



White Paper

The Innovation Funnel Fallacy

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The Innovation Funnel Fallacy

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ABSTRACT

The traditional innovation process – consisting of a funnel coupled with project screening – suffers from several practical shortcomings and flaws. Overemphasis on the role of early stages, such as idea generation, overshadows subsequent phases of equal importance. The drive to feed as many ideas as possible into the funnel may cause congestion that slows down overall progress. Furthermore, the yield may be of low quality if ineffective gates allow too many infertile ideas to pass through the funnel. Processes may be inflexible and slow to react, especially if tied to the corporate planning calendar as often proposed. This is not to imply that these problems are inherent; they are instead the consequences of poor practices.

The authors discuss the disadvantages and suggest an alternative to overcome them. The proposed approach is driven by strategic business options and also introduces additional benefits. It produces savings in sunk costs and prematurely tied-up capital. It contributes to effective and economical use of resources, because a company commits irrevocably to only one step at a time. Lastly, options enable, and by their very nature even demand, active and adaptive management.

1. NATURE AND CHARACTERISTICS OF INNOVATION

Innovation is a term that may refer to a process, an attribute, or an end result. Many confuse innovation with invention. Fire was not invented by humans, but using it as a source of heat and light, and for preparing food, is certainly an innovation.

Webster's [1] definition of innovation is "the introduction of something new," whereas invention means (1) "a product of the imagination," or (2) "a device, contrivance, or process originated after study and experiment."

Some suppose that innovation calls for invention, but this is not the case. Rogers and Shoemaker state in their classic book [2] that: "Innovation is an idea, practice, or object perceived as new by an individual", and "It is the perceived or subjective newness of the idea for the individual that determined his reaction to it. If the idea seems new to the individual, it is an innovation." It might appear odd at first, but an innovation does not need to be new; it is sufficient that to the individual it seems to be new.

Innovation refers specifically to that new thing itself that the innovation process has produced. To be considered an innovation in business, the result must be increased value in the form of new or improved functionality, reduced costs, a price increase, etc. [3].

An idea that precedes both an innovation and an invention, for its part, refers to a plan or purpose of an action, intention, or design.

2. INNOVATION PROCESS

Organizations define the innovation process in many ways.¹ Practitioners generally use the term to mean converting an idea or invention into a product, or into something that has an economic impact. For example, Thecis [4] uses the term as "the process that transforms ideas into commercial value."

The extent and scope may vary considerably. For some, the innovation process means merely creating ideas. At the other extreme it may refer to the entire management of technology – covering ideation, concept definition, product² development, product launch, and health care. In some cases it may even encompass managing immaterial assets.

¹ There are at least two ongoing initiatives aimed at harmonizing the definitions through standards: one by the Product Development and Management Association (PDMA) and the other by the European Committee for Standardization (CEN). At the time of writing, they were in beta and draft status, respectively.

² "Product" refers here to a physical product, service or a combination of them; i.e. a solution

Typically the scope ranges from idea to launch, and the most common process model is funneling or screening [5]. It starts with brainstorming or idea generation, with the objective of evaluating a broad range of inputs and refining them into several sequential stages. Some models refine the inputs into only the research and development stages, but usually the result is three to five stages, such as idea generation–screen and develop–launch, or concept–plan–develop–launch. Generally the process is a one-way, step-by-step progress. Some process models may have iterative loops, reminiscent of software engineering, but the linear approach is dominant.

The early phases of the innovation process are often referred as the fuzzy front end. Smith and Reinertsen, who coined the term, use it to describe starting the initiation of the process, when the need for a new product is apparent, and it terminates when the firm commits significant human resources to development [6].

2.1 Idea Genesis

The definition of a fuzzy front end suggests that idea generation, spurred by the need for a product, is part of the innovation process. Nevertheless, some models expect the ideas to appear “somehow” and from “somewhere” at the mouth of the funnel. The emphasis of the innovation process is on the early phases [7], and idea generation is thus often regarded as the first important stage of the creative process [8].

This proposition can be challenged. After all, does such a thing as active and purposeful idea generation even exist? Do people think faster in a hurry when overwhelmed by tasks and assignments? Certainly not – in fact, probably the opposite. Similarly, does asking a person to be creative, or ideative, actually work?

The entire idea-generating process is haphazard and unpredictable. Scott [9] notes, “... real creation is sloppy. Discovery is messy; exploration is dangerous. No one knows what he’s going to get when he’s being creative.” Mintzberg [10] observes similar characteristics in strategy creation. Strategies are everywhere, they just need to emerge. He states: “... strategies often cannot be developed on schedule and immaculately conceived.”

There are methods, like brainstorming, that are good concepts in theory but have proven inefficient in practice [8]. Brainstorming and similar forms of teamwork are, in fact, claimed to be actually less effective than individuals working independently [11]. Participants’ behavior is affected by group dynamics, alertness varies, there are distractions, and so on. Scott claims that when brainstorming is conducted the right way, as intended, it is effective [9]. Unfortunately, real-life sessions seldom consist of more than organizing sticky notes.

Scott presents several tools that might help to reduce obstacles to idea hunting [9]. DeBono, known for his classic treatise on “lateral thinking” [12], has written several books on the subject. Various other well-known methods, such as TRIZ [13], are occasionally mistaken for idea generation. They may nurture creativity, but by definition they are actually intended for problem-solving or for classifying and organizing ideas. The Internet can provide a bunch of tools, and it does no harm to give some of them a try.

So where do the ideas come from, if not conceived purposefully? They can come from anywhere. Or it could be said that ideas exist, and they just need to emerge and be identified. A well-known phenomenon called simultaneous invention supports this argument. Two people may invent the same thing at the same moment, independently and without knowing each other [9, 2].

Maybe ideas simply mature at a certain time and only then need to be recognized. Coffman & Morris [14] offer the formation of a sand pile as an analogy for the emergence of ideas. Pour dry sand onto a table. As more and more sand falls onto the table, an inverted cone gradually forms. The same is true of maturing ideas: keep a steady flow of activities going (keep pouring on the sand) until an identifiable form appears (a sand pile or an idea).

Some underline the importance of uniqueness or the originality of ideas [15]. The authors disagree, believing that the origin is secondary. As attributed to Thomas A. Edison: “Keep on the lookout for novel ideas that others have used successfully. Your idea has to be original only in its adaptation to the problem you are working on.” [16] This is what Matthews [17] also emphasized: “The ideas can come from anywhere, the initial source is not so important.”

“The best way to have a good idea is to have lots of ideas,” states Scott [9]. People regarded as creative do exactly that: collect and keep ideas. Edison is a good example. Picasso drew 45 sketches to explore ideas for both the composition and details for his work *Guernica*. On meeting a dead end, he

backtracked to earlier drawings to continue to final sketches. Sometimes he went too far in some direction, and backtracked again [18]. Besides extensively recording demos in studios, Jimi Hendrix used to write down the germs of ideas, draft lyrics and fragments of music wherever he happened to be at the time. And da Vinci surely did not have on his agenda: "Need to invent a helicopter." Instead, he consistently drew innumerable sketches of the most diverse conceivable subjects.

To recapitulate: it is important to have a lot of ideas, but it is even more important to capture and keep them for future use.

2.2 The Innovation Funnel

With regard to the above, the authors have never found a company short of ideas. On the contrary, company employees invariably complain that they have far too many initiatives in the pipeline. Struggling with prioritizing and balancing a portfolio is instead their main problem.

As Stevens and Burley revealed in their study, only a very small fraction of ideas turn out to be productive [19]. They claim that of 3000 ideas, only one makes it through to successful launch. The word successful is important here. There are well-known examples of products that fail in the market, but often forgotten is the abundance of initiatives that wither away in the development process, out of the spotlight. Other studies support this finding. Exact ratios may vary, but the phenomenon is unmistakable.

To manage with such a drastically poor yield, infertile ideas and subsequent projects must be screened out as early as possible. This will save money, time and effort, as well as reduce waste. Rescued resources can be re-focused and allocated to more promising initiatives.

An apparent solution is to screen projects along the development path. Although there are several ways of doing this, one of the best-known and most common is the funneling process [5, 20, 21]. The objective is to gradually mature a raw idea into a concept and finally into a ripe product, while at the same time discarding unfruitful ideas through inbuilt screening at the gates between development phases. This is carried out by a party responsible for project steering that decides whether the project is worth continuing or whether it should be suspended or terminated.

The authors suggest that, despite its rationale, funneling might have some real-life limitations. Firstly, it is inherently a push model. The outcome is dictated by what is fed into the funnel. How can one be sure that the right ideas get in? The industrial success curve reveals that most of the effort is spent on ideas with no potential. And therein lurks the spook, known in computer science as garbage in/garbage out [22].

Secondly, many encourage creating as many ideas as possible to improve yield [23]. This is surely a brute force approach. Does doubling the number of ideas really generate double the amount of success? Is the ratio of the success curve constant, linear, logarithmic, or does it vary? More ideas inevitably also consume more resources. At the extreme, any funnel would eventually clog up.

Thirdly, the tunnel metaphor and the expression from idea to launch give the impression that projects progress individually. One idea leads to one development, and when successful, to one launch in a foreseeable manner. That raises some questions. What if the aim and scope were not right in the first place? Of course one can, and if necessary should, re-adjust them. What if another comparable idea, with a better focus and prospects, enters the funnel? Instead of assessing the projects separately, they should be approached as a portfolio, in order to consider preferences. A new project might cause the termination of an earlier one with similar scope. Or continuing could also be justified, on the basis of the expected delay between the two launches.

Fourthly, how efficient is the screening and how to ensure that those ideas with the most potential get through? The criteria may be financial, as often suggested, a declared common scorecard that has different perspectives related to success, or projects might have specific gate criteria agreed to at commencement. Usually projects are handled individually, using some of the criteria mentioned above. What works best depends on the case. Dellaria has written a highly inspirational paper on evaluating projects within the innovation process [24]. He proposes a novel approach based on two dimensions: perception and reality. Perception is a belief (will it work?) held by a person or group of people, and may change over time. Reality (can it work?), on the other hand, never changes. It may appear odd at first, but with given assumptions and under certain circumstances, the fact as to whether an idea can or cannot work remains the same. It is similar to a law of nature. Only understanding of that fact may increase, by accumulating information. Further scrutiny of the approach is outside the scope of this paper, but Dellaria's article is well worth exploring.

A project can be evaluated also as part of a portfolio. In this case the criteria are used to compare one project with others. It is not as simple and straightforward as many might think. Lewis has conducted an excellent study on decision-making [25]. In it he analyses and explains, *inter alia*, the complexities and dynamics of selecting between candidates – in this case within a portfolio. Lewis' book is recommended for those interested in the diverse aspects of decision-making.

Fifthly, in reality it is very difficult to suspend or terminate projects. Psychological, mental, and motivational factors affect decision-making and challenge objectivity. People have a strong commitment to ideas and projects in which they recognize ownership. They have a hard time abandoning those they are attached to. Even if a project is officially terminated, work may continue under the table. The only solution is to let, or to make, people concentrate on something that is more appealing and interesting.

At the organizational level there may well be a biasing force known as the sunk cost dilemma [26]. Simply stated, this is a situation wherein one has invested (money, time, effort) in something, and at some point the decision must be made as to whether to continue with it or not. For example, someone purchases a movie ticket only to discover later that the movie is not very interesting. Two alternatives exist: suffer watching the movie, or do something that is more fun. Most select watching the movie because they have already paid for it. Usually the argumentation is more emotional than purely financial. People cannot abandon a project, development or product, because “we have put so much effort into it,” or “we have such a long tradition in this,” or “we have invested so much in building competences.” As a principle, sunk cost should neither affect, nor be taken into account in, decision-making unless the phenomenon and its consequences are really and truly understood. Lehmann gives [26] a warning example of how separate, consecutive decisions, each apparently perfectly justifiable with the information available at the time, can progress towards disaster.

As if the pitfalls above were not enough, Cooper remarks on how management sometimes mistakes tunnel for funnel. Managers forget, or ignore, the fact that after the first gate there are also several other go/kill points. Even if applied, the gates amount to little more than a project update meeting or a milestone checkpoint. As one executive laconically stated, “We never kill projects, we just wound them! [20]”

2.3 Project Portfolio Scheduling

Ongoing projects follow their respective project plans. Their progress and status are reviewed for go/kill decisions at predefined gates. What about the entire project portfolio, comprising projects in a funnel and those pending? When and how often should an assessment, with the consequent conclusions and decisions, be made?

It is often suggested that a company's annual planning cycle be followed, possibly complemented with quarterly or half-year reviews. Inflexible, rigid schedules, however, produce a serious threat. Mintzberg's remark [10] about strategy work is also valid here: “How else ... have strategies appearing on the first of June, to be approved by the board of directors on the fifteenth? One can just picture competitors waiting for the board's approval...” The authors agree. There must be slack in plans and scheduling, because new needs and ideas arise suddenly. Demarco has clearly highlighted [27] how important it is to have slack both in plans and in actual activities.

Another problem with sticking solely to a corporate annual planning cycle is that pending initiatives might be considerably delayed, in the worst case by a whole year, before being incorporated. Information inevitably becomes obsolete. One might argue that when commencing a project the assumptions and plans are confirmed to be still up-to-date and valid. Certainly so, but how intensively and how earnestly? People tend to become attached to prevailing suppositions.

Annual planning alone is apparently not sufficient, so there should be also regular reviews and updates during the cycle. Even that is not sufficient. No matter how careful an in-depth assessment is, new important information may surface immediately after an update. One must be alert and continuously keep a watch on internal and external developments of significance, and react accordingly.

3. STRATEGIC OPTIONS

To overcome the pitfalls and shortcomings discussed above, we present a different kind of approach, one driven by strategic business options. In finance, an option is a contract that gives the option owner the right, but not the obligation, to buy or sell an underlying asset at a specified strike price before a

specified date. An option has the following attributes:

- The definition and specification of the underlying asset,
- The spot price, or current value of the asset,
- The strike price, or exercise price of the transaction, and
- The expiration date, or expiry, the last possible date to exercise the option.

The concept of financial options has been applied also to business initiatives, such as capital investments. They are called real options. They deal with assessing the opportunities to invest in manufacturing, product development, processes, etc. Real options differ from the financial kind in that no outside counterparty is involved.

An essential benefit of employing options here is to avoid tying up capital in early phases. An option is, by definition, an option. Investments are not needed before exercising an option to start potential subsequent product development. The approach is also flexible, since the scheduling of activities is not dictated by a company's annual planning cycle. In the following we will discuss capturing ideas, assessing, and screening them to identify potential options for future business, and exercising those options.

3.1 Idea Capture

As discussed earlier, ideas exist everywhere and the trick is to capture and keep them for future use. Too seldom do companies register ideas in a systematic and centralized manner. And even if they do, the idea repository turns out to be merely a list of subjects. That is not satisfactory since an entry on a list barely expresses the essence of an idea, even less so as time passes and mental images fade. Morris [28] proposes specifying the characteristics of ideas by using the following three elements:

1. Description explains what the idea is, what aspect of a business it would impact, for whom it would add value, and what degree of value it might add.
2. Visualization via a simple sketch, a Venn diagram, a process flowchart, a collage, or any other means, helps others understand the idea.
3. Quantification aims to give a concrete estimation of the value of the idea.

Visual perception is powerful, and visualization provides an instant at-a-glance conception of an idea. It is advisable to employ material like photographs, data sheets, blueprints, etc, from similar existing products and to highlight the modifications and differences. It is easier to grasp the essential when a comparison to something familiar is possible. In the case of service products, visualization might seem less straightforward, but nevertheless process flows, order forms, user interfaces to online applications, and so on, can be of benefit. With totally new breakthrough products, comparison might be a challenge, but these are rare exceptions.

3.2 Identification and Valuation of Strategic Options

We prefer to use the expression strategic business options for real options. By doing so we want to emphasize the importance of options in defining strategic opportunities for business in the future. Business and technology efforts and initiatives should not only be aligned, but intertwined together as one entity. Some regard real and strategic options as being synonyms, while others find differences in them. Anyway, in this deliberation no distinction is needed.

Due to the analogy with options in the world of finance, it is often suggested that similar approaches be used for modeling and analysis. The methods may prove challenging to apply in practice because they incorporate various evaluation models, decision rules, and complex mathematics. Instead, we would like to propose an alternative, as presented by Matthews [17]. It is a down-to-earth, usable method in the spirit of traditional physics research: "Put a carefully formulated question to Nature, and she will give a clear answer."

Matthews calls it "kissing technological frogs," referring to a fairy tale. Frogs in a pond represent ideas, i.e. potential strategic options. One picks up one frog at a time and kisses it, in order to determine whether it is actually an enchanted prince. If it is, one schools it to become a king. If not, the frog is released to leap back into the pond to mature.

In practice, one addresses questions such as "Is it practical?" and "Is it desirable?" Or, put bluntly:

“Could we do profitable business with it?” The objective is to screen potential options for future business and to reduce the uncertainty attached to them. What is important in the process is duality; constantly shifting the viewpoint between business and technology [29]. Consequently, options interlock the results of both business and technology considerations.

Besides the generic framework, Matthews did not propose a practical process. The following procedure is based on the authors’ experiences, research [30], and development work. The process starts with a carefully formulated, closed question as a research object. A good question has the following characteristics:

- It is concise, a one-sentence statement in the form of a question
- It is specific in order to focus efforts on the information needed for effective decision-making
- It is concrete and comprehensible to both business and technology people
- It defines the context and scope for the research
- It declares a positive hypothesis to be challenged

The question derives directly from identified strategic challenges, and is formulated, for example, as: “Is it possible to enter and create sustainably profitable business in the XXXX market based on the existing YYYY product?” The question is a closed rather than an open one. A closed question directs research towards a definite target, and the answer is a simple, unambiguous yes or no. This could be challenged on the grounds that such an answer is information deficient, or that in a complex reality it is often impossible to declare a statement exclusively true or false. That is indeed correct. The answer must also convey the underlying assumptions: either “Yes, provided that...” or “No, unless...”

One single question is usually not enough, because it does not necessarily guarantee an unambiguous answer, in either the affirmative or negative. Many questions require complementary or counterbalancing questions [24]. In this case, the main question “Is it possible to...” may call for subsidiary questions concerning technology: “Can we justify the product development costs incurred?” and, “Can we justify the increased product health care costs?” Similar complementary questions might address, for example, the competition or markets. The research, organized as a project, progresses step-by-step and each consecutive step consists of the following actions:

- Research the question
- Evaluate the outcome and define next actions
- Reiterate until a feasible or achievable level of certainty is reached

A steering group is in charge of guiding and supporting the project. It consists only of stakeholders that have real interest in the subject, such as the business owner, technology management, and project manager. It should be compact and small enough for efficient work. No nice-to-know participants are allowed. There is another time and place for public information.

A steering group is a genuine decision-making body. It evaluates and accepts the results at each step. Assessment is based on the information given by the project manager, including a likely answer to the question, assumptions, and the estimated certainty level at that point of time. Furthermore, a steering group agrees on the actions – such as additional questions, clarifications, or new aspects to cover – needed to reduce uncertainty at the next step.

Uncertainty is always attached to an answer, and the very nature and objective of the research is to gradually reduce it. Uncertainty cannot naturally be measured, so it is an argued consensus of project management and steering. It can at some steps get larger, which may appear counter-intuitive; but new information can, in fact, reveal unknown sources of risk. In a similar manner, the answer may change from yes to no, or vice versa, as the study progresses. The process continues until it is obvious that further efforts would not sufficiently reduce uncertainties.

A positive answer with acceptable³ certainty identifies a strategic option that is added to a portfolio with the following specifications: definition of the underlying asset, certainty level, spot price, strike price, and expiration date. Certainty is the level reached through research, an asset is the development project needed, and the strike price defines the corresponding prospective project costs. The spot price, i.e., the current value of the option, is very difficult to define. It is usually management’s best guess

³ An exact, general acceptance level cannot be defined, but management must decide on it case by case

based, for example, on expected cash flows [31].

The opposite result, i.e. a negative answer, is not a failure but a success also! It is “a direct consequence of the desire to assess many options and select only a few” [17]. A decision to stop will save effort and allow concentrating on other, more attractive candidates.

Failure occurs, no matter what the outcome, when research does not reach acceptable certainty. That is a dead end. No confident results were achieved and resources were wasted. For that reason an organization commits to only one step at a time. This is very important for the mindset, because sometimes studies might have a hidden agenda and are pursued to the bitter end, no matter what emerges *en route*.

The authors have elaborated on the strategic options process elsewhere [30,22,29]. The perspective is occasionally on technology management or business models, but the observations therein are also valid here.

3.3 Exercising Options

When and how often should an option portfolio be reviewed for decision-making? Referring to strategic options, Luehrman remarks that “Business strategy is much more like series of options than series of static cash flows. The strategy sets the framework within which future decisions will be made” [32]. Executing a strategy thus involves making a sequence of decisions. Some actions are taken immediately, while others are intentionally deferred as circumstances evolve⁴. Luehrman’s statement implies that actions cannot be constrained by a company’s annual planning cycle. Instead, portfolios should be reviewed on a continuous basis and corresponding decisions made as new significant information about internal and external developments appears. Several tools exist for portfolio prioritization, but the authors find them of little use in this context and scope.

For decisions about options in a portfolio, there are three possible choices: exercise (decision to invest in a project), defer (let the option stay in the portfolio for future consideration), or abandon (an option has expired or the circumstances have changed so that it has become obsolete). Widely used financial tools, such as net present value or discounted cash flow, that are often suggested as criteria for evaluating options assume that projects follow a predetermined plan, irrespective of what might occur [32]. As a consequence, management becomes a passive agent in this respect.

In complete contrast to this, exercising options is a deliberate managerial decision that is proactively made by representative business owners and technology management. Decision-making criteria depend on the case, but they always derive from a business strategy. Therefore, it is essential also here to have a dualistic and profound dialogue between business and technology that focuses on potential choices and trade-offs. That way options enable, and in fact necessitate, active decision-making and management that are prerequisites for implementing the strategy successfully.

So far no obligations have been entered into. A company does not commit itself to investing in a product development project until it decides to exercise an option. Note that there is not necessarily a one-to-one relationship between an option and a potential consequent project. In the concept definition phase an individual option might be divided into several projects, some being combined into one, or projects may be reorganized in a new way

SUMMARY

Companies have for some time now applied the concept of strategic options in assessing opportunities for investing in product development. This can offer an alternative to the traditional from idea to launch funneling model. The method has been derived from options in the financial world. For that reason, it is often proposed that analogous tools are used for modeling and analyzing options. Due to their inherent complexity, however, they might prove difficult to use in real-life situations.

However, there is a more pragmatic approach that follows the spirit of traditional physics research. This approach researches carefully formulated questions that address potential solutions, for example, options for strategic challenges. Rather than relying on mathematical calculations and decision rules, the focus is on evaluating business and technology prospects in a dualistic manner. A discovered option interlocks the results of both business and technology considerations, in much the same way as a zipper.

⁴ Luehrman gives a gardening metaphor. Managing a portfolio of strategic options is like growing a garden of tomatoes. Any gardener would know to pick tomatoes that are ripe and perfect. Other tomatoes are rotten, no gardener would ever bother to pick them. In between are tomatoes that are edible but would benefit from more time on the vine, while others are not edible yet, and there is no point in picking them now

The process is simple yet efficient. It focuses on the essential, because a research question derives directly from identified strategic business issues. Lame ducks are discarded early, so the resources released can be re-allocated to other needs. The timing of decisions is flexible, because an option is the right, but not the obligation, to undertake an agreed transaction within a specified period of time. That avoids premature commitment of resources.

WORKING DEFINITIONS

It is essential to define the terminology used, so that the writers and readers understand it in the same way. Naturally, definitions differ, and the authors have deliberately and selectively adapted from different authoritative sources the definitions that suitably support the purpose.

Idea is a plan or purpose of action, intention, or design.

Innovation is something perceived as new to an individual (person, organization, etc.). Innovation is often mistaken for invention.

Invention is an improved device, process or composition. An invention may be derived from a pre-existing model or idea, or it could be independently conceived.

Innovation management is the process of managing innovation processes through the stages of the innovation cycle. The focus is in introducing new ideas, process, products, etc.

Management of Technology refers to systematic processes for the planning, development and implementation of a technology strategy that optimally supports the operational and strategic objectives of an organization.

Product is a physical product, a service, or a combination of these; i.e. a solution

REFERENCES

- [1] Innovation (2014) Merriam-Webster Online, Publishing New York City, NY, <last accessed 4-30-2014, <http://www.merriam-webster.com/dictionary/innovation>>
- [2] Rogers, Everett M., & F. Floyd Shoemaker (1971) *Communication of Innovations. A Cross-Cultural Approach (Second Edition)*. The Free Press. New York City. USA
- [3] Morris, Langdon (2009) Business model innovation, the strategy of business breakthroughs. *International Journal of Innovation Science*. 1(4) 41-49.
- [4] Thecis (2014) The Centre for Innovation Studies: Definition (Innovation). < Last accessed May 2014 <http://thecis.ca/index.php?catID=32&itemID=43> >
- [5] Cooper, Robert, Scott J. Edgett, & Elko J. Kleinschmidt (2002) Optimizing the state-gate process: what best-practice companies do. *Research and Technology Management*. 45 (6) 43-49.
- [6] Smith, Preston, & Reinertsen, Donald (1992) Shortening the product development cycle. *Research - Technology Management*. 35(3)
- [7] Khurana, Anil, & Rosenthal, Stephen (1997) Integrating the fuzzy front end of new product development. *MIT Sloan Management Review*. Winter
- [8] Chrysikou, Evangella (2014) Your fertile brain at work. *Scientific American*. 23(1)
- [9] Scott, Berkun (2007) *The myths of innovation*. O'Reilly Media, Canada.
- [10] Mintzberg, Henry (1994) The fall and rise of strategic planning. *Harvard Business Review*. Jan-Feb 107-114.
- [11] 12manage (2014). Brainstorming. < Last accessed May 2014, http://www.12manage.com/methods_brainstorming.html >
- [12] De Bono, Edward (1970) *Lateral Thinking*. Penguin Book Publishing. New York City, NY.
- [13] Etria, European TRIZ Association (2014). < Last accessed May 2014, <http://etria.net/portal> >
- [14] Coffman, Bryan, & Langdon Morris (2002) Hidden dimensions of innovation quest. InnovationLabs LLC <Last accessed 4-30-2014 http://www.innovationlabs.com/hidden_dimensions.pdf >
- [15] Harrington, James, & Voehl, Frank (2013) Innovation management: a breakthrough approach to organizational excellence – part 1. *International Journal of Innovation Science*. 5(4) ppppp
- [16] Ideaology-Quotes (2014). Ideaology < Last accessed May 2014, <http://www.ideaologists.com/quotes.htm> >

- [17] Matthews, W. (1990) Kissing Technological Frogs: Managing Technology as a Strategic Resource, Perspectives for Managers 5. International Institute for Management Development (IMD). Lausanne, Switzerland.
- [18] Simonton, D. K. (2014) The science of genius. *Scientific American*. 23(1) Winter.
- [19] Stevens, Greg A. & James Burley (1997) 3,000 raw ideas = 1 commercial success. *Research & Technology Management*. 40(3) 16–27
- [20] Cooper, Robert (2009) How companies are reinventing their idea-to-launch methodologies. *Research & Technology Management*. 52(2)
- [21] Institute for Manufacturing (2009) The Development Funnel. University of Cambridge. <Last accessed <http://www.ifm.eng.cam.ac.uk/dstools/paradigm/innova.html> >
- [22] Talonen, Tapani, & Hakkarainen, Kari. (2010) Gravitational Innovation Strategy. Conference Proceedings. 21th ISPIM. June 6-9. Bilbao, Spain. *The International Society for Professional Innovation Management*.
- [23] Clifford, S. (2006). How People Get Great Ideas, NSC Publishing Ltd. < Last accessed May 2014, <http://innovationinsights.blogspot.fi/2006/08/how-people-get-great-ideas.html> >
- [24] Dellaria, Joseph (2009) Clearing the “Fog of Innovation” Evaluating Ideas Accurately by Recognizing and Controlling Perceptions. *International Journal of Innovation Science*. 1(2)
- [25] Lewis, H. W. (1998) *Why Flip a Coin? The Art and Science of Good Decisions*. John Wiley & Sons. New York City, NY
- [26] Lehmann, Oliver. (2008) The Sunk Cost Dilemma. *Visionary tools Publishing*. <Last accessed <http://www.visionarytools.com/decision-making/sunk-cost-dilemma.htm> >
- [27] Demarco, Tom. Slack: Getting Past Burnout, Busywork, and the Myth of Total Efficiency, 2001. Broadway Books.
- [28] Morris, Langdon (2006) Permanent Innovation. *The Ackoff Center of the University of Pennsylvania*. Philadelphia, PA.
- [29] Talonen, Tapani, & Hakkarainen, Kari (2008) Essential Strategies Driving R&D and Technology Development. *Research & Technology Management*. 51(5) 54 – 60.
- [30] Hakkarainen, Kari. (2006) Strategic Management of Technology: From Creative Destruction to Superior Resilience. University of Vaasa, Finland.
- [31] Damodaran, Aswath. (2005) The Promise and Peril of Real Options. *Stern School of Business*. New York City. NY.
- [32] Luehrman, Timothy. (1998) Strategy as a Portfolio of Real Options. *Harvard Business Review*. Sept-Oct.