

# Driving Innovation: A Systemic Approach

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## Keywords

Innovation, systems, audit, portfolio management

## Abstract

There is currently an enthusiasm for supporting innovation in Australia, both within the management of enterprises and within all levels of Government. One view of a national system of innovation sees the individual enterprise at the core (sometimes called "the innovation dynamo" in this view) supported by science and technology infrastructure with a variety of technology transfer activities linking the two. Some innovation researchers see innovation as a people driven process. We see that certain core competencies are required. Others see innovation as a technology driven process. We see that access to particular complementary assets is required. Yet others highlight the mismatch in organisational norms between innovation (divergent thinking and disruptive change) and efficiency (convergent thinking and predictable outcomes) with Multiple internal and external factors shape the innovative capacity and practices of enterprises. Our interest is in the workings of innovation within an individual enterprise, and we have used a systems engineering modeling approach to both represent these workings and to assess the effectiveness of enterprise innovation. The model developed can be applied equally well to both technological and non-technological innovation, and helps understand the interaction a variety of factors that may support or inhibit innovation. Its application to a case example is presented, along with observations from other cases.

## 2. Introduction

In many different ways, innovation is seen as essential to the survival and growth of individual firms, and to the health of national economies, but there is a range of views about what stimulates or inhibits it. At an Australian National Innovation Summit (NIS) held in 2000, the

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then Chairman of the CSIRO Charles Allen, noted that the primary source of growth in the world's largest economies was advances in technology combined with innovation, and suggested three drivers of innovation as culture, capital, and connectivity. Sir Roderick Carnegie [1] however suggested in a recent speech at the Australian Institute of Management that 'people, not technology drive innovation'. The NIS Working Group on the Human Dimension of Innovation [2] identified that in Australia part of the problem may be our excessive reliance on individual heroes to drive our innovation. It is evident that relying on the chance emergence of such innovators is no longer acceptable. The Working Group pointed out that highly successful organizations are showing that Australia can and should take a systematic approach to identifying, developing and applying ideas, drawing on the talents of all people in an enterprise.

While there is a diversity of views relating to innovation, there are also a few recurring themes: innovation is a people-centric process, but commonly involves technology, and requires some kind of systematic approach to achieve consistent results. However, by definition, innovation involves something new. It changes the status quo and is disruptive. Enterprises focused on efficiency may have difficulty with some transitions stimulated by an innovation, and some innovative firms may be so turbulent that they do not operate efficiently in a business sense, even though they keep coming up with new ideas. So some balance is needed, as Hickman and Raia (2002:14) [3] observe: "Convergent thinking systems, which include most established business organizations, survive on order, measurement, and predictability". In contrast, most innovations occur in divergent thinking environments that thrive on disorder, imagination, and ambiguity. If a company's culture embraces one orientation and spurns the other, or keeps them too separate from one another, neither the organization nor the innovation will flourish. The convergent-thinking organization that inhibits divergent-thinking innovators because of their odd and disruptive ways will always lack the creativity and passion to make breakthrough innovations a consistent and continuous reality. By the same token, divergent-thinking innovators who loathe the convergent-thinking organization because of its rigid and stifling norms will always lack the perception and persistence to realize the potential of their innovations within the current organizational context".

What emerges from this is a paradox; both forms of thinking need to be embraced for an enterprise to survive in the long term. However, is it possible to balance divergent thinking and convergent thinking or can firms take a systematic approach to innovation that integrates convergent implementation with divergent incubation? To achieve a balance enterprises need some way of assessing the innovation attributes of the organization while considering how that compares with a desired future capability, and possible pathways and actions to achieve that capability. In this paper we present a number of linked concepts aimed at focusing and enhancing the innovation capabilities of an individual enterprise:

- The notion of an innovation landscape, reflecting the observation that innovation frequently occurs on a number of fronts
- The notion of innovation as a business process that links with other enterprise business processes
- The notion of the innovation process as a system or methodology
- The combination of these views to examine, focus, and enhance internal enterprise innovation practices

## 2. The Innovation Landscape

Early in 2003, as a follow-on from the National Innovation Summit, the Australian Government began a project to map the National Innovation System, considering both the Science & Technology community and Industry contributions. There was a significant focus on opportunities arising from science and technology discoveries, but a number of focus groups also highlighted the value of combining existing technologies in new ways, and of non-technological innovation. From our observations at the level of the individual enterprise, those wishing to embrace innovation as a source of competitive advantage need to continuously improve their innovation system, and frequently pursue parallel innovations in different parts of the enterprise. They need to compare their current position with their desired position in a number of different organizational contexts: where is the enterprise currently innovative, and is this sufficient to achieve its future goals?

Various approaches to auditing innovation are suggested in the literature and a number of Internet sites describe innovation assessment services that are available. Some emphasize individual creativity and mechanisms, some emphasize technology innovation practices, and some search for the presence of a suitable environment. Some seek to establish an innovation measure. Before setting out to improve the innovation process, Management needs to select strategically significant areas that will benefit from enhanced innovation. An enterprise may be innovative in a variety of ways, and to assist management in making such considerations we have used the model or mind-map in Figure 1 to help establish the focus of current and future activities.

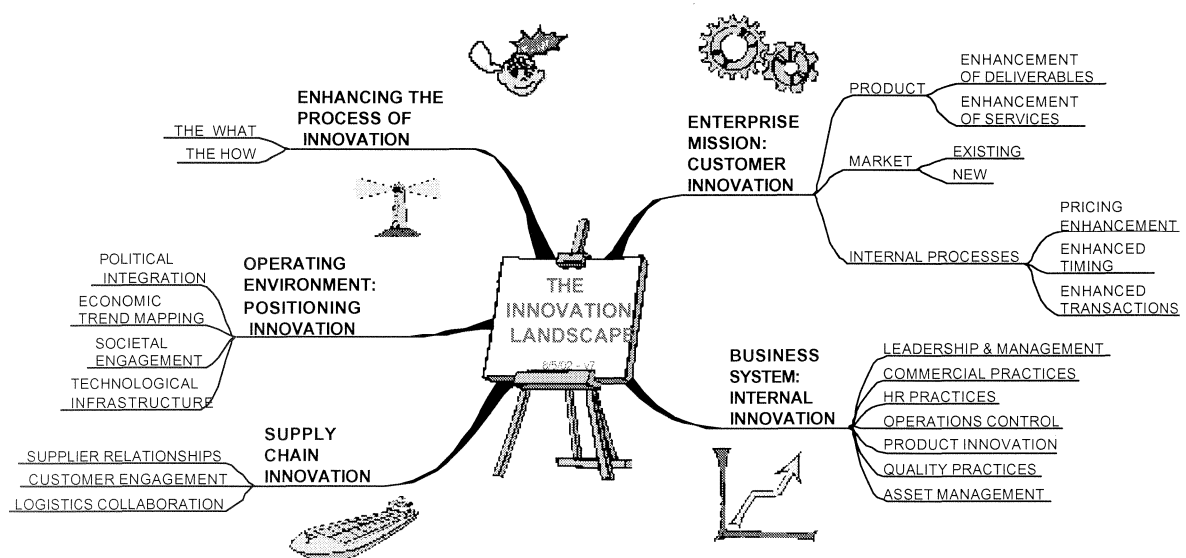


Figure 1 An enterprise level innovation landscape

### 3. Some drivers of innovation

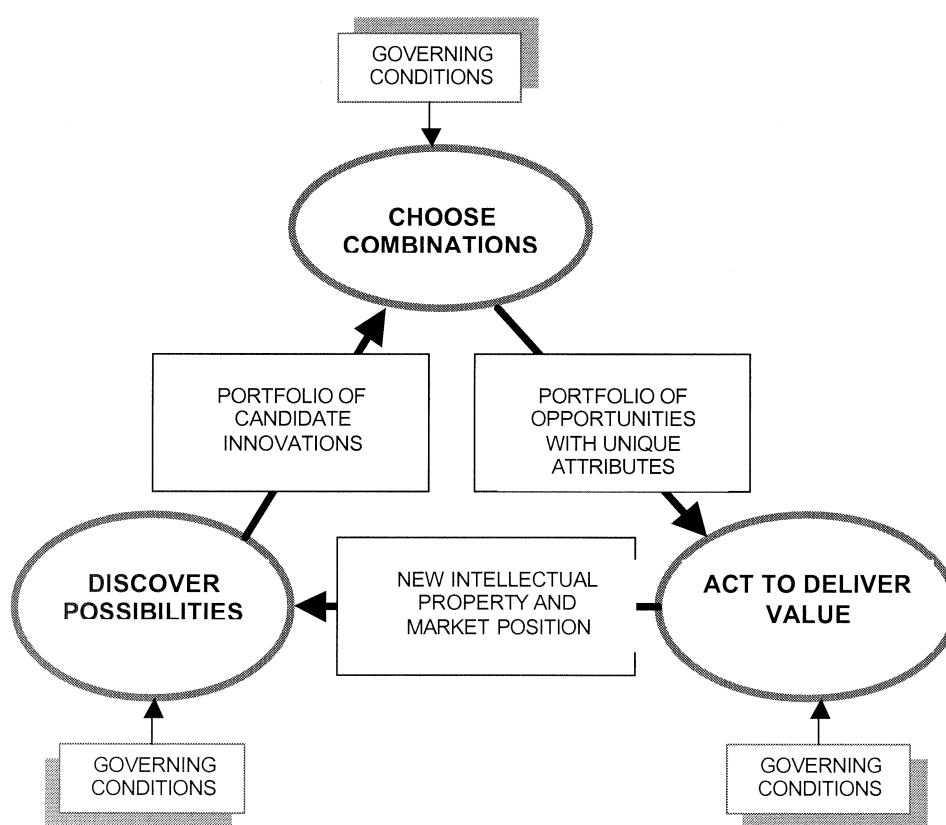
What drives a particular enterprise to innovate and the innovation strategy it chooses sets the scene for assessing the capabilities that are needed. Ulrich [4] sees three premises associated with innovation: innovation matters to the enterprise; innovation is multifaceted, and innovation is a culture, not an event, and that there are six characteristic stages; idea generation, impact, incubation, investment, integration, and improvement. The multifaceted nature of innovation leads to the notion that there may be people, technology or innovation system drivers that are blended in different ways in different enterprises. In examining some of the literature and a number of internet sites concerned with exploring innovation, the elements; people, technology and system drivers are evident with varying degrees of emphasis. Bharadwaj and Menon [5] conducted a survey of more than 600 business units of S&P 500 companies to assess the relative impact of individual creativity mechanisms, organizational creativity mechanisms and both together. They found that utilizing both mechanisms together gave best results. Only having a well-developed organizational creativity mechanism gave good results, and only having personal creativity mechanisms gave lesser results. We suggest that the way the combination of people and organizational creativity impacts a particular enterprise will depend on the nature of that enterprise. Kickul and Grundy (2002:85) [6] found that in a small business "a prospector strategy orientation mediated the relationship between proactive personality and three types of innovation: innovative targeting processes, innovative organizational systems, and innovative boundary support arrangements". Exploring possibilities and taking action was the norm. Where efficiency is important, for example in a large established company in a mature industry competing on price, or in a government department enacting a particular charter, innovative people and practices may not be at the core of operations, but may be seen to be important to its long term future.

The enterprise external environment drives innovation. Thomas [7], in a study of industrial policies in ten nations, concluded that a very demanding environment could be conducive to innovation. Afuah [8] argues that factor conditions such as natural resources, skilled labour, capital, universities, and private research laboratories, which are a supply of scientific, technological and market knowledge can be sources of local advantage. Supported by such a platform of excellence, new ideas can be nurtured into products and services. The nature of the local demand for products and services reflect the local firm's ability to innovate, and some studies of regional clusters have shown a common pattern of smaller innovative firms clustering around a larger client with extended market reach. Customer needs, preferences and expectations should be broadly articulated to organizations and manufacturers to provide some focus for them in their innovative thinking. In addition, suppliers too, can be critical in generating new product or service ideas, and supporting them through subsequent development and commercialization. Local rivalry can improve the ability of firms to innovate. Firms may pick up knowledge from each other, and build on it to improve and survive leading to more innovative ideas. Finally, government policies in most countries assist organizations to innovate through funding, assistance, consultancy and other policies.

Little [9] considered the likely impact of government policy intervention on six attributes of

innovative SMEs: Vision and Strategy, Managing the Competency Base, Creativity and Idea Management, Culture and Climate, Intelligence, and Organization and Process. Within this framework, some 45 specific enterprise attributes were listed, highlighting the complex nature of the innovation process. It was suggested that certain kinds of government intervention could be effective, whilst other initiatives might not: a reinforcement of the contingent nature of innovation.

Multiple internal and external factors will condition an enterprises specific needs and approach to innovation, but we contend a generic representation of innovation as a process can still be identified. Figure 2 shows how certain activities, governing variables, and specific organizational practices combine to characterize a system of innovation conceived as a business process that may be applied equally well to a variety of areas of the innovation landscape illustrated in Figure 1.



*FIGURE 2 Practices to be managed in a system of innovation*

Within this overall system, activities of exploration and discovery, choosing winners, and taking action to add value, regardless of the overall innovation focus, have been identified. For example the exploration process may be technology research in a product innovation context, or it may be cross-sector benchmarking in a business process innovation context. Two intermediate stage-gates are observed: one that manages options arising from the exploration stage, and another that manages investments following the activity of choosing winners. Two portfolios are established,

one being analogous to a portfolio of share options (opportunities with unique attributes) and the other being analogous to a share investment portfolio. The management of investments in these portfolios provides a linkage with other enterprise business management systems (e.g., finance, R&D).

#### **4. Assessing and enhancing innovation capabilities**

Enterprises wishing to embrace innovation as a source of competitive advantage need to continuously improve their innovation system. Various approaches to auditing innovation are suggested in the literature and a number of Internet sites describe innovation assessment services that are available. Some emphasize individual creativity and mechanisms, some technology innovation practices, and some search for the presence of a suitable environment. Some establish an innovation measure.

The innov-8 [10] approach seeks to establish a culture of innovation through a focus on leadership, facilitation skills, idea generation and management practices. An approach developed by Voss, et al [11,12] considers the interaction between product innovation, process innovation, product development and technology acquisition; enabled by resources, leadership, systems and tools. A progression matrix characterizing generic stages of development is constructed around these attributes to provide a form of map that a particular enterprise can establish its position on. Chaston [13] offers a questionnaire approach aimed at assessing an enterprise's strategy and its connection to innovation, the extent of technological and R&D skills available, external interactions that might stimulate innovation, the existence of a systematic way of managing innovation, and the extent to which rhetoric promoting innovation is matched by the reality. Bubner [14] has developed a process (waveglobal [15]) that considers how well innovation is managed by scoring several factors: leadership for innovation, strategy for innovation, external environment for innovation, internal environment for innovation, the innovation production process, measuring and maintaining innovation. A weighted composite score is also developed and this can be used to assess progress or make comparisons with other enterprises. Another approach was described in a recent workshop in Australia (Ryan and Auer, [16]) that focuses on an audit, rapidly generating a lot of ideas, and applying particular techniques to screen and select ideas for progression.

Whilst these approaches assess many important innovation attributes, and offer a range of improvement tools, they do not provide a holistic view of the total process that would integrate with the convergent thinking part of the enterprise referred to by Hickman and Raia [3]. We have chosen a management view, with a focus on organizational (as compared with individual) creativity capacity as the basis of an assessment process.

#### **5. A systems engineering view of the process of innovation**

We argue that if we can represent innovation as a system, then we can explore deficiencies in that system using fault-tree analysis concepts. The system modeling tool we have chosen to use

is IDEF0 [17] which defines a process as a series of linked activities, each with its own inputs and outputs, but also operating in accordance with some rules or constraints, and requiring particular resources or mechanisms to be effective. Within this overall system, activities of exploration and discovery, choosing winners, and taking action to add value identified earlier in Figure 2, have been characterized. Two intermediate stage-gates are observed: one that manages options arising from the exploration stage, and another that manages investments following the activity of choosing winners. The management of innovation involves selecting appropriate processes for each of the three activities, providing appropriate inputs (I), constraints (C) and mechanisms (M), and managing two stage-gates. Figure 3 shows how certain competencies, unique resources, and specific organizational practices interact to characterize a systems engineering view of innovation. (Beckett, Hyland and Soosay [18]).

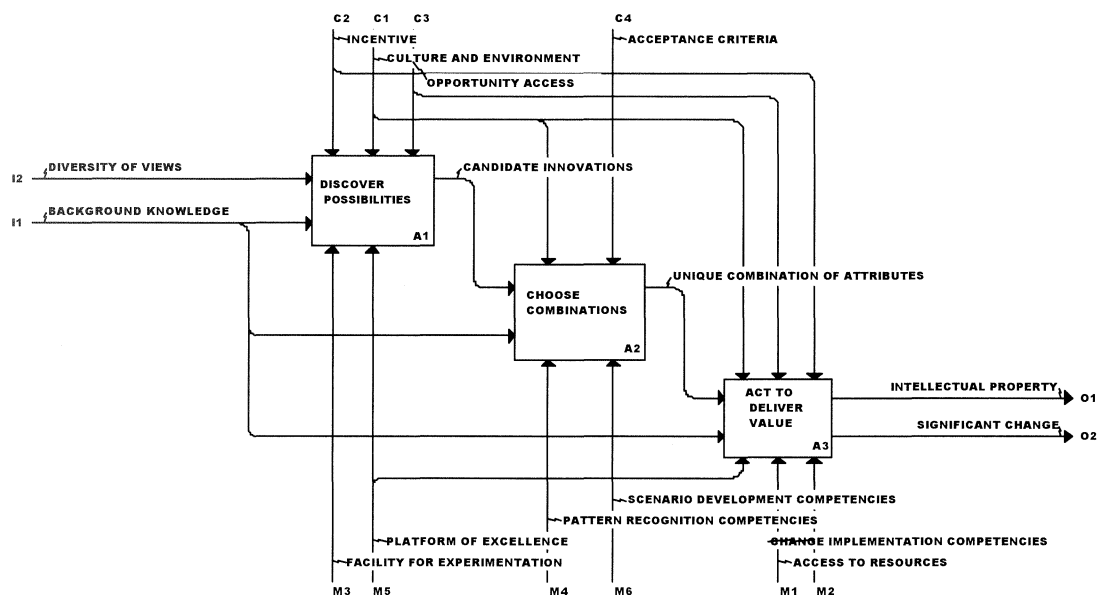


Figure 3 Activities in the innovation process (developed by Beckett and Hyland)

#### 4.1 Activities

There are three activities in the innovation process model, and the first is “discover possibilities” (A1). Discovering possibilities can be aligned with traditional research activities, or with some other process such as benchmarking, with an output of candidate innovations. Whilst researchers and inventors may feel that they have identified an innovation at this stage, this output is seen here as contributing to a portfolio of possibilities that have to be combined with other considerations before a particular candidate innovation is acted on. “Choosing combinations” (A2) involves identifying combinations of ideas and circumstances that will enable an innovation to deliver value to an enterprise and its customers, and can be aligned with the development of commercialization / implementation strategies and the selection of a portfolio of investments. Finally “acting to deliver value” (A3) has an objective to deliver value from the innovation and

to integrate it with convergent business processes, which generally requires access to significant resources and the introduction of internal change. It is argued that unless a good business case has been previously made, and there are sufficient incentives to change, then this process may fail.

## **4.2 Inputs**

There are two key inputs to the innovation process: background knowledge (I1) and diversity of views (I2). Background knowledge provides inputs about products, processes, and linkages between their components and the market or value chain as a necessary part of current understanding to initiate and support the innovation process. Without this background, the significance of new opportunities or the steps necessary to act on them may not be appreciated. Some observers of the innovation process have noted that individual innovations often occur at organizational boundaries. Innovative products or processes are novel combinations of existing artifacts or a combination of new and existing artifacts so they require a diversity of views to support their conceptualization (I2). Without a variety of views of products, processes and applications, innovative linkages are unlikely to be established.

## **4.3 Constraints**

Every system operates within constraints and innovation processes are not immune from this. Within the innovation process we characterize four constraints. The first is a culture and environment (C1) that supports the free expression and exchange of a diversity of views, sharing of knowledge, risk-taking, and linkages between disparate parts of an enterprise that are needed to support the evolution of an innovation. In any enterprise, this must be balanced against maintaining focus on current business activities, protection of intellectual property and controlling risk exposure, potentially sustaining unproductive tensions between creativity, entrepreneurship and sound business management. There are also arguments that innovation is stimulated by a demanding environment and by competition. Taken together, this suggests a need to synchronize the internal and external environment to sustain effective innovation. Next there is evidence that some form of incentives (C2) are needed to deliver on prospective innovations, as innovation can be a risky business. Incentives may be related to personal motivation. Incentives may be provided at an enterprise level, such as tax benefits and government grants. Opportunity access (C3) relates to access to an innovative environment. Innovative individuals need the time and permission to access people, places and capabilities that can help develop their ideas, and to assist with the implementation of these ideas. For example, time release from a routine job and access to external experts may be needed to progress an idea, or opportunities to access potential investors may be needed at the implementation stage. Finally organizations need to establish acceptance criteria (C4) for innovations to proceed past the discover possibility activity. At any given time, innovative enterprises will have a portfolio of candidate innovations, and as part of the assessment and prioritization process there is a need to consider criteria related to potential risk, resource limitations, potential future benefits and strategic fit.

## **4.4 Outputs**



The key outputs of an innovation process whether or not it is analyzed using a systems approach are new ideas, formalized as intellectual property (O1) and significant change (O2) in market positioning. The primary outcome of the innovation process is tacit and/or explicit intellectual property that is not only embodied in a product or process innovation, but can be leveraged by providing a base for further innovation, or leveraged by packaging it as a tradable asset. Effective innovations lead to significant changes that are reflected in market preferences or in the ways people work together. Whilst innovative enterprises are receptive to and competent at internal change, they must also recognize the need to change the external environment to derive the best value from their innovation initiatives.

#### **4.5 Mechanisms**

Emerging from the innovation literature it is clear that organizations need certain attributes and capabilities to enable them to be innovative. Within the systems approach we have identified six mechanisms that are intended to provide some guidance in understanding what capabilities and competences an organization needs. Clearly to implement an innovation and draw full value from it a firm needs to provide access to facilitative resources (M1) such as a delivery system or a particular manufacturing technology may be needed. Even if the innovating enterprise has all the technologies at its disposal, it may not have the capacity to implement something new when the opportunity arises, so it cannot act to deliver value. An entrepreneur with an innovative business idea may need to access independent advice and mentoring, as well as financial or other resources to be able to act on that idea. As innovation results in change, organizations need to have some change implementation competencies (M2). Introducing a new product or process may require the innovating enterprise to acquire new technologies and competencies. Even if this is not the case, during transition from the current practice to an improved one, the old and the new will co-exist for some time, potentially making operations less efficient, and temporarily requiring additional specialist support.

In some cases key physical facilities for experimentation (M3) are needed to support the discovery process. In other cases permission to experiment, and time and funding to do it may be sufficient. Pattern recognition competencies (M4) help to ensure we are not re-inventing the wheel. People who are good innovators recognize patterns and combinations that others might miss. They might recognize an opportunity for a technology enhancement or they might recognize a market trend or a supply chain opportunity. A platform of excellence (M5) starts with talented people who can work together effectively. There is evidence that ordinary teams deliver ordinary results. Just having available talent and an adequate number of people is not sufficient. Under appropriate circumstances relating to accessible inputs, leadership controls and interpersonal mechanisms, extra-ordinary teams can consistently produce extra-ordinary results. This is particularly so in the discovery and action phases of innovation, and whilst different teams may be required for each of these phases, they must be able to interact effectively. Finally imagination is required, not only to conceive a potential innovation, but to consider its development and application. One needs to consider the possibilities and the impact of change following its introduction, and to do this well an organization needs scenario development competencies (M6). Introducing an innovative product that simply wipes out an existing product range may not in the long run be beneficial to a firm. One way of dealing with this is to imagine

and investigate a range of scenarios.

#### 4.6 Stage-gates

It is argued that the discovery process alone does not yield an innovation, but provides possibilities. Some candidate innovations (Gate 1) may lay dormant for years until a complementary technology emerges, or some way of combining it with other attributes such as a market application is identified. Also for an innovation to be enduring it should have a combination of attributes (Gate 2) that are hard to duplicate, either via some unique combination of technologies, or some unique supply chain initiative, or a combination of the two. Just having a new technology or a patent may not be sufficient if it cannot be brought effectively into exclusive use, or if it can be readily imitated.

## 6. Stimulating action

Assessing the innovation capacity of an enterprise is one thing, but stimulating action is another. An assessment may highlight areas for improvement in an enterprises' innovation capability, but if no action is taken, then the assessment has been of little value. The actions that are appropriate for a particular enterprise will be dependent on characteristics like size, the nature of the enterprises' market, and its ability to free resources to make changes. One size does not fit all. It is our observation that there are two distinct aspects of the innovation process. **What** is done and what factors have an influence (e.g. as presented in Figure 3) is consistent over all circumstances. However, **how** it is done is highly situation dependent, for example, the circumstances of an entrepreneurial start-up company will be different from those of an established multi-national company. In addition, strategic choices like the selection of incremental or radical innovation practices and the focus of innovation activities will influence the techniques applied within each of the primary activities within our model.

Innovation is often thought of as a step change in product attributes or operational practice; however it is not uncommon for this to be achieved via a succession of incremental innovations. From our research we have observed some different types of incremental innovation, as shown in the table 1, and in this context we need to assess which type of innovation best suits the organization under analysis. The discussion of what current organization practices might be stopped, what practices should be continued, and what new practices might be established is instructive using table 1 as a framework. What product, technology and market changes are sought and what are the implications of these circumstances. We have observed that some particular types of innovation best suit organizational norms and strategic needs, influencing who should be involved in a particular innovation and how it's progress should be best managed (e.g. from within current operations or in parallel)

Using the frameworks presented in Figures 1 and 2 and Table I together, we have been able to explore strengths and weaknesses in a firm's innovation process, areas where innovation is focused, and implementation norms (incremental / radical). We will now discuss the application of this approach in a case study firm.

	<b>Stopped</b>	<b>Go on with</b>	<b>New</b>
<b>Parametric</b>	Nothing	All	Minimal change to produce new product or service
<b>Developmental</b>	Nothing except things that do not work any longer	All	New product, same process & organizational frame
<b>Adaptive</b>	Sub-optimisation, stop under-utilization	Optimization existing routines; better utilization of competencies, incremental innovation of technology	New generic products
<b>Strategic</b>	Stop with existing technology (is technological Discontinuous, with 'architectural aspects',	Same market. Same organizational competencies	New users, new process- and product qualities. New methods, new definitions and new actors
<b>Transformative</b>	Stop with nearly all existing activities (markets, products, processes, organizational infrastructure)	No existing activities	New markets, new products, new processes, new technology, new organizing process

*Table 1 Innovation Types (Smid, G and Beckett, R. [19])*

## 7. A case study

### 7.1 The Company

The case study Enterprise is Austool ([www.austool.com.au](http://www.austool.com.au)), a privately owned collaborative venture established to provide an "Australian Centre for Toolmaking Innovation". Toolmaking companies in Australia are quite small, and a number of them recognized that they would have to collaborate in a variety of ways to compete in an international market place. Their business environment is very competitive. Many choose to stay small to be able to operate with minimal overhead costs. So how is Austool innovative itself, and how does it support innovation in a stakeholder group that is difficult to engage with?

### 7.2 An innovation review

Using the representation of innovation presented in Figures 1 and 2, we start an assessment by identifying where the focus of current innovation maps on our innovation landscape, then explore the innovation process at work by asking some key questions. 1. What exploration and discovery activities are currently in place, and is there an adequate flow of prospective innovations? 2. Is someone responsible for managing a portfolio of prospective innovations? 3. Are prospective innovations matched with a unique combination of market delivery attributes? 4. Is someone responsible for managing a portfolio of investments in innovations proceeding to market? 5. How are these investment projects managed to deliver value? And finally is the innovation process creating new intellectual property and enhancing market position, providing a springboard for subsequent innovations? Depending on the answer to a particular question, further questions are asked to assess potential deficiencies in an activity and the possible source of any deficiency; is it in an input or output, or in a control or mechanism?

Austool is an organization with minimal financial resources, and operates more like a networked virtual enterprise than a traditional organization. Its focus is on technology diffusion, and its initial innovation focus has been on engaging with the external environment; identified as positioning innovation in Figure 1. It has also sought to operate under an innovative business model (internal innovation in Figure 1) where suppliers of technology set up a “trade show” of the latest equipment in Austool’s premises, and this equipment is used for advanced apprentice training. It is establishing four internal functions: tool design support, tool manufacture support, education & training support, and a knowledge broking function.

The processes used in discovering possibilities and exploring options are personal networking, demonstration projects, technical problem solving, technology roadmapping, and collaborative R&D. A significant portfolio of options flowing from these activities was observed, but the process for managing the portfolio was not well established. Action was stimulated by external deadlines, such as the opportunity to apply for government funding.

The processes for choosing combinations of capability and market needs that make business sense to both Austool and its stakeholders involve facilitating product commercialization with the clients of toolmakers, drafting industry capability development project proposals, matching member complementary capabilities to tackle projects beyond their individual scope, the establishment of a tool design virtual enterprise, and the establishment of a tool manufacture virtual enterprise. The current investment portfolio is focused on the management of a number of government grants that facilitate technology diffusion, and there are clear responsibilities identified for the management of this funding.

Action to deliver value is through member projects and running industry workshops and other events. Design and production problem-solving services are in the process of being established, and plans for stimulating industry competency development are still being refined in conjunction with a number of educational organizations. Austool’s innovation program aims to continuously improve the market positioning of its members in particular and the Australian toolmaking industry in general. In the process Austool will develop and gain access to Intellectual Property

of various sorts that can be the basis of subsequent developments. The measures of success currently being employed are membership development, linkages established, templates available and effectiveness of the knowledge broking function in linking members with sources of knowledge new to them.

### **7.3 Some suggested actions**

Austool has a fair idea of what it wants to do, and is utilizing a number of processes to achieve the outcomes sought. At the time of the review, the focus on innovation made operations a little chaotic, and more convergent thinking business processes need to be put in place to improve its ability to deliver value. The Austool Board is aware of this, and is active in organizational development. Austool must be regarded as successful at this time as it is attracting increasing membership, and is continuing to win competitive government grants. In terms of figure 1 of this paper, Austool needs to retain its emphasis on positioning innovation, increase its efforts relating to internal innovation, and start developing innovative ways of delivering technology diffusion services i.e. enhanced product innovation. In terms of Figures 2 and 3, Austool needs to refine its value delivery activities. From inspection of Figure 3, this would imply considering conditions relating to incentives, culture and environment and opportunity access. Access to different kinds of resources, a platform of excellence, and change implementation competencies are inferred mechanisms to consider.

Turning now to Table 1: what should Austool stop doing, what should it keep doing, and what should it start doing? In the preceding paragraph some of these activities were outlined. We suggest that the answer is different for each focus area. In the positioning innovation area, we consider there is scope for adaptive innovation. In the internal innovation area, we suggest there is also scope for adaptive innovation. In the customer innovation area however, we suggest a non-traditional approach to stakeholder engagement is needed, implying the need for strategic innovation. We make this latter recommendation because Austool is attracting membership not only from toolmaking firms, but also from toolmaking client firms, technology providers and educational providers. In this circumstance, Table 1 suggests that Austool needs to start with new users, new process and product qualities, new methods, new definitions and new actors. At the time of writing, we have observed some movement in this strategic direction.

## **8. Discussion**

We have presented several concepts that are visualized in three diagrams that help us to map the focus of innovation and the nature of innovation processes at work within an enterprise. We have presented one table that helps us examine the kinds of innovation and implied actions that may be adopted within an enterprise. Applying this to a case study company whose charter includes the pursuit of innovation reveals substantial complexity, but we have observed the three premises that Ulrich [3] associates with innovative enterprises: innovation matters, innovation is multifaceted, and innovation is a culture, not just an event. The approach presented here helps us unravel the multiple facets of innovation within a particular enterprise; where innovation is focused, what processes are utilized and how effective they might be. Our experience in using this approach in other enterprises also frequently compares the current innovation focus areas with those needed to achieve the enterprise strategic outcomes. For example one enterprise had

been innovative in physical asset management, but sought to grow through developing new products and entering new markets. This meant that different innovation processes were needed to explore possibilities.

We have found that our case study enterprises relate quickly and easily to figures 1 and 2, but that Figure 3 and Table 1 are considered to be too complex. For us however, they provide the real basis for suggesting future actions. As such we have concentrated on figures 1 and 2 with clients and using Figure 3 for our analysis.

At a recent industry oriented conference, Du Plessis [20] highlighted the need for all employees to have a common understanding of what innovation is if it is to be embraced across all organizational functions. We are finding that Figure 2 provides a model that will work equally well in describing shop floor initiatives like lean manufacturing as it does in describing initiatives at the enterprise strategic planning level. In a similar way, this model can be used recursively within each activity. For example if the process of exploration and discovery in the context of product innovation is R&D, then that process itself involves exploring possibilities, choosing combinations of things for experimentation, and delivering value from field trials. So this model provides a common language for thinking about innovation in a number of different contexts.

The model starts with divergent thinking being dominant in the “exploration and discovery” phase and finishes with convergent thinking being dominant in acting to deliver value. From this point of view, we have found it helpful to describe the transition through a number of different “worlds”. We project exploration and discovery as the world of the researcher involving researcher plus technology investment. In this world we explore a variety of possibilities, maintain an alternative concepts portfolio, choose practical possibilities, maintain a technology development portfolio, demonstrate technology application, leading to an investment options portfolio that provides a landscape of opportunities. We project the “choose combinations” phase as the world of the venture capitalist – covering both pre-seed and seed funding investment phases. Here we explore investment opportunities, maintain a portfolio of candidate investments for investigation, manage an assessment process (e.g. Bell-Mason [21]), maintain a portfolio of business case scenarios, negotiate partnerships, start up ventures and maintain an investment portfolio with strategic mix to cope with the risk of some investments failing. We project the “acting to deliver value phase as the world of the entrepreneur – a further venture investment and sustainable business development phase where we explore lead user opportunities, maintain market development and production options, choose a growth strategy, maintain infrastructure investment options, establish logistics and refine delivery processes, and finally leverage our market position, identify an exit strategy and next opportunity.

## **9. Concluding remarks**

The applied research reflected in this paper had its origins in addressing real industry issues. Announcing that an enterprise will embrace innovation and appointing an Innovation Manager is helpful but not sufficient. Stimulating a flood of innovative ideas is helpful, but pursuing them all is commonly beyond the capacity of any enterprise. Filtering out the best ones is helpful, but by definition, innovation is something different, and introducing change can be disruptive. Changing an enterprise process or product can be helpful, but it must deliver value of itself, and provide a platform for subsequent innovations to be a powerful driver. By simply postulating that if there is such a thing as a process of innovation, and that we can map it using systems engineering tools, we have been able to evolve a model that helps us deal with all of these issues.

Our initial research found that most studies of innovation centred on new product or process development. But some enterprises do not have their own products, and there are many examples of innovative initiatives, such as Amazon.com that utilizes existing products and technologies. We were building models that will represent these circumstances too.

In our application of the figures and table presented in this paper we have been able to help understand and enhance the innovation practices of a number of quite different enterprises undertaking different kinds of innovation. Curiously, we have found that all of the enterprises that have chosen to work with us are already innovative in some way to start with, but want do better or innovate in a different context. We have not discussed the issue of leadership here (we have considered this in other papers), but we have formed the view that if the leaders of an enterprise do not understand what innovation involves, there will be little innovation, despite any rhetoric to the contrary. We suggest that if enterprise leaders do understand what is involved, but do not introduce a business system to manage innovation, then it will not be sustained. There are early indications that the approach presented in this paper provides such a sustainable business system. However for a business process to be valued it must deliver results that are clearly evident from measures of success associated with. This is also a substantial topic that has not been discussed here, but there is currently a trend [22] towards having formal processes to put a monetary value on each of the kinds of portfolios represented in this model and using this as a way of tracking value creation.

## 10. References

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