

Innovation and HROs

Tim Kastelle

Contents

Introduction	3
Innovation Definitions	3
Innovation as a Process	3
Types of Innovation	3
Scale of Innovation	4
Innovation and the HRO	5
Ideas for Using Innovation to Support High Reliability Organising	5
Benefits of an Innovative Mindset	6
Thinking Differently About Risk	7
Leadership and Innovation	8
References	10

Figures

Figure 1: Different types of innovation in the Oil & Gas Sector (Mitchell and Steen, 2014)	4
Figure 2: Barriers to Business Success (Mitchell and Steen, 2014)	6
Figure 3: Performance Gains Through Innovation (Kastelle, Merchant, and Verreynne, 2016)	8

Introduction

The absence of an explicit discussion of the role that innovation plays in creating and maintaining High Reliability Organisations (HROs) is both striking and puzzling. As Johnston (2021) points out, to date the discussion has been limited to a very restricted definition of innovation, in a very limited number of contexts. And yet, becoming an HRO is by definition a process of change, which in turn requires innovation to succeed. This gap is indeed puzzling. Before discussing how innovation is necessary in becoming an HRO, it is first necessary to be clear on some of the core knowledge that we have about innovation as a process.

Innovation Definitions

Innovation is an often-used yet still fuzzy term. We define it as: executing new ideas to create value (Kastelle and Steen, 2011). All three elements need to be present to innovate. People often think of innovation as only ideation. New ideas are necessary, but not sufficient for innovation. A new idea that has been executed is invention – also necessary, also not sufficient. The element that is most often missing is value creation (Kastelle, et. al., 2018). Several important ideas flow from this definition.

Innovation as a Process

First, this definition implies that innovation can be approached, and managed, as a process. People often view the idea of “Innovation Management” as an oxymoron. It can be, if you only define innovation as generating new ideas – this is an act that is indeed notoriously difficult to direct (though it’s not impossible – see Csikszentmihalyi, 2013 for extensive discussion). Within organisations, best practice in managing innovation involves developing processes and metrics for the following steps: idea generation, idea selection, implementation, keeping the organisation and people engaged (sustaining), and getting people to adopt the new idea (diffusion) (Eggers and Singh, 2009)). This process is circular more than linear, and the way that one part is managed influences the way the rest of the parts operate. For example, if the primary Idea Selection rule is “choose the ideas that the boss likes the most,” this will change the type of ideas that are put forward.

Organisations normally struggle the most either with a combination of Idea Selection and Implementation, or with a combination of Sustaining and Idea Diffusion (Kastelle and Steen, 2011). Idea Generation is rarely the weak point for organisations. It is ironic then, that this is the area in which the most help is available. Cynics might suggest that this is because it is actually the easiest part of the process. Well-managed organisations usually have an explicit innovation process in place that addresses all of these stages (Dodgson and Gann, 2010).

Types of Innovation

The second implication that follows from this definition of innovation is that many different things can be innovated – it is not simply about developing new technology. Figure 1 shows six different forms of innovation in the oil and gas sector from a research report undertaken by EY and the UQ Business School (Mitchell and Steen, 2014): product, process, supply chain logistics, service, service distribution, and management. This is a modification of Doblin’s popular definition of ten types of innovation – a typology that makes more sense for retail or manufacturing firms. The typology developed for the oil and gas industry was extended in a follow-up study that looked at innovation and productivity in mining (Mitchell, et. al., 2014, and Mitchell, et. al., 2017). The focus of these three industry reports is on adapting the most widespread models of innovation to suit the minerals industries.

The point of all of these innovation typologies is to shift the emphasis away from a focus on only technological innovation to a broader range of possibilities. A technology-only focus means that innovation is something that only comes about as an outcome of often expensive Research & Development (R&D) processes. This broader focus, however, demonstrates that all parts of business operations can be

addressed through innovation – at least, all of the parts of operations that are value-creating can be innovated.

Innovators in our study demonstrated how innovation can occur in many areas. The examples provided are grouped into six types of innovation.

Types of Innovation	Examples from surveyed firms
Product	<ul style="list-style-type: none"> ▶ More efficient down hole pumps ▶ Drilling and completions technology ▶ Environmentally safe oil change technology ▶ Vehicle wash down water recycling system ▶ Vapour Recovery Units (VRUs)
Process	<ul style="list-style-type: none"> ▶ Floating Liquefied Natural Gas (FLNG) ▶ Flux-core welding for cryogenic tanks ▶ Seismic acquisition and processing ▶ New pipeline installation methods
Supply chain logistics	<ul style="list-style-type: none"> ▶ Modularisation of LNG construction ▶ Design for Manufacture and Assembly (DFMA) ▶ Advanced supply chain analytics for integrated logistics support
Service	<ul style="list-style-type: none"> ▶ Rapid land rehabilitation ▶ Cloud based engineering drawing management
Service distribution	<ul style="list-style-type: none"> ▶ Land owners trained as field service providers ▶ Remote monitoring and optimisation of well production
Management	<ul style="list-style-type: none"> ▶ Training software/learning modules ▶ Human Resource (HR) development ▶ Improved business processes

Figure 1: Different types of innovation in the Mining Sector (Mitchell and Steen, 2014)

Scale of Innovation

The third important implication of our innovation definition is that there are different scales of innovation. One commonly used typology defines ideas as:

- 1) new to the firm,
- 2) new to the industry, and
- 3) new to the world (Mitchell and Steen, 2014).

Developing New to the World innovations carries greater levels of risk and uncertainty than the other two, but also greater levels of reward for success. Similarly, working on New to the Industry ideas is riskier, more uncertain, and potentially more rewarding than only working on New to the Firm ideas, which is basically Benchmarking.

A second way to view the scale of an innovation is by the impact the new idea has on an industry. Those innovations that improve the day-to-day operations of an individual firm, or that provide modest but measurable improvements for customers and other stakeholders are often referred to as Incremental Innovations. Those that fundamentally change the structure of an industry are called Disruptive or Radical Innovations. The latter usually take the form of a major change in technological performance (research suggests that a 10X performance improvement is usually required (Dodgson and Gann, 2010)), or a major business model innovation (Kastelle, et. al., 2016).

It is common to see Disruptive Innovation valorised over Incremental Innovation. However, Incremental Innovation can be astonishingly powerful in large volume. One of the most radical innovations of the 20th Century was the development of the Toyota Production System, which was simply the accumulation of thousands of incremental process improvements.

There are other major areas of innovation research, but these are the ones that we will focus on in looking how innovation is essential to developing HROs.

Innovation and the HRO

There is a hidden tension in the discussions of HROs. The five principles at the core of this concept put forward by Weick and Sutcliffe focus on increasing reliability, primarily through measures designed to increase resilience. However, there are two different ways to be resilient. One is to reduce the risk of failure or disruption in the first place. This approach is designed to reduce variance in the way that an organisation operates. Weick and Sutcliffe's principles of 'Track small failures' and 'Remain sensitive to operations' both support progress on this path. The second path to resilience is to increase the repertoire of an organisation's potential responses as this is the best way to deal with unexpected changes in the operating environment. This approach requires organisations to increase variance in operations so that they can draw on this increased set of routines and actions in times of turbulence. Weick and Sutcliffe's principles of 'Avoid oversimplification' and 'Take advantage of shifting expertise' are necessary for following this path.

These two different ways to approach the fifth principle – 'Maintain capabilities for resilience' – is at the core of the difficulties managers have had in implementing the actions needed for High Reliability Organising. This may also explain why effective research on HROs has proven difficult to undertake. Failure to resolve this tension will result in the failure of change initiatives designed to facilitate High Reliability Organising.

Managers face different versions of this core problem. When approaching innovation strategy, there is the choice of just continuing operations as they are, without trying to do anything new at all (Non Innovators). In most sectors, roughly 30-40% of organisations fall into this category (Kastelle, Merchant and Verreyne, 2016). A second option is to focus only on innovation that makes existing operations more effective, or more efficient – this is basically variance-reducing innovation (General Innovators), with 40-50% of organisations in this category. Finally, the remaining 5-10% of organisations focus both on making existing operations more effective while also exploring more disruptive innovations (Novel Innovators). In other words, they manage to undertake innovation strategies that are both designed to reduce variance (increasing efficiency) while also increasing variance through novelty seeking.

Our contention is that this last group is by far the most likely to undertake actions that lead to High Reliability Organising. But how?

Ideas for Using Innovation to Support High Reliability Organising

There are several key ideas that will facilitate using innovation to develop HROs: creating the right mindset, thinking differently about risk, and integrating the HRO-supporting processes into the overall leadership approach,

Benefits of an Innovative Mindset

In innovation research, having the ability to resolve the tension between undertaking both efficiency-improving innovation (variance reducing) and more disruptive innovation (variance increasing) is called having an Ambidextrous Mindset (Tushman and O’Reilly, 2002). The study by Mitchell and Steen (2014) mentioned previously shows the benefits of this mindset.

As discussed, the authors outline the six different forms of innovation used in the mining sector. In a study of over 120 organisations in that sector in Australia, they then asked how many of them had introduced ideas that were new to the firm, new to the industry, or new to the world in each of the six categories in the past three years. Many firms had not introduced any new ideas in any of the categories in that period, while a similar number had introduced new to the firm ideas in one or more categories. A small number had introduced multiple new to the industry or new to the world ideas over that time. These answers sorted the firms into three categories: Non Innovators, General Innovators, and Novel Innovators.

Next, the firms were given 18 common barriers business success, and asked which of these gave them problems. Figure 2 shows the results.

Figure 2: Factors cited as barriers to business success

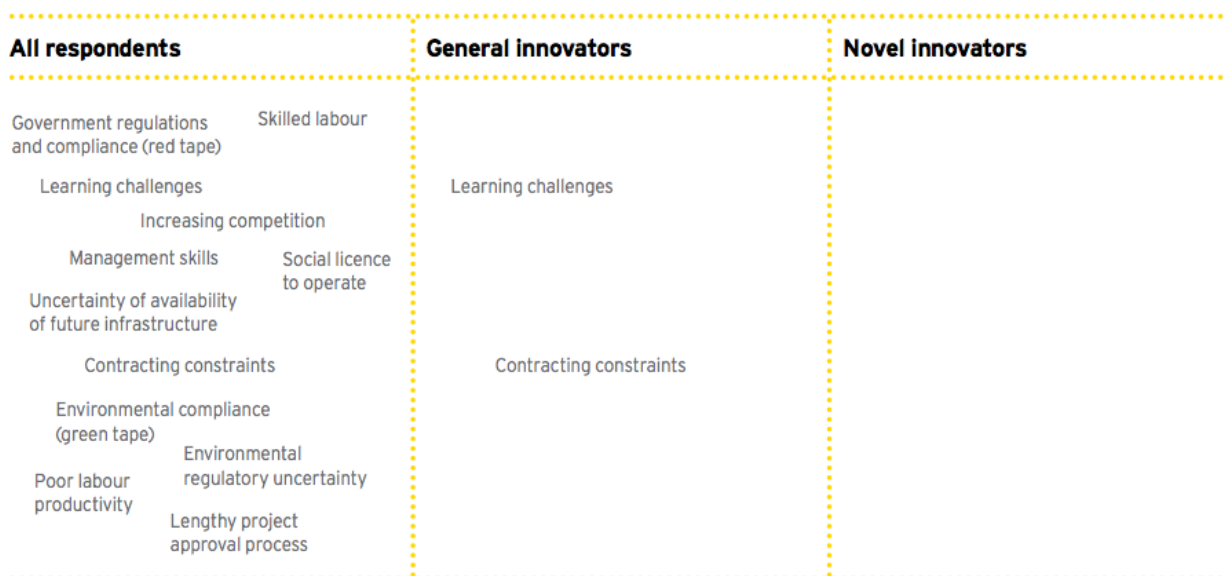


Figure 2: Barriers to Business Success (Mitchell and Steen, 2014)

The results were interesting. For the Non Innovators, nearly every possible barrier to success gave them problems. The General Innovators were in better shape – their main problems were learning challenges and contracting constraints. The latter is interesting as this is one of the primary forms of innovation in the construction industry (Davies, Dodgson and Gann, 2016), and this shows that it is becoming increasingly important in the mineral industries as well. Finally, the Novel Innovators didn’t experience any of the common barriers to success as problems. In the interview part of this research, managers in this group generally thought that the barriers to business success actually gave them a competitive advantage, since they had the processes in place needed to deal with them, while their competitors clearly did not.

But this study wasn’t about innovation – it was about productivity. And the key finding in it is that in the previous three years, the Novel Innovators were **27 times more likely to have experienced a productivity gain** than the Non Innovators. In other words, instead of trading off efficiency for exploration, the Novel Innovators experience much higher success in both categories. In part, this may be due to a difference in

mindset – where Non Innovators see everything as a barrier to success, while Novel Innovators feel much more in control of their circumstances.

Thinking Differently About Risk

When implementing new ideas, there is always an initial cost which will, if everything goes well, eventually lead to a greater payoff. The normal way that we evaluate which ideas to pursue is to calculate the Discounted Cash Flow (DCF). In a stable business environment, where the risks and payoffs to new ideas can be calculated with some degree of accuracy, this method for selecting which ideas to pursue makes sense (Christensen, et. al., 2008). But that is not necessarily the environment in which we operate.

The core assumption behind DCF analysis is that if we do not implement the new idea, then there is no loss and no gain. Our baseline remains the same. Rejecting ideas with a negative DCF calculation is rational, and it seems safe and conservative. But what if the baseline changes?

There are two things that can shift the baseline. An organisation's competitors can introduce either a string of small innovations, or one or two more disruptive innovations, thereby changing the competitive landscape. This means that doing nothing leads to a worse competitive position – the baseline for the DCF calculation has moved down, which in turns means that all of a sudden a bunch of new ideas that looked like they would be cashflow negative now actually should have been implemented. The second thing that can change the baseline is changes in the external business environment. In the past 25 years, in Australia we have experience a number of shocks to the business environment: the Asian Financial Crisis, 9-11, the Global Financial Crisis, and the COVID-19 pandemic.

When these external shocks are combined with apparent changes in the global economic governance regimes (Bremer, 2012), it seems as though the level of turbulence that we have been facing recently is unlikely to dramatically decrease. External shocks can have either positive or negative impacts on an industry, but in both cases, the change the baseline for our DCF calculations.

The outcome of changing baselines is that when using DCF to evaluate new ideas, rejecting ideas that increase smaller, short-term risk may actually lead to increased longer-term risk of catastrophic failure. In fact, this sort of catastrophic failure has been increasing substantially among Fortune 500 firms over the past fifty years (Hagel, Seeley-Brown and Davison, 2009), which suggests that this is happening in reality.

This rejection of short-term risk might lead to another problem. Cohen and Levinthal (1990) demonstrated that firms that are actively trying to innovate are better able to absorb new ideas that come from outside sources than are firms that Non Innovators. This finding means that trying to use a fast follower strategy without also trying to generate novel innovations internally is much harder than it seems. This might explain the struggle that Non Innovators have in achieving efficiency gains discussed previously.

This also means that the common innovation solution in the minerals industry of outsourcing innovation and risk to the Mining, Equipment, Technology and Services (METS) sector might also be riskier than it seems (Steen, et. al., 2018). Particularly in increasingly turbulent business environments, there is a strong argument for moving more innovation capacity in-house, consequently increasing the amount of uncertainty and risk taken on by mining firms.

The best practice for evaluating risk using methods other than DCF is to use some form Real Options analysis, or, as McGrath and MacMillan (2009) refer it to it, Discovery-Driven Growth. This approach uses the idea of affordable loss, rather than projected gain as the core evaluating metric. In other words, the primary calculation is that of the market value of knowledge about what will or won't work. This leads to the development of a stream of smaller experiments, rather than a smaller number of big bets. It is an approach that is also very consistent with Weick and Sutcliffe five HRO precepts.

Leadership and Innovation

The final point to consider is the relationship between leadership and innovation. We already know that changing the approach to leadership can support the develop of High Reliability Organising (Haslam, et. al., 2021). The mechanisms the enable this are still not entirely obvious. Another study that we did provides some further insights (Kastelle, Merchant, and Verreynne, 2016). This was based on a smaple of 2500 firms based in Southeast Queensland. As with the study by Mitchell and Steen (2014), we sorted firms into the same three categories of Innovators (with slightly different names). And we also looked at the different strategies firms were pursuing to explore the interactions between innovation and strategy. There were four strategy categories – lowest overall cost, high customer intimacy/responsiveness, and best product were the first three. The fourth emerged from the data – firms that aren't following any one clear strategy (No Point of Difference).

We then mapped all the different combinations of innovation levels and strategy against a performance metric that included market share, growth, and customer satisfaction. The first finding was that the No Point of Difference firms significantly under-performed relative to nearly all of the other categories. In this group, it didn't matter what their level of innovation was – on average they were poor performers. We then set this performance level as the baseline, and compared all the other categories to this (Figure 3).

High Innovation	0.84	1.20	1.37
Some Innovation	1.14	1.12	1.25
No Innovation	1.10	1.09	1.23
	Low Cost	Customer Intimacy	Best Product
	No Point of Difference	1.0	

Figure 3: Performance Gains Through Innovation (Kastelle, Merchant, and Verreynne, 2016)

The best-performing category was highly innovative (Novel Innovators) firms following a Best Product strategy – their score on the performance metric was 37% higher than the baseline group.

There are a couple of important conclusions from this study and one big question. The first conclusion is that as in the Mitchell and Steen study, the Novel Innovators outperform the less innovative firms. The second is that without a clear strategic point of difference, innovation performance doesn't matter. Therefore, in any change process, strategy must be addressed first.

But there's also one important question: is the better performance caused by innovation, or by something else? There are many studies like this in different areas of business research. Firms with higher levels of diversity and inclusion also outperform their peers, as do firms with higher levels of trust, flatter hierarchies, and so on. And firms that are classed as HROs also perform very well. In all of these studies, there are usually about 5% of firms that are exceptional, about 35% that are terrible, and the rest are in the middle. What if that 5% in all these studies are all the same firms? That would suggest that there is another underlying cause for this high performance.

Jeffrey Pfeffer and Bob Sutton ask a very interesting question in their book *The Knowing-Doing Gap*:

“Why has it been so difficult for other automobile manufacturers to copy the Toyota Production System (TPS), even though the details have been described in books and Toyota actually gives tours of its manufacturing facilities? Because “the TPS techniques that visitors see on their tours—the kanban cards, andon cords, and quality circles—represent the surface of TPS but not its soul.” The Toyota Production System is about philosophy and perspective, about such things as people, processes, quality, and continuous improvement. It is not just a set of techniques or practices: On the surface, TPS appears simple.... Mike DaPrile, who runs Toyota’s assembly facilities in Kentucky, describes it as having three levels: techniques, systems, and philosophy. Says he: Many plants have put in an andon cord that you pull to stop the assembly line if there is a problem. A 5-year-old can pull the cord. But it takes a lot of effort to drive the right philosophies down to the plant floor.” (Pfeffer and Sutton, 1999, p. 31)

This is also the key to our question about innovation and HROs as well. Whether we are talking about increasing quality, or safety, or innovation, or being an HRO, the issue can not be solved at the surface level with a set of practices and techniques. The issue must be addressed at the level of philosophy. The difference between the Novel Innovators and the Non Innovators isn’t that the Novel Innovators have better tools (though they probably do have better tools too), it’s that they have a philosophy that integrates both incremental and disruptive innovation into their day-to-day practice.

Doing this is also the first step towards becoming an HRO. And this requires leadership. This is the common underlying element among all of those different studies of firm performance – good management. The prescriptions for becoming an HRO, are simple, but not easy: adopt a philosophy that encompasses all of these core precepts. Change the way we think about risk. Innovation is an essential ingredient in becoming an HRO, but it’s not enough by itself. It has be connected to a clear strategy, and be driven and supported by a strong Identity Leadership Approach.

References

- Bremer, I. (2012) *Every Nation For Itself: Winners and Losers in a G-Zero World*, New York, NY: Portfolio.
- Christensen, C., Kaufman, S. and Shih, W. (2008) 'Innovation killers: How financial tools destroy your capacity to do new things,' *Harvard Business Review*, 86(1): 98-105.
- Cohen, W. and Levinthal, D. (1990) 'Absorptive capacity: A new perspective on learning and innovation,' *Administrative Science Quarterly*, 35(1): 128-152.
- Csikszentmihalyi, M. (2013) *Creativity: The psychology of discovery and invention*. New York, NY: Harper Perennial.
- Davies, A., Dodgson, M. and Gann, D. (2016) 'Dynamic capabilities in complex projects: the case of London Heathrow Terminal 5,' *Project Management Journal*, 47(2): 26-48.
- Dodgson, M. and Gann, D. (2010) *Innovation: A Very Short Introduction*. Oxford, UK: Oxford University Press.
- Eggers, W. and Singh, S. (2009) *The Public Innovator's Playbook: Nurturing Bold. Ideas in Government*. Deloitte Research, available from http://www.deloitte.com/dtt/cda/doc/content/dtt_ps_innovatorsplaybook_100409.pdf
- Hagel, J., Seely Brown, J. and Davison, L. (2009) 'The big shift: Measuring the forces of change,' *Harvard Business Review*, 87(4): 41-50.
- Haslam, S.A., Jetten, J., Maskor, M., Bentley, S. and Steffens, N. (2021) 'The two-stage social identity model of High Reliability Organisations,' Sustainable Minerals Institute High Reliability Organisations Forum Paper.
- Johnston, S. (2021) 'What do we really know about HROs?' Sustainable Minerals Institute High Reliability Organisations Forum Paper.
- Kastelle, T., King, S., Verreynne, M.-L. and Kambouris, P. (2018) 'Experiences using a science-based Lean LaunchPad program and its impact on national innovation system evolution,' *International Journal of Entrepreneurship and Small Business*, 35(3): 356-370.
- Kastelle, T., Merchant, N. and Verreynne, M.-L. (2016) 'What creates advantage in the 'Social Era'?' *Innovaitons: Technology, Governance, Globalization*, 10(3-4): 81-91.
- Kastelle, T. and Steen, J. (2011) 'Ideas are not innovations.' *Prometheus*, 29(2): 199-205.
- McGrath, R.G. and MacMillan, I. (2009) *Discovery-Driven Growth: A Breakthrough Process to Reduce Risk and Seize Opportunity*, Cambridge, MA: HBS Press.
- Mitchell, P., Bradbrook, M., Higgins, L., Steen, J., Henderson, C., Kastelle, T., Moran, C.J., Macaulay, S., and Kunz, N.C. (2014) *Productivity in Mining: Now comes the hard part, a global survey*. Sydney, Australia: Ernst and Young.
- Mitchell, P., and Steen, J. (2014) *Productivity in mining: A case for broad transformation*. Sydney, Australia: Ernst and Young.
- Mitchell, P., Steen, J., Sartorio, A., Bolton, W., MacAaulay, S., Higgins, L., Kunz, N.C., Yameogo, T., Hoogedeure, W., and Jackson, J. (2017) *How do you prepare for tomorrow's mine today?* Sydney, Australia: Ernst and Young.
- Pfeffer, J. and Sutton, R. (1999) *The Knowing-Doing Gap: How Smart Companies Turn Knowledge Into Action*, Cambridge, MA: Harvard Business Review Press.

- Steen, J., MacAulay, S., Kunz, N. and Jackson, J. (2018) 'Understanding the innovation ecosystem in mining and what the digital revolution means for it,' in Clifford, M., Perrons, R., Ali, S. and Grice, T. (eds), *Extracting Innovations: Mining, Energy, and Technological Change in the Digital Age*, New York, NY: CRC Press.
- Tushman, M., and O'Reilly, C. (2002) *Winning Through Innovation*, Cambridge, MA: HBS Press.
- Weick, K., & Sutcliffe, K. (2011). *Managing the unexpected: Resilient performance in an age of uncertainty* (2nd ed.). New York, NY: Jossey-Bass.



Contact details

Tim Kastle

T +61 7 3346-8158

E t.kastle@uq.edu.au

W business.uq.edu.au/profile/212/tim-kastle

CRICOS Provider Number 00025B