An entrepreneurial decision process model describing opportunity recognition

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Abstract
Purpose – The purpose of this paper is to expand upon existing theories of entrepreneurial cognitions. It constructs an information-processing framework of entrepreneurship (I-P^e) that holistically maps out the entrepreneurial opportunity recognition process. This framework demonstrates how various entrepreneurial needs and attitudes, as well as entrepreneurial motivators, impact on the diagnosis and assessment of informational cues. It describes how opportunity-related information is processed by entrepreneurs in order to reach a decision of acceptance or rejection of potential business opportunities.

Design/methodology/approach – The paper commences with a case study of New Zealand’s winner of the Entrepreneur of the Year Award, Bill Day and his company Seaworks, a marine contracting firm. The case content is based on personal interviews by the authors as well as secondary data. The case describes how Seaworks achieved its current level of success. A number of Bill Day’s uniquely entrepreneurial behaviours are then mapped into a cognitive framework describing influential elements of the entrepreneurial decision processes. This framework is derived from interdisciplinary research encompassing the study of entrepreneurship, psychology and cognitive neuroscience.

Findings – Entrepreneurs have a heightened ability and awareness for recognising and audaciously exploiting business opportunities. They persistently and continually seek opportunity-laden information in order to satisfy internal motivators such as need for achievement and the fulfilment of competitive urges. The case study describes an entrepreneurial mind that is attracted and stimulated by elements of excitement and fun. This entrepreneur is driven by business challenges that match and stretch his skills, knowledge, and abilities. Business related informational cues are sought and processed to calculate profit potential, the level of risk, and the cost of enactment. Final calculations are filtered. Benefits and potentially positive outcomes are amplified in the calculation process, while potential complications are regarded as challenges to be overcome rather than obstacles to be avoided.

Practical implications – The I-P^e framework derived from this research clearly demonstrates uniquely entrepreneurial decision processes. It advances our understanding of entrepreneurial cognitions and entrepreneurial decision behaviours, which has applications for the teaching of business skills as well as increasing our understanding of the phenomenon that has been termed “entrepreneurship”.

Originality/value – This paper is based on an original case study written by the authors and integrates cognitive theory within the context of entrepreneurial behaviour in order to explain why entrepreneurs are so successful at recognising and exploiting opportunities.

Keywords Entrepreneurialism, Entrepreneurs, Decision making, Cognition, Psychology

Paper type Case study
Introduction
This discourse expands on the theory of entrepreneurial cognitions proposed by researchers such as McGrath *et al.* (1992) and Baron (1998). Entrepreneurial cognitive processes will be examined from an information-processing (I-P) approach. The subsequent entrepreneur-specific I-P model provides new insights into entrepreneurial decision-making and has numerous practical applications for understanding and teaching the psychological phenomenon that has been termed entrepreneurship, particularly the opportunity recognition process.

The following will focus on entrepreneurial cognitions, particularly addressing how and why entrepreneurs, as compared to the general population, demonstrate stronger opportunity recognition and opportunity exploitation behaviours, as well as more robust problem solving behaviours. Sexton and Bowman-Upton (1991, p. 18) ask whether entrepreneurs are different from other business owners and corporate managers. They answer with both a yes and a no response. They claim that entrepreneurs are different in their attitudes toward opportunities and resources when compared with non growth-oriented small business managers and bureaucrats, but also make the claim that they are no different from those who seek growth and changes in government, non-profit and profit sectors, and other walks of life. In this respect, a greater understanding of entrepreneurial decision processes could potentially benefit anyone concerned with the study of individuals who drive and sustain growth and change.

Method
This research provides the basis for constructing an I-P framework describing entrepreneurial decision processes that are specifically related to the act of opportunity recognition. The framework is constructed from interviews with Bill Day by the authors as well as secondary data gleaned from a variety of sources including published articles and news media releases. The subsequent I-P framework is constructed from existing literature and research largely supportive of the psychological school of entrepreneurial behaviour.

Background
Bill Day was the winner of the 2000 Ernst and Young Entrepreneur of the Year Award in New Zealand, and was one of the judging panel for the Ernst and Young World Entrepreneur of the Year Award in 2002 (NBR, 2002). He is the owner of Seaworks, a New Zealand-based marine contracting firm employing 130 staff. Seaworks offers a diverse range of services including ocean salvage, cable laying, and innovative solutions for assisting deep sea oil exploration and maintenance.

Bill was once asked to help a researcher with her study on attitudes toward failure. His response was the following:

I think that this is the first time someone has wanted to speak with me about my expertise in failing. Many a man would be insulted but over the years I have learned to happily wallow in my incompetence. You will be pleased to know that it is not just business that I fail in. I did a year as a social worker and most of my clients either killed themselves or went to jail leaving me with a pleasantly light case load but the undeniable knowledge that I was a failure as a social worker. My looks have constantly branded me a failure in the search for women’s hearts and I spent many years getting used to constant rejection until I finally found a partner.
with a serious optical deficiency. In recent years I have managed not to find the wreck of the General Grant [thought to contain gold bullion] despite devoting three summers of my life to it. This year you will be delighted to hear that I crashed a helicopter.

I can undoubtedly assist you in your study of failure but you may need to chase down another role model for the success side of the equation. If, after all this, you are foolish enough to still want to talk with me then I am sure that I can find the time between appointments with Accident and Emergency and the Official Assignee (personal communication, 2004a).

The above quote encapsulates the entrepreneurial spirit that researchers have come to recognise. It demonstrates humour in the face of adversity, and indicates a sense of robustness, an ability to bounce back from failure. It also suggests that Bill Day’s psychological characteristics and subsequent decision behaviours play an important part in his business success.

Entrepreneurial cognitive processes and culture
Research by Mitchell et al. (2002a) has demonstrated that entrepreneurs, compared to non-entrepreneurs, have distinct cognitions. In addition, there appears to be a common universal culture of entrepreneurship. These findings are specifically relevant to the cognitive processes of entrepreneurs. As Mitchell et al. suggest, this knowledge can lead to the design of training and education for would-be entrepreneurs, and it can influence policy designed to encourage entrepreneurial behaviour. Such research may even influence non-entrepreneurs in their decision processes, so that they can become more entrepreneurial in their decision behaviours. Mitchell et al.’s findings suggest specifically that:

- there are similarities in venture-creation decisions across cultures; and
- entrepreneurs seek and diagnose opportunities and then access required resources needed to exploit that opportunity.

Wright et al. (2000) describe entrepreneurial cognitions as the more extensive use of heuristics (ways of enhancing the discovery of information) and individual beliefs that impact on decision-making. This contrasts with the more systematic and structurally coordinated managerial decision-making. According to these authors, entrepreneurial cognition is differentiated from managerial cognition through the predominance of strategic decision-making that is influenced by individual heuristics. With his/her ability and motivation to seek and recognise opportunities (Krueger and Brazeal, 1994), authors such as Shane and Venkataraman (2000) have argued that the individual entrepreneur is crucial to the success of the venture. Yet, as pointed out by Mitchell et al. (2002b), attempts to isolate psychological or demographic characteristics that are common or unique to all entrepreneurs, have generally met with failure.

The search for universal entrepreneurial characteristics may have been misleading in its endeavours. It is argued that the identification of common decision processes and behaviours is more important than the classification of common demographics and psychographics in trying to better understand the phenomenon of entrepreneurship.

Information-processing
Much of the information that arrives at the senses is never perceived, in that we are not consciously aware of everything at any one time. In order to understand and explain
behaviours and how people structure their decisions, psychologists have developed a number of frameworks and paradigms. Gross (1996) explains that I-P is the dominant paradigm within cognitive psychology. In this paradigm it is believed that cognition involves only a few basic cognitive processes such as recognition, categorisation, and association, and that information flows can be modelled using a common language.

According to Matlin (2002, p. 10), two important components of the I-P approach are:

1. that a mental process can best be understood by comparing it with the operations of a computer; and
2. a mental process can be interpreted as information progressing through the system in a series of stages, one step at a time.

Some authors disagree with this approach. For example, Flanagan (1992, p. 5) appears to ridicule cognitive psychologists and I-P theories because he claims that they attempt to describe the workings of the mind while paying little significant attention to consciousness. One particular group he terms young connectionist upstarts. Searle (1995, pp. 150-1) relates the following points which underline some of the more philosophically-oriented arguments which are seen to complicate the pursuit of improved understanding of the mind’s architecture through the use of models of an I-P nature:

- Human beings have a variety of interconnected ways of accessing and representing features of the world to themselves. These include perceptions, thoughts, language, beliefs, desires, pictures, maps and diagrams.
- Some of the representations that people hold, such as beliefs and statements, purport to be about how things are in reality. To the extent that they succeed or fail, they are said to be true or false, respectively.
- Systems of representation, such as vocabularies and conceptual schemes, are human creations, and to that extent arbitrary. It is possible to have any number of such systems for representing the same reality.
- Actual human efforts to get “true” representations of reality are influenced by a variety of cultural, economic and psychological factors. Complete epistemic objectivity is difficult, sometimes impossible, because actual investigations are always from a particular point of view, motivated by all sorts of personal factors, and acted within a certain culture and historical context.
- Having knowledge consists of having “true” representations for which we can give certain sorts of justification or evidence. Knowledge is thus by definition objective in the epistemic sense, because the criteria for knowledge are not arbitrary and are impersonal.

Both Flanagan and Searle raise complex questions concerning what is reality and how it is best represented and articulated from a cognitive perspective. However, Matlin (2002) argues that the I-P approach has been enormously influential in persuading research psychologists to adopt the cognitive psychologist’s perspective. Wickens and Flach (1988) argue that the I-P paradigm has contributed both knowledge and tools relevant for understanding human performance. Although I-P models have their detractors, it is argued that they advance our understanding of the workings of the
mind beyond simple demographic descriptions and behavioural observations. For example, Pech (2003) utilises an I-P model to describe the cognitive architecture of army officers within a leadership context. This model has demonstrated that the phenomenon of leadership cannot be portrayed in a simple diagram that plots a position on a bipolar scale. Similarly, the entrepreneurial act cannot be adequately encapsulated in lists of common behaviours and characteristics.

The following I-P framework attempts to simulate an element of biological plausibility by mapping major decision factors and their patterns of connectivity. Such models have evolved beyond the computer metaphor so derided by Flanagan. They now attempt to represent what the neural system knows and how it will respond to inputs and transactions associated with that particular knowledge. The following discourse will attempt to advance such I-P models further by including attitudes and motivations within an entrepreneurial context. The model will focus specifically on executive cognitive decision functions related to entrepreneurial behaviours, as opposed to attempting to describe micro-level decision processes.

Case study
The following provides a very brief glimpse into the achievements and decision behaviours of entrepreneur Bill Day and his marine-based operations. The subsequent entrepreneurial I-P model is based on more comprehensive data than has been provided here:

Don't look for a job son, look for a customer (Bill Day).

Although the 1986 sinking of the large Russian cruise ship, Mikhail Lermontov, in the Marlborough Sounds of New Zealand was a disaster for the cruise shipping industry, it presented an enormous opportunity for two business partners, Malcolm Blair and Bill Day. These two young diving and salvage partners had several years earlier purchased and refitted what Bill has called “the world’s ugliest boat” (Knight in Gilbertson and Gilbertson, 1995, p. 101), or the Little Mermaid as she was officially called. Malcolm and Bill’s business, Divers World, became the main subcontractor for the Mikhail Lermontov salvage operation, with the Little Mermaid, previously the laughing stock of the diving community due to its lack of aesthetic appeal, providing the salvage platform for the operation. This initial foray into large-scale salvage also provided the partners with a financial and experiential platform for far greater operations.

With the Little Mermaid as a recognised salvage platform and the experience gleaned from the Lermontov operation, the partners now had a significant barrier to entry for potential competitors. No one else in New Zealand had the combination of a recompression chamber, air diving equipment using hoses, and lifting and cutting equipment, all sourced from the same boat. The partnership split amicably at this stage with Malcolm focusing his energy on the successful Divers World company, which catered more for the needs of the enthusiast diver. Bill and the newly named company Seaworks subsequently purchased three ships, each with its own specialisation. One, named Seasurveyor, a 30 m monohull, was purchased speculatively to solve a problem with the transfer of oil from production storage in the Maui oil field off the west coast of New Zealand, to waiting tankers struggling with the extreme weather conditions. Bill argues that:
I bought Seasurveyor before Shell Todd was convinced it was the best boat and we were the best company to do the job. It was a punt (Light, 1998, p. 20).

According to Bill Day, the ship Seaworker was also designed and purchased on a punt in response to a tender from the New Zealand company Transpower to make a robotic survey of its underwater cables. Bill invested $500,000 in the design and construction of the vessel before the contract was signed (Light, 1998, p. 22). While Seaworker has performed beyond all expectations with its high technology gadgetry, a much lower tech and smaller vessel, named Seawatch, provided cheap and innovative solutions for its clients. Seaworks attempts to meet all of its client commitments using a similar low cost and innovation-intensive philosophy. According to Bill, entrepreneurs must “have the skill and confidence to employ people who are better than them … most of Seaworks’ people have skills which far exceed mine” (Light, 1998, p. 24). This combination of employing highly skilled staff, recognising and exploiting opportunities, and the need for delivering innovative solutions, provides Seaworks, a relatively small player, with serious competitive advantage on the greater international marine contracting business “seascape”. Seaworker, its contract with Transpower completed, now subcontracts for a Saudi Arabian pipeline-laying firm. With its relatively small size and robotics technology, Seaworker can go into shallow areas where larger contractors are unable to operate. Shutting down of flare towers on oil rigs during maintenance periods costs millions of dollars per day. Bill claims that with his vessels and technology, Seaworks is able to function around the drilling rigs without the need to shut down the flare towers (personal communication, 2004b). Seaworks has expanded further into underwater robotics by purchasing a robotics manufacturing company that can design and build innovative robotic vessels specifically for Seaworks’ requirements.

Bill Day has deliberately chosen a number of strategic thrusts and operational tactics to ensure that Seaworks continues to prosper and grow. He credits Seaworks’ success to the difficult decision he had to make some years ago to sacrifice the things he loved most about his work: diving and skippering. He knew that he had to develop new skills if the business was to grow. He had to stand back from the operational functions in order to learn the more abstract conceptual skills required for managing the growing business. This meant focusing on the bigger picture, that of seeking innovative solutions to the problems faced by potential clients (personal communication, 2004b).

He quickly established teams of competent employees, delegated authority to make operational decisions, and established a culture that reflected a relaxed management style. He relates the example of the purchase of one of his ships from the United Kingdom. The ship had two messes to separate the officers from the crew. In a ceremonial “flourish” with his employees looking on, Bill started up his chainsaw and cut through the dividing wall between the messes (after carefully but unobtrusively checking for electrical cables and other obstructions) so that everyone was able to eat and relax together (personal communication, 2004b). Such symbolic gestures help to reinforce a culture reflecting united egalitarianism and devolved decision-making.

Seaworks tries to attract the best people by paying above award salaries. Bonuses can exceed NZ$100,000 per year. Bill claims that his staff are important not only to the integrity of the company but also to him. Recently one of Bill’s staff was diagnosed with high blood pressure. To counter the problem they now both go power-walking around Wellington Harbour every lunch break.
Bill spends much of his time knocking on doors in locations such as Singapore and Saudi Arabia to generate work for his company. The majority of Seaworks’ business has moved away from New Zealand. This means that the daily operational decisions are left to his trusted colleagues, as Bill prefers to think of them. He encourages staff to solve problems rather than waiting for him to make the decisions. Bill claims that he copes with the challenge of running such a company by using humour, being optimistic, and by not thinking too much about the problems. When confronted with a major obstacle he asks himself whether he did everything that was possible. If the answer is yes, he concludes that there is nothing more he can do, so there is no point in worrying about it:

Failures don’t paralyse me with fear; we have a can-do culture (Light, 1998, p. 23).

Growth and success have led to increasing diversity of projects, growing employee numbers, and more dispersal of vessels and staff around the globe. This has demanded the introduction of a variety of systems, policies, and embedded procedures. Bill fears that every new system may result in loss of innovation. This has presented Bill with one of his greatest challenges, the encouragement of growth, while maintaining a culture of continuing innovation.

Bill’s current managerial style is markedly different from the approach that was adopted at the start of the business. At the outset, the focus was on technical skills and a shotgun approach to attract work contracts. He concentrated on opportunity recognition, seeing value where others saw none, and on motivating his employees when faced with adversity. Bill admits that this early manner of doing business meant that he may have been poor at processing the downside of risk. He was happy to commit his resources on a hunch rather than on detailed information. However, he emphasises that he always saw the greater goal on the distant horizon with complete clarity. Although Bill’s can-do approach may appear lacking in meticulous project analysis, perhaps even smacking of audacious risk-taking, the company has only found itself in strife twice. On each of those occasions the project had increased in scope beyond the original project specifications.

With the increasing technological complexity of the ocean contracting industry, Bill claims that his employees have more advanced technical skills than he ever had. He now adopts more of a sniper approach for attracting further work by focusing narrowly on the company’s specific areas of competitive strength. But he does admit that sometimes projects have been accepted simply because he hates the thought of a rival firm taking the work. He has a highly competitive streak that drives him to seek out new and challenging projects. Having delegated operational issues, Bill has more time to focus on strategic issues and to ensure that Seaworks learns from the growing accumulation of experience. For him the elements of fun and excitement have not been lost through the company’s growth process:

If it’s not fun, we won’t do it (personal communication, 2004b).

For example, in 2003 the company bid for a lighthouse servicing contract in New Zealand, “not because it was lucrative or even part of our core capability, but because we decided that it would be fun flying around the country in a helicopter” (personal communication, 2004b).
An entrepreneurial cognitive and decision process model

Wright et al. (2000, p. 592) argue that entrepreneurial cognition refers to the more extensive use by entrepreneurs of heuristics and individual beliefs that impact on decision-making. These authors contrast this with managerial cognition, which they claim refers to more systematic decision-making. They also claim that entrepreneurs’ strategic decisions are significantly influenced by their individual beliefs and values, and that this may provide an insight into their successful decision-making.

Hodgkinson et al. (1999) also refer to the use of heuristics, within the context of strategic decision-making, and how these are utilised in an attempt to make the world manageable when dealing with the dynamics of business complexity. Franzoi (1996, p. 117) defines heuristics as timesaving mental shortcuts that reduce complex judgements to simple rules of thumb. Franzoi cites the research of Pratkanis (1989) concerning conditions under which people are more likely to use heuristics rather than engaging in a more systematic analysis. These conditions include:

- when there is no time to engage in lengthy analytical processes;
- when there is information overload;
- when the issue is considered not to be very important;
- when there is little information available for making a decision; and
- when something about the situation calls to mind a given heuristic, thus making it cognitively available.

Matlin (2002, p. 370) argues that people are more likely to use heuristics than algorithms when solving problems. People do not normally use an exhaustive (algorithmic) search when they can resort to a quicker rule of thumb. But, on reviewing Pratkanis’ conditions above for using heuristics, it would be dangerous to make an assumption that entrepreneurial decision-making can be explained predominantly through the use of heuristics. While incorporating heuristics, a more absolute explanation must be found. For example, in relation to pilots, Wickens and Flach (1988) assert that, although decision-making is critical to air safety, pilot decision-making has received only a minimum degree of research interest. Stubbart (1989, p. 326) makes a similar observation about managers and the importance of their decision processes, “yet it [managerial cognition] is seldom explicitly mentioned in the academic literature”. It appears that there is a dearth of practical, non-laboratory, and illuminating research concerning decision processes.

Figure 1 attempts to describe what Wickens and Flach (1988) call the three general characteristics that define the decision-making task. This is an extremely simplistic illustration of the I-P factors influencing decision-making, which unfortunately gives no clue as to the differentiation between unique decision processes of an entrepreneur and the decision processes used by the “rest of the world”. Missing from this model are the influencing factors of emotion, biases and heuristics. However, for the sake of simplicity Figure 1 provides an initial architecture upon which entrepreneurial decision processes can be overlaid. From the case, it is obvious that Bill Day exhibits a number of more complex decision elements in his decision behaviour. For example, the “fun” element is considered to be important, and the issue of overcoming a “challenge” is a driving factor. The need for “innovation” is also a recurring element. Without a culture of innovation the Seaworks team would have been unable to tackle a large
number of projects. The impact of “flexibility” is considered crucial for growth of the business. Another factor to be considered is lack of resources acting as a spur to improvisation and creation of simpler, cheaper alternatives.

To this end, a more comprehensive I-P model is needed to frame the entrepreneur’s cognitive behaviours. In order to provide a biologically plausible representation, such a model must incorporate Wickens and Flach’s (1988) general decision-making characteristics, as well as heuristics and emotive and attitudinal factors. Cunningham and Lischeron (1991, p. 47) in their summary of approaches for defining entrepreneurship, highlight the emotive and attitudinal factors representing entrepreneurial behaviour, including:

- unique values and characteristics such as risk taking and need-achievement (the Psychological School of Thought);
- opportunity and innovation orientation (the Classical School of Thought);
Further psychological mechanisms and elements that differentiate the entrepreneur may include know-how, memory and filtering devices, intelligence, and perhaps even enjoyment levels. Pressley and McCormick (1995, p. 80) point out that much of thinking is *knowing how*, termed procedural knowledge, and using such knowledge appropriately. Without the know-how an entrepreneur would not achieve a great deal. Cognitive psychologist Andy Clark states this “eloquently” when he writes:

…[W]here real intelligence is concerned, it ain’t what you know, it’s the way you know it (Clark, 1989, p. 30).

Decisions are often filtered through attitudes, beliefs and values. Filtering of information that conflicts with preconceptions may result in poor risk assessment or an inflated assessment of one’s personal capability, leading to poor decision-making outcomes (Pech and Durden, 2003).

According to Sternberg and Lubart (1995), essential attributes for creative people who find novel solutions include intelligence, knowledge, motivation, an encouraging environment, an appropriate thinking style, and a suitable personality. Research by Amabile (1997) has demonstrated that intrinsic motivation is a crucial element for creative behaviour. Such intrinsic motivation can be characterised by being interested, excited, and personally challenged by a work task. Amabile contrasts this with extrinsic motivation, which operates on the basis of the promise of rewards, dictates from superiors, or striving to win a competition. These findings on creative behaviour can also be attributed to the entrepreneurial personality. Walton (2003) discusses the significance of creativity in an entrepreneurial context highlighting the need for a number of interpersonal factors such as motivation and access to information. These elements and psychological mechanisms should all be included when attempting to represent an entrepreneurial I-P architecture. Intelligent cognition requires the activation of perception, memory, attention, motivation and learning (Christ, 1991), none of which can be studied in isolation.

Figure 2 attempts to represent entrepreneurial I-P based on the psychological mechanisms, decision cues, characteristics, attributes, and emotive and attitudinal factors of an entrepreneur such as Bill Day. This I-P® (entrepreneurial I-P) architecture is not an attempt to either test or prove the superiority of one cognitive theory over another. This application of cognitive theory is simply a means to an end, which in this instance is an attempt to identify more clearly uniquely entrepreneurial decision influencers and processes.

The framework shown in Figure 2 is based upon the premise that a significant percentage of deliberate and intentional cognitive processes can be understood and explained and that a significant proportion of human behaviour is planned, premeditated and purposive. It is assumed that ad hoc behaviour (which may be more difficult to perceive and explain) represents a real, but less significant, proportion of total desirable entrepreneurial behaviour. This perspective is in direct contrast with Bolger’s assertion that most of life is ad hoc (Bolger cited in Hooker, 1993, p. 24) and Kosko’s argument that we have only one decision rule:

I’ll do it if it feels right (Kosko, 1994, p. 17).
An entrepreneurial information-processing (I-P) architecture mapping information and decision processes

**Figure 2.**

- **Informational cues**
  - Opportunity seeking leads to identification of further informational cues

- **Basis for choosing an appropriate action**
  - Evaluation of several sources of information to assess the situation or understand a potential opportunity

- **Probabilistic nature of the information**
  - Cues used for decision making may be unreliable or uncertain, therefore introducing an element often described as ‘good luck’

- **Emotive & attitudinal filter & amplifier comprises**
  - Enthusiasm
  - Audacity
  - Fun
  - Determination
  - ‘Gut’ instinct & intuition
  - Confidence—can-do
  - Emotional intelligence
  - Creativity & innovation

- **Intrinsic motivational filter & amplifier driven by need for**
  - Leadership
  - Opportunity orientation
  - Achievement
  - Challenge
  - Success
  - Fun
  - Excitement & stimulation
  - Competing & winning

- **Decision & diagnostic rules**
  - Profitability
  - Feasibility
  - Health & safety & practical details
  - Project size
  - Competitiveness
  - Prior experience and skills
  - Acceptable risk
  - Time and scope
  - Resources (have, get, or make)

- **Opportunity assessment and opportunity diagnosis**
  - Heuristics
  - Technical and business skills
  - Procedural knowledge & intelligence
  - Logic and reason with innovation
  - Involvement from external sources
  - Cost benefit analysis
  - Risk assessment

- **Success leads to reinforcement and strengthening of connections, stimulating repeat behaviours. Failure may lead to avoidance behaviours**

- **Choice**

- **DECIDE & ACT**

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**Notes:**

1. **Basis for choosing an appropriate action**
   - Evaluation of several sources of information to assess the situation or understand a potential opportunity

2. **Probabilistic nature of the information**
   - Cues used for decision making may be unreliable or uncertain, therefore introducing an element often described as ‘good luck’

3. **Emotive & attitudinal filter & amplifier comprises**
   - Enthusiasm
   - Audacity
   - Fun
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   - ‘Gut’ instinct & intuition
   - Confidence—can-do
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   - Creativity & innovation

4. **Intrinsic motivational filter & amplifier driven by need for**
   - Leadership
   - Opportunity orientation
   - Achievement
   - Challenge
   - Success
   - Fun
   - Excitement & stimulation
   - Competing & winning

5. **Decision & diagnostic rules**
   - Profitability
   - Feasibility
   - Health & safety & practical details
   - Project size
   - Competitiveness
   - Prior experience and skills
   - Acceptable risk
   - Time and scope
   - Resources (have, get, or make)

6. **Opportunity assessment and opportunity diagnosis**
   - Heuristics
   - Technical and business skills
   - Procedural knowledge & intelligence
   - Logic and reason with innovation
   - Involvement from external sources
   - Cost benefit analysis
   - Risk assessment

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**Decision process model**
Figure 2 follows Rumelhart and McClelland’s (1986, p. 75) “neurally inspired” concept and attempts to replace the “computer metaphor” with the “brain metaphor” as a model of the entrepreneurial mind. It further attempts to incorporate such elements as Goleman’s (1995) emotional intelligence. Bass (1990) has demonstrated that key components of emotional maturity are associated with managerial effectiveness and advancement. It can, therefore, be inferred that such intelligence will also impact on entrepreneurial decision behaviour.

Figure 2 should not be viewed as a linear or serial process model. It more accurately describes information flows and decisional filters that may be serial in some parts, recursive in others, have feed-forward as well as feedback loops, and also be parallel distributed. Rumelhart and McClelland (1986) describe such mental models in their groundbreaking dual volumes on parallel distributed processing (PDP) (McClelland and Rumelhart, 1986; Rumelhart and McClelland, 1986). The PDP understanding of cognition relates the thought process to a number of neural activities occurring in parallel across various parts of the brain. While the diagram depicts each nodular network cluster or decision activation pattern as an isolated, self-integrated and closed circuit system, in reality the networks would integrate and overlay each other during the decision-making process and reverberate in parallel rather than as isolated thought processes. The I-P\textsuperscript{e} architecture attempts to represent a biologically plausible framework by mapping clusters and networks which are consistent with research of the brain. This research has established that information is not held in any one location but is distributed in many locations and connected by intricate neural pathways (Hintzman, 1990; Hendry and King, 1994; Solso, 1995; Matlin, 2002). Robert Van Gulick discussing consciousness states that:

The more we can articulate structure within the phenomenal realm, the greater the chances for physical explanation; without structure we have no place to attach our explanatory hooks (Flanagan, 1992, p. 59).

Ungson et al. (1981) provide a long list of researchers who either question or support the scientific rigour of such process-tracing approaches. Arguments opposing process-tracing approaches can be counteracted to some extent by placing less significance on the mathematical modelling approach utilised in the early process-tracing models and by including the successive stages in the decision-making process as shown in the I-P\textsuperscript{e} model. It is also important to distinguish between impulsive and consciously deliberate actions as the planning stages of the latter are more carefully programmed, and therefore, more readily accessible to phenomenological study, than the former.

An I-P model can fall into two broad categories. The first is a pattern transforming (feed-forward) network that has links from input units through to output units with all activity flowing one way. The second category is a recurrent network which has bi-directional connections involving feedback of activation allowing units to influence and constrain each other in finding the best overall pattern that fits the input (Smith, 1996, p. 897). Figure 2 more accurately shows a recurrent network where an activated unit or neural cluster (such as may be represented in a sense of passion about a potential enterprise) may feedback to a previously evoked unit (such as heuristics that calculate profit potential) to stimulate further informational or decisional activity.
The informational cues in this representation (Figure 2) are shown in the top left corner of the diagram. Decision makers are reliant on informational cues in order to reach a decision, solve a problem, or recognise an opportunity. Entrepreneurs are known for actively seeking and exploiting opportunities (Bolton and Thompson, 2000). It could be argued that they deliberately expose themselves to more opportunity-laden informational cues in their particular fields of interest than perhaps occurs with the average person. These informational cues may also not be universally obvious to everyone as opportunity-bearing potentialities. The opportunity-seeking entrepreneur, however, seeks or attracts such informational cues. The data in these cues are then filtered and potentialities are quickly amplified and considered for further exploration and development. Figure 2 attempts to express the parallel aspect of this cognitive process by showing the entrepreneur’s intrinsic decision needs to the right of the informational cues and the emotive and attitudinal factors below the information cues. This reflects an element of biological plausibility as our emotive centre lies below the parts of the brain where our higher reasoning occurs (Schwartz and Begley, 2003).

Entrepreneurs display a variety of needs that drive their opportunity seeking “obsession”. These needs either filter or amplify the potentialities within each of the opportunity-related informational cues. Goleman (1995) points out that emotions and passion will often overwhelm reason and logic, therefore, it could be argued that the entrepreneur’s emotions have a powerful influence on his or her decision processes. Opportunity recognition may require a large number of informational cues and if these cues find congruence with the entrepreneur’s sense of passion and knowledge as well as meeting intrinsic needs, the opportunity diagnosis process becomes relatively simple. Figure 2 describes a complete absence of reliance on such external decision cues as time-worn traditions and the need for justification procedures such as would be the experience of someone working in a management position. The entrepreneur is not hindered by tradition, nor locked into old paradigms or company procedures, and is therefore, able to circumvent or completely omit cognitive processes that would normally delay business decisions in bureaucratically-structured organisations. This helps account for the speed with which entrepreneurs are able to make relatively complex opportunity recognition and exploitation decisions, as well as explaining why such decisions are easier to make for an entrepreneur than for a “procedure-ridden” manager.

The entrepreneur may require further information before making a final decision, and this would result in a cognitive feedback process, with information flowing in a bi-directional manner. Questions of an informed nature are formulated in search of appropriate answers. A high need for achievement may stimulate a sense of enthusiasm about a particular opportunity of which the entrepreneur has become aware. This enthusiasm will spark a desire for more information – a tunnelling of attention (Hockey, 1970). Informational cues may further trigger the entrepreneur’s competitive sense (shown in the far right corner of Figure 2). Heuristics based on past success and a high self-efficacy will stimulate the opportunity assessment and diagnosis stage (bottom right corner of Figure 2), prompting rapid I-P with a bias toward the use of opportunity-seeking decision rules that calculate profit potential, risk, probability of success, and resource requirements. Finally, the entrepreneur is able to express a sense of choice in the decision process. If the risk element is calculated
to be too high, the profit potential too low, or the elements of excitement and competitiveness are lacking, the entrepreneur may choose to decline pursuing the opportunity further and begin the search for another opportunity.

Applications and limitations
Smith (1996, p. 896) terms the recognition of common competencies as prototype extraction. It has been assumed that the case study of Bill Day, winner of the New Zealand Entrepreneur of the Year Award, and his company Seaworks, typically represent entrepreneurial cognitive behaviour. An assumption has been made that the I-Pe architecture is representative of some important aspects of general entrepreneurial decision behaviour. It could then be seen as a prototype extraction model, useful for:

- providing a structured framework that informs about entrepreneurial decision behaviour and a potential pattern of connectivity;
- providing standardised explanatory terms which can be easily interpreted and applied to further research and which attempt to explain how entrepreneurs seek and exploit opportunities;
- focusing on the manner in which entrepreneurs add value to opportunity-seeking decision processes;
- providing researchers with a starting point for the study of higher-order cognitive or intellectual performances, their interconnections, knowledge clusters and relationships; and
- identifying critical decisional and informational processes for education and training purposes that can be linked back to applied entrepreneurial behaviour, or to assumptions that can be made from such behaviour, thereby scientifically justifying expenditure of resources for entrepreneurial training and educational purposes.

Entrepreneurial behaviour, as with any complex phenomenon, may never be captured and explained in its entirety. Each node of the I-Pe framework has only been described in the most rudimentary manner in an attempt to capture the holistic opportunity-seeking decision process. The I-Pe framework described in Figure 2 attempts to highlight causal entrepreneurial success factors. These include an opportunity-seeking orientation, and needs-based motivators such as high need for achievement, high need for challenge, high need for excitement and competition. It also describes attitudinal capacities such as a sense of audacity, determination, intuition and confidence, and innovative problem solving. Opportunity diagnosis is represented by a number of psychological mechanisms including knowledge and skills, heuristics, the ability to deploy logic and reason. But these are also “coloured” by such considerations as fun and the need to accept and overcome the inherent challenges of the opportunity in question. For an entrepreneur, these information processes are stimulated by a risk and profit “calculator” that a managerial decision maker may not possess. The manager may also not have the decision generator of “choice” that the entrepreneur can deploy throughout the opportunity calculation decision phase.

Further research could potentially place weightings on the more important elements of the decision process as well as indicating more accurately the hierarchy of the
informational flows. Some parts of the I-Pe framework can be taught to those interested in improving their entrepreneurial ability, such as opportunity assessment calculations and the necessary knowledge and skills needed to tackle the task. However, the framework demonstrates that needs and attitudes have a recurring influence on opportunity recognition and diagnosis processes, and these may be more difficult to stimulate within the would-be entrepreneur.

On a more positive note, research undertaken in the last two decades by a growing group of neuroscientists has demonstrated beyond any doubt that the brain has a high degree of neuroplasticity. According to Schwartz and Begley (2003), the adult brain is extremely flexible. Schwartz’s successful treatment of patients with obsessive-compulsive disorder has demonstrated the brain’s remarkable ability to develop new neural pathways and learn new constructive behaviours. The findings from such ongoing research may suggest that, once equipped with appropriate knowledge of specific entrepreneurial decision processes, complementary learning techniques may encourage a wider spread of entrepreneurial behaviour.

Conclusion
Bill Day lives an exciting life. His business achievements are a successful element of his life that others may wish to understand and/or replicate, whether for themselves or within a teaching environment. This paper has identified cognitive elements, filters, amplifiers, needs, and psychological mechanisms driving successful entrepreneurial decision behaviours. The resulting I-Pe framework, while in no way claiming to be comprehensive, does provide a clearer understanding of entrepreneurial opportunity seeking and opportunity recognition processes. Shane (2000) claims that reasons for explaining entrepreneurs’ successes at discovering opportunities have not been adequately addressed in the entrepreneurship literature. The I-Pe framework, while being consistent with the assumptions of psychological theories on entrepreneurship (Shaver and Scott, 1991), expands upon one of these assumptions, and should therefore, address some of Shane’s concerns. This psychological assumption is that fundamental attributes of people, rather than information about opportunities, determine who becomes an entrepreneur. The I-Pe framework suggests that opportunities are recognised as a result of the entrepreneur’s search for informational cues and questioning of those things that most people take for granted. It suggests that information provides the catalyst for entrepreneurial behaviour but only because the entrepreneur is actively searching for opportunity-laden information. The entrepreneur demonstrates great hunger for information that has opportunity potential. This is then processed in a meaningful manner, feeding motivators such as the need for achievement, and fulfilment of competitive urges. Potential obstacles are “beaten down” through sheer determination, audacity, and the application of innovative solutions. Heuristics provide a rapid diagnosis and calculation of profit and loss potential as well as the level of risk. If the entrepreneur’s sense of intuition (based on skills, knowledge, and willingness to take risks) sends positive signals concerning the information, the opportunity is then enacted through a high need for challenge and excitatory stimulation. An entrepreneur is willing and able to act upon the findings of an opportunity diagnosis, and this is what results in the phenomenon known as entrepreneurship.
This framework in some ways reflects Carl Sagan’s view of the mind. He described the right brain hemisphere as a pattern recogniser which requires the left hemisphere to analyse critically the patterns that have been generated (Sagan, 1977). The entrepreneur is an active pattern seeker, searching for patterns that suggest opportunity, challenge, need fulfilment, and fun. These patterns are then filtered through a variety of mental sieving devices that reject, accept, or transform information that has been actively sought and processed. Motivated by a variety of needs and attitudes, the entrepreneur will decide whether to assess or reject each opportunity using numerous decision criteria. Some of these criteria are stimulated by the element of choice. An entrepreneur often has choice, where a manager does not. The manager must comply with organisational policy and procedure, whereas an entrepreneur has few if any such constraints. The entrepreneur is free to act consistently with the needs of the information. It can, therefore, be argued that entrepreneurs differ from the “rest of the world” by the needs that drive them, the attitudes that fortify them, their hunger for generating opportunity-related informational cues, and the manner in which they process and then act upon such information that stimulates their intrinsic motivational triggers.

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