revisit and refine the problem statement 7. Identify key success attributes	8. Brainstorm solution components 9. Identify critical challenges to delivery 10. Identify key assumptions for options to be valid 11. Evaluate the relative merit of solution components	12. Develop appealing packages of solution components 13. Develop quick 'pitches' to test solution packages 14. Evaluate and prioritise packages	15. Make prototypes 16. Identify and expose critical assumptions 17. Run learning tests with stakeholders 18. Refine solution packages and select best option	19. Scope needs of critical implementers 20. Run learning launches 21. Design solutions to impediments 22. Move to implementation
Useful tools* – Problem Articulation toolkit – Job to be done – Systems mapping – Stakeholder Influence Paths – Ethnographic Survey – Causal Layered Analysis – HexORs risk analysis – Value Chain Analysis – Testing Program Logic		– Innovation Triggers – Metaphorical Stimulus – Personality Storyboards – Scenario Analysis – Integrated Solution Design		– Prototype Fidelity – Delta Framework – Delivering Successful Change – Business Case	

● Investors should be reviewing the calibre of insights, investment logic and solution design at each of the four key milestones above.

* These tools are contained in Innergise's *Tools that Transform* toolkit.

Case study: Port expansion project

The Australian economy has always benefited from the export of its abundant resources. This was never more evident than during the recent resources boom when iron ore exports grew enormously, underpinned by demand from China. Indeed, demand was so great that mining companies invested heavily in expanding their enabling infrastructure.

Rio Tinto faced a bottle-neck in their supply chain. Ships sometimes waited days to berth and be loaded with ore, costing the company millions of dollars. Expansion of their port facilities was required. Studies determined the best solution was to build a second export port facility adjacent to its first, comprised of a rail head, stockpiling area, conveyer and materials handling systems and a large wharf. The cost of this planned 4-fold expansion to export capacity would exceed $1billion.

The project site, although large, was physically constrained within Rio Tinto's property boundary, one side of which was defined by the coastline.

While several issues existed with the site and proposed solution, they were common to projects of this type. Water demands were very high, principally to control dust.

Energy consumption to lift and move millions of tonnes of ore were also large, likely requiring augmentation of power supply by building a new gas fired power station.

Noise and dust levels were already an issue with the existing (smaller) port facility, impacting residents in nearby townships. Indeed, noise levels were known to exceed regulated limits.

Sensitive turtle breeding habitat existed in the adjacent coastal zone, which would be affected not only by physical encroachment but also noise and light throw.

These were all issues to mitigate in some way as part of the development project. Rio Tinto had a range of teams working on them via the community consultation, planning and approvals and engineering processes. Indeed, the project was progressing to plan and would soon enter the detailed engineering phase.

Could a better solution be found to their business needs? This was the question posed to Rio Tinto. Seeing merit in the fresh perspective offered by intentional design, the company initiated a design review within the few days remaining before the engineering work commenced in earnest.

This is what happened.

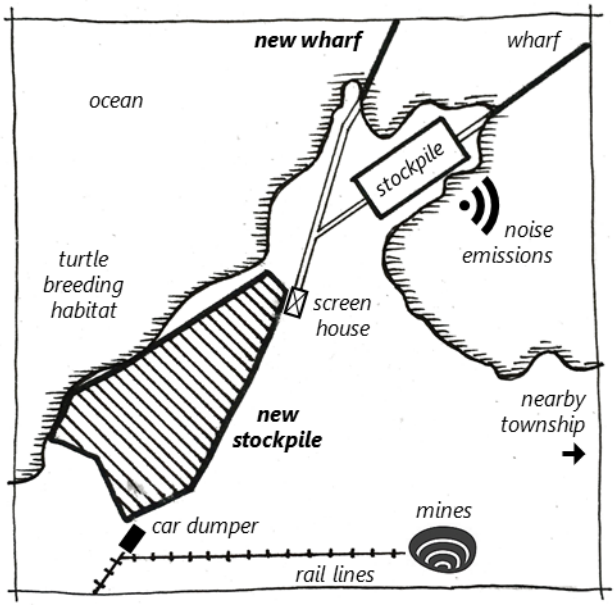


Figure 5. The situation before intentional design was applied

The mining company's original situation and plan for the port and iron ore handling facilities involved:

- Large and expanding stockpiles
- Large volumes of water for dust control
- Large and growing energy consumption
- Encroachment into turtle breeding habitat
- Noise levels an existing and growing problem
- A disgruntled community, affected particularly by dust
- Physical site constraints

Phase 1

Define the problem and its context

The first step is to define and contextualise the perceived need, expressing it as a clear problem statement.

This is a critical and often revealing step. Yet it's one that action-oriented professionals can struggle with in their desperation to name and implement "*the* solution".

Start by naming the problem. It will be an unmet need of an organisation, customer or group of people. Don't fall into the trap of focusing effort solely in response to an immediate client, ignoring the end clients or users and impacted stakeholders.

Recognise the different and critically inter-related needs of other stakeholders. Think about your strategy for engaging the people most in control of your success? Ask questions that unearth hidden information about stakeholders' attitudes, beliefs and values.

Experience demonstrates it's then vital to put the problem in context – both in space and time. Projects, whether about physical infrastructure, services or even organisational programs, never sit in isolation. Connections and dependencies will exist that help to better define the problem and how risks and opportunities may evolve and emerge over time. Explore how the future operating context might unfold.

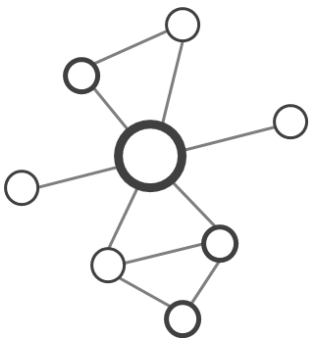
Ignoring these considerations risks having a shallow and incomplete understanding of needs, putting the absolute value of the project at risk.

Case study, continued

A range of people across Rio Tinto's business functions (like planning, engineering, operations, marketing and community engagement) were brought together to share and integrate their knowledge, needs and perspectives. They were given a large sheet of blank paper and asked to draw the project. An uncomfortable silence ensued. The apparent but unstated question was "Why? We all know what the project is."

Then a person picked up a pen and started drawing. Others joined in. After 5 minutes a rich picture existed of the port, handling facilities and connections to rail lines, power, water and shipping. People were overheard saying things like "I didn't realise that was part of this project!" and "Why do we do that? I've never thought it made much sense." It became clear that no-one really had understood the project.

Attention then turned to the issues and risks the project faced. A simple framework was used to unpack the financial, technical, community, environmental, legal and operational issues. How the issues would evolve over time was examined, as were important causal inter-relationships. The team now better understood the emerging risk profile and identified several important issues that had either been ignored, misunderstood or under-played.



No project or program exists in isolation. It has links and dependencies that are essential to understand. They provide important insights and expose often overlooked or misunderstood risks and opportunities.

Phase 2
Synthesise insights

The purpose of synthesis at this step is to (a) refine the problem statement, and (b) define the attributes and qualities of a great solution.

Typically this work will involve a large volume of new or previously overlooked information that will have emerged. It needs synthesis to distil the key new insights and their implications for the project.

At this step, visual techniques are very useful. They help people 'join the dots' amongst complex information. Indeed, it's hard to collaborate when information or an idea remains in someone's head. Thinking visually – sketching and making models – is a key component of collaborating, synthesising, generating ideas and prototyping [12].

Again it's important to maintain a clear view of stakeholders, particularly those who control success of the project not only in its design and development but also in implementation and operations. Designing to help people be successful is a powerful practical objective. Therefore think about how this need is reflected in the refined problem statement and solution attributes.

Case study, continued

Each participant was asked to reflect upon their new, richer appreciation of the project and its operating context. "What would the perfect port look like?" was the question. Their answered needed to come in the form of their own personal sketch. Each person presented their illustration, talking about one unique or defining feature.

Everyone's drawing was different. Some ports blended seamlessly into the landscape, others used subsea slurry pipelines to convey the ore to ships rather than have large wharf structures. Others were visually vibrant, adding to the interest of the landscape.

Having shared their sketches a person observed "What stands out to me is that all of our drawings are different to what we'd planned to build. We should and can do something much better."

The team then re-examined the problem statement and objectives for the project. There was consensus that it had been too narrowly defined. Several new objectives were added that were felt to be critical to enduring success of the project.

The team had achieved a more realistic and useful expression of their project, what it should do and, importantly, what it shouldn't.

Phase 3
Generate many ideas

At this stage the goal is to develop as many potential solutions as possible. In fact, this means components of solutions.

Virtually any program or project of any scale or significance will have several components and actions that need to occur in parallel to achieve successful delivery and operations. Combine this with the many cause-and-effect relationships at play (offering different points at which interventions or solutions could be offered) and there will be many plausible solutions.

Furthermore, it's improbable than any one person or group will have *the* right answer. Nor will a past ('used') solution to a similar problem be directly transferable and useful.

A project team that recognises and accepts this reality will thus be open to exploring many ideas including those that might seem far-fetched at first glance.

Case study, continued

The team were broken up into smaller groups but not along disciplinary or functional lines. Diverse of composition was important. Each group was given one of the project objectives and tasked with identifying all the possible solutions as well as the challenges to implementing those solutions.

With their understanding of the systemic nature of the project, teams were encouraged to identify possible solutions at any point in the system no matter how big or small they were. Unsurprisingly, many ideas emerged.

For example, in response to a target to significantly reduce energy use, the ideas included: optimising energy use in plant operations, generating renewable power, using low energy lightbulbs, and reducing the number of ore handling transfer points to optimise the conveyor system efficiency.

There was an important flow-on effect from this task. People were quietly amazed at how many plausible solutions they had identified. Rather than feeling overwhelmed, people felt inspired. It was within their grasp to deliver a far superior project.

Phase 4
Aggregate to solutions

The next step is to consolidate ideas into synergistic, systemically-viable solutions.

Typically some iteration in the process of constructing solutions is required. In a way it's an early phase of prototyping as solutions emerge, get challenged and modified. Of course the challenges are not just on technical grounds relating to engineering or short-term capital cost considerations, but from a place of deeper insight.

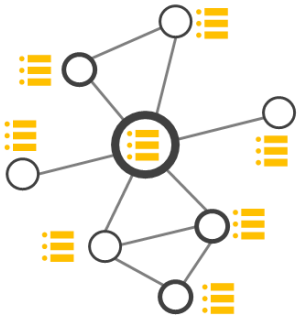
It's at this stage the merit of different, and now superior, solutions becomes apparent. The stronger human focus and concern for success of people, not just delivery of a physical asset, brings additional decision parameters to the fore.

In general, the solution options comprised of "packaged ideas" should be evaluated against three broad criteria: the desirability for stakeholders, the technical feasibility, and financial value created.

Case study, continued

Teams were asked to prioritise their ideas to tease out the most promising concepts. The rich picture or systems map of the port was used as an integrating tool. Prioritised solution ideas were placed on the map to identify where in the system they made a contribution to meeting the project objectives.

As each group shared and placed their most attractive ideas, the energy and excitement in the room rose palpably. Why? People could see powerful connections between their ideas – making each of the individual components a more attractive part of a whole.



Rather than gravitating toward a single solution, generate many ideas across the project 'system' that could ultimately contribute to a solution. Then explore links and synergies to package up ideas into alternative solutions ready for further evaluation.

Phase 5
Prototype

Often people gravitate too quickly to a solution and think of it as '*the* solution'. Frankly this is either naïve or arrogant. It's far more pragmatic, realistic and useful to recognise that a promising idea will inevitably have some wrinkles in its design or challenges in execution that need to be ironed out. Thus it's useful to embrace promising solutions under the banner of prototypes.

A prototype is an early solution, model or business case built for the purpose of testing, learning and refinement. It's important for it to be clearly defined – its scope, how it will operate, how it will meet defined needs.

The behaviour around the prototype should not be one of advocacy but inquiry, seeking to learn what needs to change to make it more appealing and valuable over its operating life.

An incomplete solution presented as a sketch or model is good because it is far more inviting for potential users to interact with it and feel they can offer suggestions for improvement.

When presenting a prototype also be explicit about the key assumptions that must hold true in order for a solution to remain viable. You really need to test them.

Finally, have alternatives available to explore if some assumptions prove invalid or proposed solutions are unappealing to stakeholders.

Case study, continued

The project team identified the bones of design that offered a number of substantial benefits. It appeared entirely feasible from a technical perspective; indeed, it required no new or novel technology and overall was a substantially simplified solution. However, it assumed the solution would be operationally viable and require collaboration across a number of business functions.

To undertake this testing process efficiently, the team developed a list of key solution components and the critical underpinning assumptions. The list was then prioritised in terms of importance. Important components with critical assumptions to tests were listed for exploration first.

For example, the representative of the rail group that delivered ore from the mines to the port had indicated they were exploring different operating regimes. Running the rail network to facilitate 'just in time' delivery of the ore seemed possible but needed to be tested and confirmed before it could be locked down as an agreed solution component.

Phase 6

Ramp up to implement

New solutions invariably require a shift in behaviours and business processes to deliver. It's dangerous to think a new solution will be embraced and implemented effectively even if it is technically and commercially superior.

Attention therefore needs to turn, again with a design mindset, to create the conditions under which people are engaged, resourced and supported to succeed as they implement the preferred solution.

Case study, continued

Rio Tinto would not itself be undertaking the detailed engineering design and delivery of the port project. Rather it would be engaging consultants and contractors to undertake that work. So the team then worked on translating their improved design for the port facility into the engineering specification. To crystallise the key features of the design to be delivered, the team refined the performance measures for the few original key result areas (KRAs) as well as defining several new KRAs corresponding to their expanded set of objectives.

For example, a 50% reduction in water use per tonne of ore exported became a new KRA. This compared with the corporate efficiency improvement target of 6%. The team recognised this as powerful evidence of the value of the intentional design process; the company's efficiency goals had not just been met but massively exceeded.

Beyond the specification the team also turned their attention to the important coordination task. The integrated nature of the solution they had defined meant that it risked being undermined in delivery if collaboration was not maintained. Adjustments to the project management arrangements were identified to responsibilities and processes adapted to suit.

10% of capital cost, over $100 million, saved in 3 days

Case study outcome

So what did emerge as the preferred solution for this new port infrastructure? How did it compare with the original plans in terms of scope and cost effectiveness?

The solution is illustrated in the schematic below. It came about like this. Operators from the mines, recognising that high water use was a problem at the port, suggested that excess 'waste' water (from mine dewatering) be used to precondition the ore before it was sent by rail to the port. That way less water would be required to keep dust down.

The rail operators, who had been contemplating changes in operational routines, suggested 'just in time' delivery of the ore to the port. This meant only a much smaller stockpile of ore was required as a buffer against any problems in the mines or rail system.

A smaller stockpile provided material handling engineers with the opportunity to better optimise the location of the stockpile both in space and elevation. It had two key benefits: (a) less handling of the ore, thus requiring less energy, and (b) no risk of encroachment and impact on the turtle habitat.

These shifts in approach significantly simplified the port expansion project, reducing the capital cost and ongoing operations and maintenance costs.

It was decided that some of these savings could be reinvested into the existing port facility. In particular, low noise idlers would be retrofitted, enabling the whole expanded facility to operate within regulated noise limits.

This elegant solution emerged by expanding the view of the project outside of the original boundary, and engaging other stakeholders in the expanded system in a way that understood their needs and capabilities as well.

Rio Tinto's director of studies commented "This is a great process. We should apply it to all our projects. Indeed, we should re-examine our entire portfolio of assets using the same approach."

In the space of three days, Rio Tinto had achieved a cost saving conservatively estimated at 10% of capital cost or $100 million. No new, sophisticated technology solution was required. Just better placed effort.

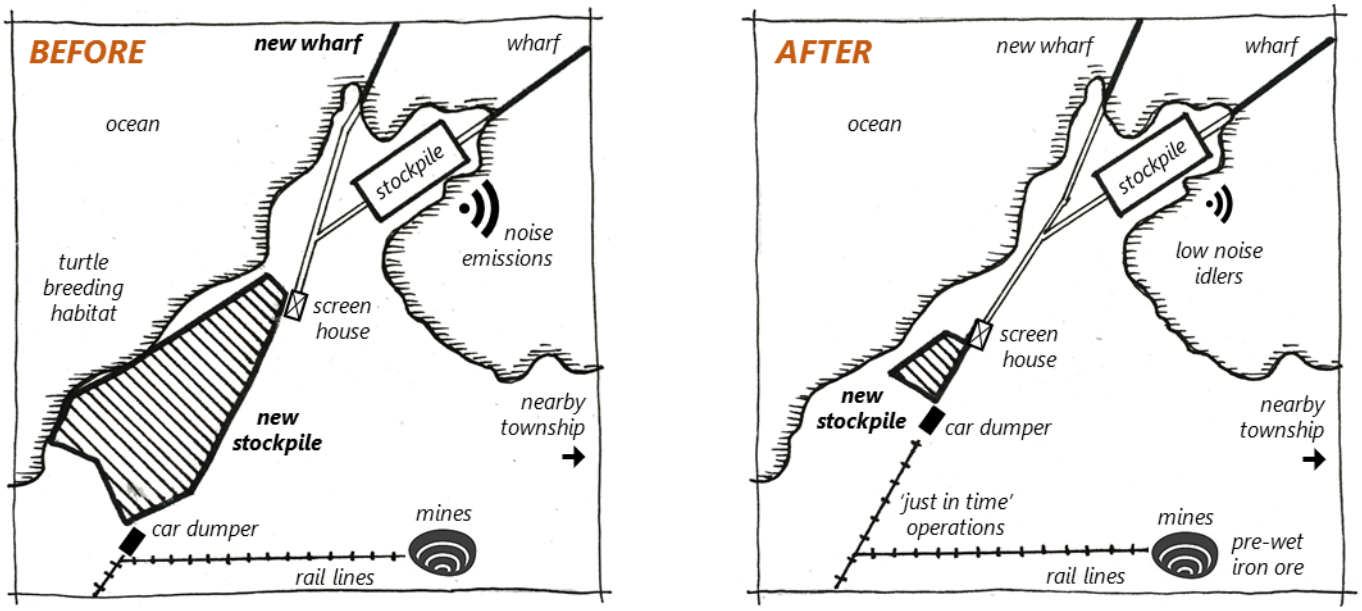


Figure 6. The situation after intentional design was embraced

The redesigned, more sustainable solution comprised:

- A far smaller stockpile
- Reduced ore handling
- Less noise and dust
- Massive reduction in water and energy consumption
- No turtle habitat encroachment
- Overall simpler design
- Reduced capital and operating costs
- Reinvestment in low noise idlers to reduce the total noise footprint

Prototyping infrastructure – what does that look like?

People involved in developing new infrastructure projects would not be unreasonable in thinking that stakeholder and community engagement is fraught with risks. Every project seems to have its opponents, emboldened by the power of social media to magnify their voice and influence. So the thought of 'prototyping' the designs for new infrastructure with stakeholders would be a frightening prospect and one to be avoided.

But this need not be the case. Indeed, intentional design by its very nature aims to reduce and even eliminate this risk by factoring in stakeholder interests and values from the outset. Indeed, the perception that stakeholder engagement is risky and time consuming needs to be challenged head on. Here's a real case study from a project that shows how prototyping can be achieved with great outcomes [11].

Case Study. *A power utility was preparing to undertake public consultation. They were in the approvals phase of the largest transmission line project they'd undertaken in 20 years. Lack of community support had become a serious business issue that affected not only new projects but also ongoing maintenance. The proposed transmission line had the very real potential to provoke negative community reaction, create major delays, incur additional costs and further erode the company's social licence. The utility fully intended to consult with stakeholders, but had assumed a conventional 'decide and defend' approach. After some debate and with a little trepidation, they adopted a different approach. The project challenge was reframed as "How can we assess alignment options and identify the best route, building community support and trust through the process?"*

Instead of explaining their plans to stakeholders and defending their rationale and decision, the utility's managers sat down with people living along the transmission line corridor to talk about their interests, needs and places of value. They also co-developed criteria against which to evaluate route options. Then, by mapping that information, new insights and many more route options emerged that preserved stakeholders' needs and values. In effect, the utility had engaged in a form of 'co-design'.

The results went way beyond what was thought possible. Most of these options were cheaper than the two routes identified by the utility's planners and engineers. Not only was the capital cost lower but implementation costs were also reduced. When the plan was submitted to government and made available for a period of public comment, not a single community objection was lodged (a very surprising result for this type of project). As a consequence the government deemed that an EIA was no longer required. This saved the utility $2million and shaved 2 years from the project timetable.

The project's approach was recognised in several Excellence Awards, and turned what could have been an adversarial process into one that built trust along with the company's social licence.

Realising the potential

Design as a mindset is an idea that, once you've really got it, won't leave you. Intentional design is a practice that, once experienced, reframes what's possible. You won't see the world, your business or its challenges the same way again. You'll shake your head in wonderment at the mediocrity of practice that pervades our infrastructure sectors. You will also see enormous opportunities.

Of course intentional design doesn't solve all problems. It helps people and organisations cut through complexity. It's great for innovation. It fosters collaboration. But it's not the right set of tools for optimising a well-defined project or business operating in a stable, predictable environment. Clearly those conditions are increasingly hard to find, particularly in the context of infrastructure projects and programs of any real significance.

A design approach can, however, invert normal practice. When people are keen to rush into action with assumed infrastructure solutions, either to win work or complete a business case and start engineering, design leaps out as an insightful conscience reciting the old phrase "if you fail to plan, you plan to fail." Intentional design, while highly value

creating, butts up against the traditional efficiency-driven management style.

So what should you be doing? Here are some recommendations, tailored to an Australian context, but transferable to other jurisdictions.

Infrastructure Australia (IA)

1. Develop awareness of design methods, leveraging case studies to validate and promote transferable insights.
2. Promote design thinking to accelerate learning and performance improvement in infrastructure design and delivery (faster than post-project reviews).
3. Require evidence of intentional design in new infrastructure submissions seeking endorsement from IA.

State Governments

4. Support the work and recommendations arising from Infrastructure Australia.
5. Use intentional design to enhance the quality of problem definition, strategic interventions and solution options in line with Investment Management Standards. (Refer to Appendix A.)
6. Encourage the application of intentional design and seek evidence of such in market-led infrastructure proposals to government.
7. Ensure business processes and procurement models are adjusted to maintain the integrity of integrated solutions throughout the design and delivery process, particularly at stage gates and when change orders are initiated.

Private sector infrastructure owners

See recommendations 5 and 6.

Consultants and Contractors

8. Embrace intentional design to improve understanding of clients.
9. Embrace intentional design as a method to conceive higher-value project designs, thus increasing the prospect of higher project win rates.
10. Embrace intentional design as a method for developing new and enhanced service offerings.

Box 4. Local government improves public services by hiring designers [7]

Barking & Dagenham Council, in east London, wanted to improve its waste services. Rather than turn to its engineering and maintenance team first, it turned to a design agency. By conducting research with local people, the designers identified causes of major frustration and confusion for both residents and the council. Workshops with residents generated more than 70 ideas for improved services. Many were put into practice, including clearer information about waste disposal options, and closer working relationships with local shopkeepers and traders to keep alleyways clear of rubbish. Not only did services improve, the council also made savings of £20,000.

This is just one example of design thinking being practiced in the UK. While it's not a panacea for public service reform, UK Design Commission argues that public sector leaders need to acquire design skills if they are to refashion services to maintain their relevance, productivity and cost effectiveness. Even a basic level of design training and information is required to know when to apply design thinking and how to buy professional design support.

Do you need design facilitators?

It's important not to confuse intentional design in the infrastructure space with master planning or urban design. Professionals working in these fields will bring their own perspectives and tools to the infrastructure planning and design task, but they are different to design thinking methods. Intentional design is a way of working that is not the privilege of any conventional discipline or profession working with infrastructure.

So in the early stages of applying intentional design, perhaps dipping your toe in the water as a trial, it is beneficial and arguably essential to get the support of an experienced design facilitator.

People will be quite literally learning a new skill, and just like learning and perfecting a new sporting skill, it takes time and benefits greatly from coaching. Without that coaching there's a chance you won't realise the success that is possible and give up. In and of itself this might not seem significant, unless competing organisations are gaining benefits and succeeding in securing projects and attracting investment.

Over time, and with the benefits of intentional design demonstrated and proven, it may be useful to develop the skills in-house. Samsung, for example, have gone down this route for one important, practical reason. Having determined they will adopt design thinking as a business-wide way of working, they realised that people working within the business were more likely to overcome any internal resistance than would external consultants [2].

Some more questions answered

Is intentional design relevant with all project delivery models? Yes it is, but collaborative models like alliances most easily support the adoption of intentional design practices. But it really comes down to the desire of project owners and sponsors that are creating or enhancing infrastructure assets to create the maximum value and do what's required to achieve that outcome.

Is the effort mainly concentrated at the early stages of a project? What about the detailed engineering and delivery phases? It's true that the greatest benefits are designed in from the outset (see Figure 4) but those benefits can be eroded if the focus is lost during latter stages, such as when control over the project changes hands or when variations in scope arise. So it's worth investing in a person to facilitate and maintain an eye on integration through all project phases in order to realise the benefits. This is a clear role sitting alongside a project manager or design manager.

I have smart, experienced people working in teams to get my projects developed. So I'm confused – what's different in the intentional design process to what they're already doing? This is a very common reaction. There are many differences which can be explained in some depth, underpinned by psychology and neuroscience, which we won't seek to do here. But two key differences are (a) genuinely thinking together (vs cooperating side by side) and (b) a sharper, sustained focus on delivering outcomes (vs outputs). Experience proves the best and most powerful way to understand the differences is to get involved and apply the method.

Safe next steps

Collaboration and innovation are on the tips of everyone's lips for a reason. People recognise they are now central to their ongoing success. Intentional design is a proven method that integrates those things in a practical, outcome-focused way.

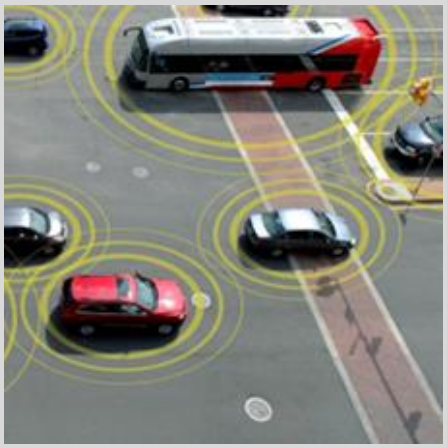
So what should you do now? Here's two recommendations:

- Talk with your colleagues about the business situations you face where this method would be useful. Get a sense of the potential scope of application.
- Invite an intentional design practitioner to share their experience and case studies, to further develop your thinking.
- Trial intentional design on a real project in which you have an interest. (But don't apply it in a trite way or as a Band-Aid. You put its value at risk and will be wasting people's time.)

Remember that intentional design typically offers a quick and substantial return on investment. **It's about better placed effort, not more effort**.

Just consider ...

... the merit of intentional design in crafting the successful roll-out of new infrastructure supporting self-driving vehicles, requiring car manufacturers, technology providers, regulators, city and national governments, service firms, and end users to collaborate in new ways, and to engage in new behaviours [10].



source: www.wired.com

source: www.abc.net.au

Consider also the challenges with the opportunity of distributed battery and renewable energy generation technology allowing households and businesses greater opportunity to participate as both consumers and producers in the energy network in real time.

Then there's integrated urban water management, where governments are striving to make greater use of multiple sources of water, requiring the support and involvement of water retailers, local councils, households, plumbers and more.

What projects do you have that could benefit?

source: www.eco-business.com

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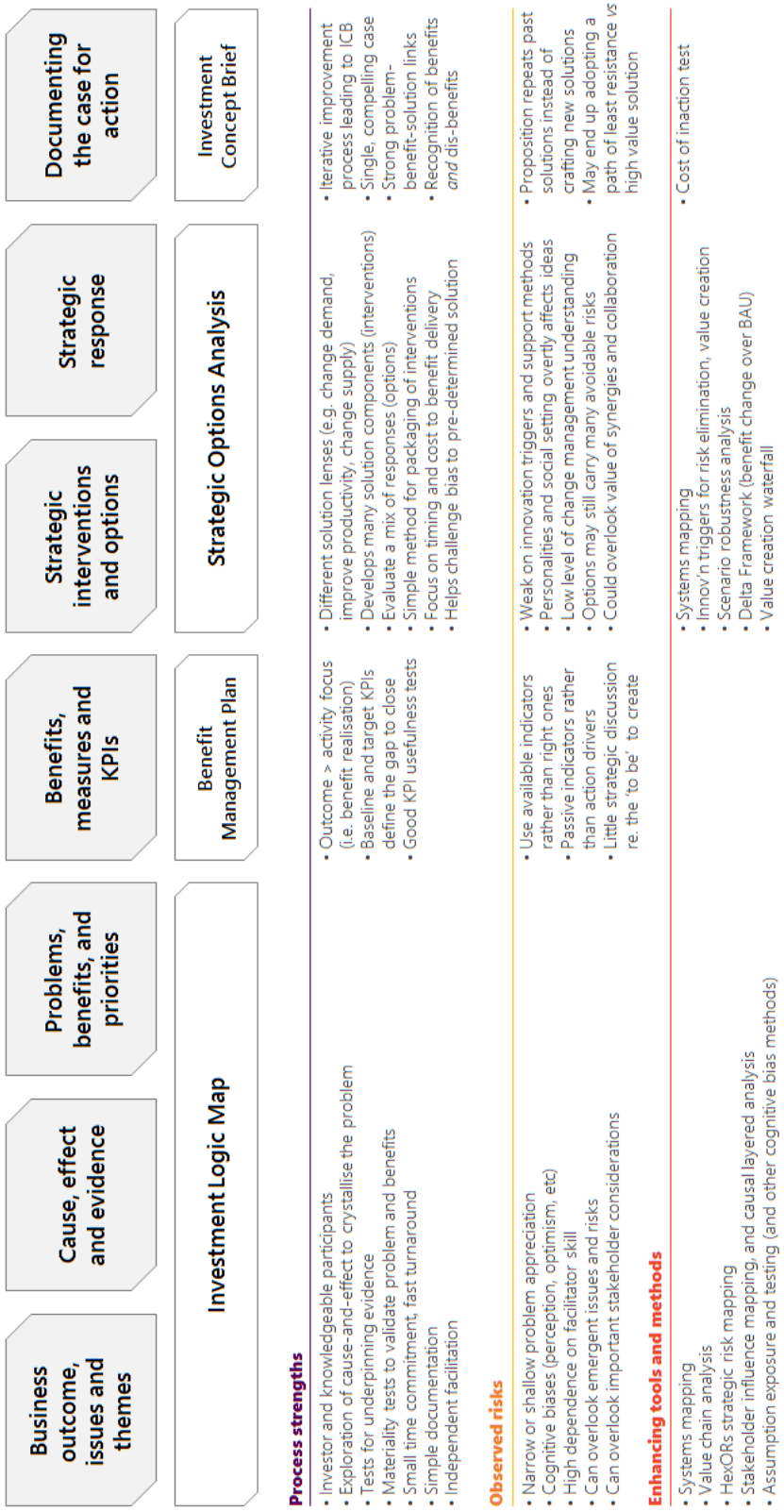
Appendix A – Intentional design enhances investment logic

The process flow applied to developing the investment logic for government programs and projects (shown below) is broadly mirrored by that applied by intentional design. The tools and methods of intentional design can be directly transferred to enrich the insight applied to problem definition and development of interventions and solution options. Training and practice in intentional design therefore has wider, enduring benefits. (*Note*: while the risk factors identified below do manifest and influence the process and calibre of investment logic mapping (ILM), they are not unique to ILM and are likely to exhibit themselves in other program and project development processes.)



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