Risk or Innovation,

Which One Is Far more Preferable in Innovation Projects?

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Abstract

The object of this research is to identify the sources of risk in innovation projects and to determine whether they could be managed better. Due to the diversity of opinions and theories over the nature of risk, reaching an agreement about risk management is difficult. This will be a major problem if any effort is made to proactively manage 'risk' in naturally 'risky' areas such as innovation. Some risk management could be valuable, but perhaps too much, or inappropriate risk management might stifle innovation. It is necessary and valuable to consider the process of innovation from conceptualization to commercialization, how uncertainties are formed, how they are managed in that context, and how the techniques of risk management can be further deployed to enhance the success rate of innovation projects. Various approaches have been proposed to risk management in general, however the extent to which they are relevant for managing innovation is uncertain. Thus, during this paper, the general model of innovation and the process of risk management for managing the parameters which create the risk in these projects are explained.

Keywords: Innovation, Management, Risk, Analysing Risk, Project

1. Introduction

Establishing something new is the essence of product innovation. Since this process necessarily involves risk, an early risk identification and management is required in innovative firms. So the purpose of this paper is to explore methods for managing risk in the innovation projects. In the meantime, the proposal method for managing the risk in specific kind of innovation will be explained more.

In the next section, definition of innovation and different types of innovations are described. Continuously, different stages of innovation are presented. Section three illustrates the definition of risk, sources of risk and risk management systems. Section four states the methodology of this research. Section five explains the proposal method for managing the risk in the innovation projects and includes the example of that and section six concludes this paper.

2. Innovation

Innovation is the main source of economic growth (Mokyr, 2002) and a key source of new employment opportunities as well as providing potential for realising environmental benefits (Foxona et al., 2005). One of the most important arguments is that, in the global economy, where economic actions can be more cheaply carried out in the low-wage economies such as China, the main way in which the other economies can compete and

survive, is to find new and better products and processes, In other words, to innovate (Storey and Salaman, 2005).

2.1 Definition

According to the Oxford Dictionary of Economics 'innovation refers to the economic application of a new idea. Product innovation involves a new or modified product; process innovation involves a new or modified way of making a product' (Black, 1997). According to Afuah (2003) innovation is the employing of new knowledge to provide a new product or service that the customers want. In another words, it is invention + commercialization. Van de Ven (1986) describes innovation in terms of a new idea, which may be a recombination of old ideas, a plan that challenges the present order, a formula, or an exclusive method which is perceived as new by the involved individuals.

2.2 Different Types of Innovation

Literature provides different categories of innovation classified by type, degree, competence, impact, and ownership (Narvekar and Jain, 2006). Innovation can be considered in both manufacturing and service sectors of different sizes (small, medium and large). Although there is a difference between these two sectors, the general definition and process of innovation are the same. Services have their own characteristics different from manufacturing. For instance, services are intangible, perishable and heterogeneous (Johne and Storey, 1997; Song et al., 1999).

Tidd et al. (2005) says innovation is not just about opening up new markets; it can also present new ways of serving older and established ones. He classifies the innovation into 4 groups (Product, Process, Position and Paradigm) each of which can happen along an axis, running from incremental through radical change. Incremental product innovation entails the introduction of an improved product, which, compared with its predecessor, has at least one additional desirable characteristic or is efficient with the same characteristics. In contrast, radical or fundamental product innovation takes place when a new market has opened up and the innovator begins to satisfy a hidden demand (Ferguson and Ferguson, 1994).

By considering the different kinds of innovation which is mentioned above, as Figure 1 shows, for this study three dimensions were selected to classify the innovation types. First one is based on kind of company (manufacturing or service).The other one considers the innovation based on product or service. Among different kinds of innovation which are mentioned in the literature like marketing, organization, position, paradigm and so on, the product and process were selected. Since it seems in general point of view all of these different kinds of innovation can be categorized based on these two dimensions (product and process). Also these two kinds of innovation are more common in comparison with other ones. The last dimension assesses the innovation according to incremental or radical. The degree of novelty has an affect on this dimension. It means if the degree of novelty increases (based on the national or international consideration), the dimension is moving from incremental to radical situation.

As figure 1 shows, in general, the kind of risk management is more related to incremental or radical dimension. Radical innovation has high risk in comparison with incremental which has a low risk. So for managing the risk in the radical one (which some times this innovation is new in the world or country) the more complex risk management methods (e.g.: Risk Standard Model) are needed. In incremental situation that are like the improvement, the simple risk methods (e.g.: risk log) can be used. It should be paid attention that the size of company can affect on amount and kind of risk management.

For example one small company may spend a lot of time and uses the different and precise method for managing the risk in one incremental innovation project, since it has a limited resources but a big company just uses the one and simple method for the same project. In this paper the proposal method -Risk Standard Model- for managing the risk in radical innovation will be explained.

2.3 Different Stages of Innovation

It is suggested by several studies that there is usually a formal process for developing new products and services in firms with high performance in innovation (Griffin, 1997; Tatikonda and Rosenthal, 2000 and Shaw et al., 2001). In service firms, however, it does not appear to be common to use the formal process (Mitchell Madison Group, 1995). This formal process includes 'creativity and ideas management, selection and portfolio management and implementation management' (Oke, 2007). Tidd et al. (2005) argue that innovation is a general activity associated with growth and survival and a common fundamental process can be seen in all firms, which involve: Searching, Selecting, Implementing and Learning.

A stage-gate approach for managing the process of innovation (which has been adopted by many firms) is recommended by Cooper (1999); it allows the firms to manage, direct and control their innovation efforts. However, there is a major critique of Cooper's stage-gate approach, which focuses mainly on process factors. Other organizational factors which have an impact on innovation performance need to be considered.

The Pentathlon framework (Goffin and Pfeiffer, 1999; Oke and Goffin, 2001) is a general one for managing innovation which addresses several soft organizational and process issues (figure 2). Goffin and Pfeiffer (1999) declare that in order to achieve successful innovation management, companies should perform well in five areas (which are demonstrated in figure 2) and make sure that efforts in these areas are integrated. Narvekar and Jain (2006) point out another framework for considering innovation. This framework demonstrates an interactive innovation process which has three stages: ideation, incubation and demonstration.

The inputs to the process are the triggers through in-house R&D (human and structural capital), feedback from customer (relational capital) or through a serendipitous incident. The intuitive nature of those who involved in the innovation and the absorptive capacity of the organization, intervene here to have an influence on the production of the innovation process. Usually, the output of the process is a patent or a new process or a new product.

In spite of having many models of the technological innovation process in literature, the process is not vivid (Narvekar and Jain, 2006). Innovations vary widely in terms of nature, scale, degree of novelty etc. However it can be seen that the same basic process is operating in each case (Tidd et al., 2005). In summary, each innovation projects (in all manufacturing or service industry) may have five following stages:

1- Creativity

Searching the external and internal environment and processing relevant signals about threats, opportunities and also ideation.

2- Selection

Preliminary assessment and deciding by considering a strategic view of how the organization can be best developed; to know which of these signals to respond to.

3- Incubation

Transacting to the actual product development and producing the prototype production.

4- Implementation

Translating the potential idea into something new and launching it in an external or internal market.

5- Learning

Learning from progressing and building their knowledge base and improving the ways in which the process is managed.

3. Risk

For companies in order to launch new products speedily and successfully, taking risk is essential. The ability to identify and manage risk is considered to be vitally important in risky innovation.

3.1 Definition

There is no single, universally employed definition of the word risk (Green and Serbein, 1983). Its definition is changing as it becomes interwoven with innovation and a rapidly globalizing world. Companies in order to survive must innovate at a previously unparalleled rate and within the framework of greater uncertainty. This means the risks they take are deepening (Taplin, 2005). In the more technical and specialized literature, as Ansell and Wharton (1992) say, the word risk is used to imply a measurement of the chance of an outcome, the size of the outcome or a combination of both. According to the standard definition of risk, it is "the combination of the frequency or probability of occurrence and the consequence of a specified hazardous event" (Edwards and Bowen, 2005). Some former writers in the field drew a distinction between uncertainty and risk. A risk situation is defined as one in which a probability distribution for consequences is made on a meaningful basis, agreed upon by the set of relevant experts, and therefore it is 'known'. Uncertain situations arise when an agreement among the group of experts cannot be gained, so there will be an undefined probability distribution on the set of outcomes (Hertz & Thomas, 1919).

3.2 Sources of Risk

Any factor affecting project performance can be a source of risk, and when this effect is both uncertain and significant in its impact on project performance, the risk arises (Chapman and Ward, 1997). Ackermann et al. (2007) argue that the categorization of risk in a simple way can be extremely unhelpful since the categories may

be viewed as independent of each other. In addition to considering a wider range of risk categories, it is significant to consider more than just the risks themselves but also their impact on one another. In order to represent the different aspects of risk in an accurate way, it is important to consider risk as systemic. According to them the categorization of risk is: Political, Customer, Partner and Supplier, People, Reputation, Market and Financial.

In other categorization of sources of risk based on Green and Serbein (1983), risk aspects of the enterprise may be considered under the following major headings: Property and personnel, Marketing, Finance, Personnel and production, Environment. So with paying attention to the different sources of risk and purpose of this paper, the best categorization of them, which suits for this study, could be found as follow:

- *Environment* (government policy, exchange rates, availability of skilled labour, weather, culture)
- *Technical* (new methods, technologies, materials)
- *Resources* (staff, materials, finance)
- *Integration* (software modules, new & old systems)
- *Management* (multiple parties' experience, use of project management techniques, HRM, set the tight goals, product transition management, organization structure, organization behaviour)
- *Marketing* (customer, competitors*)*
- *Strategy*

3.3 Risk Management System

Risk management means 'the process of understanding the nature of uncertain future events and making positive plans to mitigate them where they present threat or to take advantage of them where they present opportunities' (Taplin, 2005). By considering that one of the main features of innovation will always be 'risk', risk management needs to facilitate innovation rather than stifle it (Taplin, 2005). A methodical approach to risk management enhances the ability of an organization to manage risks at all stages. The important purpose of risk management is to improve project performance by means of systematic identification, appraisal and management of project-related risk (Chapman and Ward, 1997). A systematic approach to risk management has to encourage decision-making inside an organization which is more controlled, more consistent and yet at the same time more flexible (Edwards and Bowen, 2005). According to Edwards and Bowen (2005) (figure 3) it is safe to say that a good risk management system for a project should encompass these processes:

- Establishing the appropriate context(s)
- Recognizing the risk of the project which the stakeholder organization will face
- Analyzing the identified risk
- Developing responses to those risks
- Controlling and Monitoring the risks during the project
- Allowing post-project capture of risk knowledge

Chapman and Ward (1997) say that most specific risk management processes are explained in terms of phases (stages) which are decomposed in a variety of ways, some are related to tasks (activities), and some are related to deliverables (outputs/products). They present the nine-phase RMP that is more detailed than most specific process. This structure depicts an alternative approach to managing risk. Smith and Merritt (2002) provide the other process for managing the risk. This process consists of 5 steps for managing the risk.

In summary, it can be said that all risk management systems have the four following phases:

1. *Identifying parameters* (defining and focusing)
2. *Analysing (*probabilities and prioritizing)
3. *Solving* (e.g.: Defer action for more information, Accept risk, Buy out risk (transfer to a third party), Parallel contingency development)
4. *Monitoring and learning (*New risk identification, Creating action plan for risks now above threshold, Concluding successful action plan and redeploying resources, Documenting the experience for use in future projects)

4. Methodology

By considering the different kinds of purpose of research and research strategy, also some criteria for selecting the kind of research strategy (especially research questions), this research uses the case study as a strategy for research. As research project may have more than one purpose; this research is also placed between explanatory

and exploratory research. This research concentrates more on the qualitative approach than quantitative, because finding the quantitative data during the innovation project is very difficult and at some points impossible (There are not any quantitative documents in different companies about innovation projects which they had done).

Because of the importance of theoretical model in any kind of case study, this study started the research with a hypothesis model (figure 4).

As figure 4 shows there are five decision points in this process. Each of these points need some information/criteria for approving the last stage and going to next stage (or back or abandon) and also should consider the parameters which create the risk in the next step. This is a dynamic diagram and there is an interconnection and overlap between different decision points.

Based on hypothesis model, this structure is a method for better fitting the innovation process and risk management system together. These different stages of risk and innovation and elementary model for matching these two issues were considered in some cases from Iran and UK. Based on the purpose, strategy of research and method of gathering the data, also with considering the different definitions of analysing method, the explanation building is the method for analysing the data in this thesis. In this paper, the second step of risk management system (analysing) will be explained more.

5. Method for Managing Risk in the Innovation Projects

Keizer et al. (1991) have been developing a novel method to diagnose and control risks in innovation projects: the Risk Diagnosing Methodology (RDM). This method lets a firm identify comprehensively and systematically the technological, organizational and business risks that a project might faces, and to formulate and implement appropriate risk management strategies. This method includes nine steps which are: 'initial briefing, kick-off meeting, individual interviewing of participants, processing the interviews (design of a risk questionnaire), answering the risk questionnaire, constructing the risk profile, preparing a risk management session, risk management session, drawing up and execution of a risk management plan' (Keizer et al., 2001).

In risk analysis, typically we are trying to understand, how risks are generated, assessing their probabilities and impact, ranking them and screening out minor risk (Emblemsvag and Kjolstad, 2006). Proper risk analysis lets an organization to achieve an understanding of the relative severity of its risks on a project (Edwards and Bowen, 2005). Different methods for analysing risk from quantitative to qualitative, include: Monte Carlo simulation, Hazard identification methods, Failure modes and effect analysis, Fault tree analysis, Event tree analysis, What if' scenarios, Risk Mapping, Influence diagram etc.

Method which will be used in this research consists of four phases. In following, the summary of different stages of this method (how they work) will be described and in next section the case application will be explained for analysing the risk. It should be emphasized that various parameters like kind of innovation, industry and company have an affect on method, so therefore different methods may be appropriate for different conditions. Consequently this general method should be calibrated with different situations.

For the first phase of risk management -Identifying Parameters- some of the parameters as mentioned at section 3.2 can be selected as parameters that create risks based on the kind of industry, size of companies, the countries which the companies are located in and situation of company.

In the second phase -Analyzing- the company should estimate probabilities of events and the impact of their consequence and also prioritize these different risk factors in order to solve them, because, the company can not solve all the risks (limited recourses, time etc.) and also the innovation is inherently risky, and if the company wants to manage all risks, it may cause to stifle the innovation. With considering the conditions of radical innovation, standard risk model (figure 5) would be a good method for this purpose. Based on this method, expected loss for each of the risks could be calculated, and the risks could be prioritized based on the expected loss.

Risk events are the parameters which are recognized as risk. But for calculating the probability of risk event and probability of impact, the following method can be used. For instance, it can be assumed that the *Technical* (refer to section 3.2) is the risk event. Based on different parameters which are mentioned as a risk, technical risk includes three risk event drivers which create this risk. These risk events are: new methods, technologies and new materials. For each of these risk events, different scenarios could be written with different probabilities of success (Table 1) (In different situations these scenarios and their probabilities could be changed). So after calculating the probabilities of success, P_e can be calculated as: $P_e = 1- P_{success} = 1- (P_1 * P_2 *\ldots)$

To find the reasons for each of the risk events drivers, the scenario method could be used. Same method could be applied for impact. Each of these parameters which create the risk is more effective in one or some of the stages

of innovation project, and cause the problem(s) in these stages. Although in general, they affect the whole stages; separating them is also possible. According to Table 2, if each of the risk event affects different stages of innovation, they would have different probability of success. If they affect more than one stage, the probability of success is equal to multiplying them. So the probability of failure for impact (P_{ij}) equals one minus the probability of success.

For calculating the expected loss, total loss should also be found. But it could be assumed that the total loss for all risk is equal, because all of these risks will cause the reduction of success in the market and losing the profit. So if the total loss were the same for all risk events and impact, it does not have an effect on prioritizing the risk. Thus all risk could be prioritized based on result of multiply P_e and Pi, because the L_t in all is equal.

In phase three, the company should find different methods for solving these risks in different stages of innovation and in phase four, the company should monitor the process and also learn for future risk management system.

5.1 Case Application

In this section the proposed method for analysing the risk in risk management system will be applied for one case. January 2003, lightweight Medical(Note 1) directors Neil Tierney and Neil Farish were considering the options open to their Edinburgh-based industrial design company. The commercialisation fund upon which the development of their Lightweight Incubator for Neonatal Transport (LINT) product depended on to secure patenting had failed to materialise.

According to parameters which create the risk during the innovation project and also information based on case, it can be said that environment, marketing and resources are three parameters which are creating the risk during this case. So in second phase these parameters should be considered and prioritized. Tables 3, 4 and 5 suggest these three risk event (marketing, resources and environment) with their risk drivers. In the Lightweight case, for *Resources* risk, just finance plays a role as a risk event driver. In *Marketing* risk all three drivers (customer, competitor and market) exist and in *Environment* risk event, intellectual property is as a risk event driver. For each risk event the P_e * Pi for prioritizing them are calculated as shown bellow.

Marketing ()

$P_1 = 0.7$
$P_2 = 0.5$
$P_3 = 0.5$

$P_{success} = 0.7 * 0.5 * 0.5 = 0.175 \Rightarrow P_e = 1 - P_{success} = 0.825$

Marketing has an affect on implementation stage of innovation $\Rightarrow$ $Pi = 1 - 0.1 = 0.9$

$P_e * Pi = 0.7425$

† *Intervener Parameter*: introducing the future innovation before the maturity in life cycle of the previous innovation in the market, would have a negative effect on the probability of success.

‡ *Intervener Parameter*: if the competitors advertise about their future products which is not yet in the market, but with good attributes of competitions, this would have a negative effect on the probability of success.

Resources (Table 4)

$P_1 = 0.5$ $\quad P_{success} = 0.5 \quad \Rightarrow \quad P_e = 1 - P_{success} = 0.5$

Resources has an affect on implementation and incubation stages of innovation

$\Rightarrow \quad Pi = 1 - (0.1 * 0.3) = 0.97$

$P_e * Pi = 0.485$

† *Intervener Parameter*: broad range of innovation would have a negative effect on the probability of success.

Environment (Table 5)

$P_1 = 0.7$ $\quad P_{success} \Rightarrow 0.7 \quad P_e = 1 - P_{success} = 0.3$

Environment has an affect on implementation, incubation, selection and creativity stages of innovation

$\Rightarrow \quad Pi = 1 - (0.1 * 0.3 * 0.5 * 0.7) = 0.9895$

$P_e * Pi = 0.297$

So with pay attention to these results the company at first should consider the marketing risk after that, resources and in the last one environment. Also company based on their abilities should find the methods for solving some or all of these risks.

6. Conclusion

On the one hand companies need innovation to endure in the market competition but on the other hand one of the most important aspects of innovation is risk. If the companies do not consider the risk, the project will be failed and if they apply a lot of risk management systems, these methods could stifle the innovation. This research attempts to provide the system for managing the risk in the innovation projects and also to create a method for prioritizing different risks factors and to manage the most important ones in second stage of this risk management system for some kind of innovation.

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Note

Note1. Case from: Scottish Institute for Enterprise (www.sie.ac.uk/cases)

Appendix

Table 1. Risk event probability

Risk event: Technical			
Risk event drivers			Probability of success
new methods (P_1)	technologies (P_2)	new materials (P_3)	
			0.9
			0.7
			0.5
			0.3
			0.1

Table 2. Impact probability

Impact	Probability of success
learning	0.9
creativity	0.7
selection	0.5
incubation	0.3
implementation	0.1

Table 3. Risk event drivers for marketing

Risk event: Marketing			
Risk event drivers			**Probability of success**
(P_1) Customer†	**(P_2) Competitor ‡**	**(P_3) Market**	
Product is different and best in all attributes and satisfy all of the new demands of customers	There is not any competitor product and entrance to this market is difficult	The company is in this market and has a relation with customer and also supplier and buyer are in coordination with the new idea	0.9
Product is different and best in some attributes and satisfy some new demands of customers	There is not any competitor product and entrance to this market is easy	The company is in the similar market but has a relation with customer and also supplier and buyer are in coordination with the new idea	0.7
Product is different and has advantages in one or two attributes but it can't satisfy the new demands of customers	Products with low capabilities of competing and difficulty for entrance to this market	The company is not in this market but has a relation with customer and also supplier and buyer are in coordination with the new idea	0.5
Product just has advantage in comparison with present products	There are competitors product and entrance to this market is difficult	The company is in this market just as a "niche" and does not have a direct relation with customer and also supplier and buyer are not in coordination with the new idea	0.3
Product is different and has advantages in one or two attributes but it is worse in other attributes and can't satisfy new demands of customers	There are powerful competitor products and entrance to this market is easy	The company is not in this market or the similar and does not have a relation with customer and also supplier and buyer are not in coordination with the new idea	0.1

Table 4. Risk event drivers for resources

Risk event: Resources	
Risk event drivers **(P_1)** **Finance†**	**Probability of success**
Financial resources for innovation is enough within the company	0.9
Financial resources for innovation should be supplied with external and some available external resources and good proposal is accessible	0.7
Financial resources for innovation are not in the company and they should be supplied from available external resources and a good proposal is accessible	0.5
Financial resources for innovation are not in the company but the familiarity with external sources is available and a relatively good proposal is accessible	0.3
Financial resources for innovation are not in the company and for consuming the external resources, researches should be done as there is no familiarity with them and a relatively good proposal is accessible	0.1

Table 5. Risk event drivers for environment

Risk event: Environment	
Risk event drivers **(P_1)** **Intellectual property**	**Probability of success**
intellectual property rules are done completely and within the short time	0.9
intellectual property rules are done completely but within the relatively long time	0.7
intellectual property rules are done partially complete and within the short time	0.5
intellectual property rules are done partially complete and within the relatively long time	0.3
intellectual property rules are done incomplete and within the long time	0.1

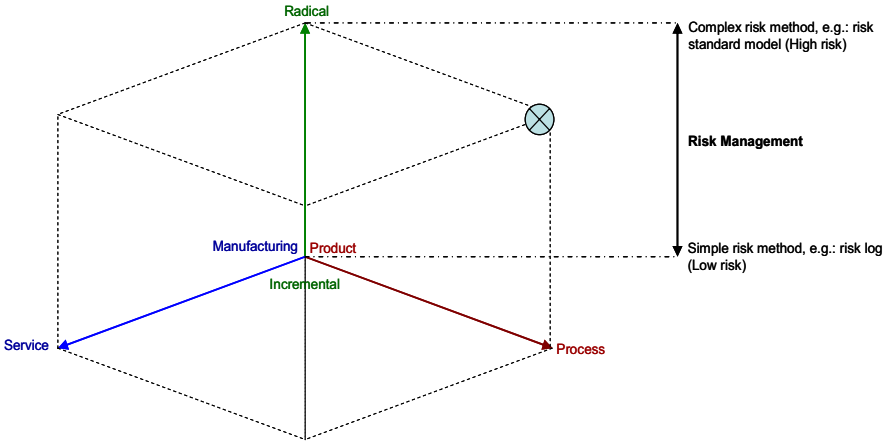

Figure 1. Classification of innovation

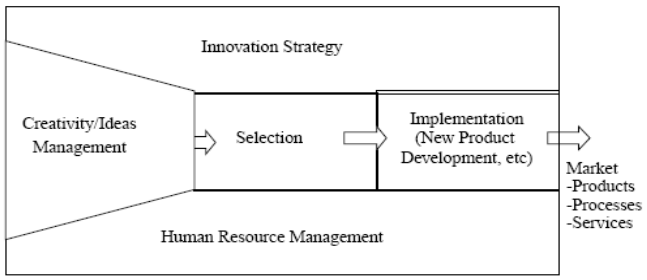

Figure 2. The "innovation pentathlon" (Goffin and Pfeiffer, 1999; Oke and Goffin, 2001)

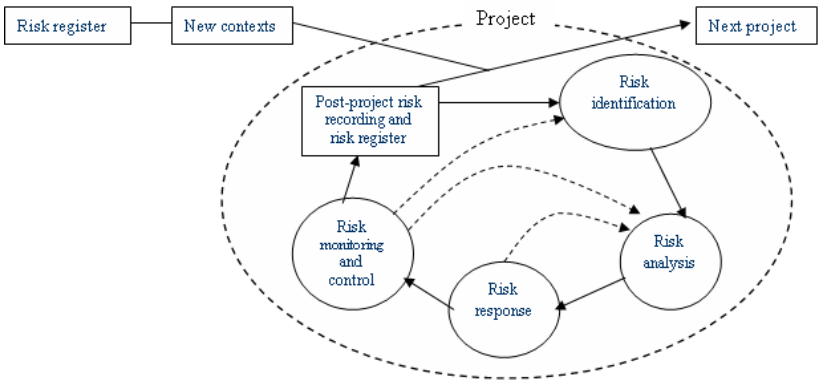

Figure 3. Systematic cycle of risk management (Edwards and Bowen, 2005)

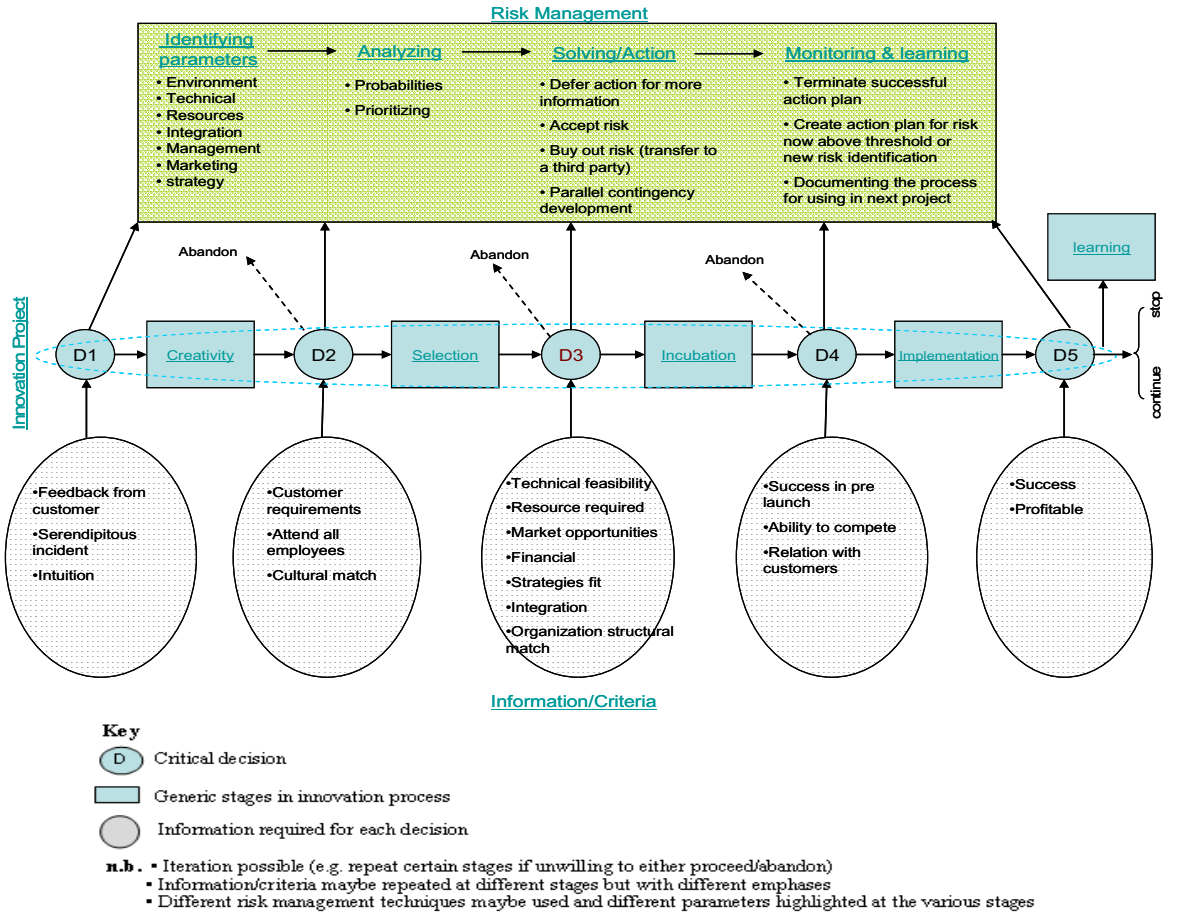

Figure 4. Snapshot of innovation process and risk management system

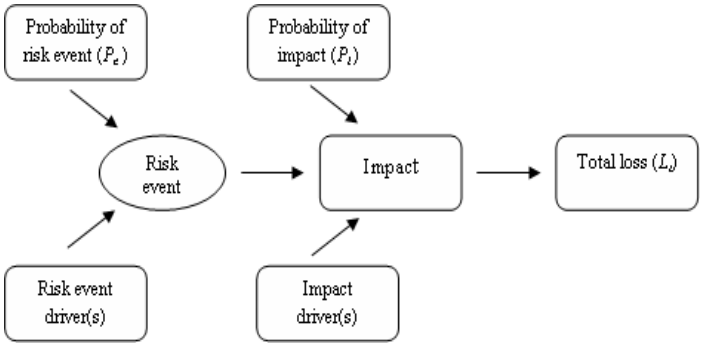

Figure 5. Standard risk model (Smith and Merritt, 2002) (Expected loss (L_e) = L_t * P_e * P_i)