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WORKING PAPER

Review: innovation process frameworks

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Abstract

Innovation publications have been recently described as fragmented and inconsistent. Consequently the field requires work to synthesise the literature and provide a coherent review of frameworks that have been developed in the area. This paper addresses these shortcomings by first examining the contentious issue of what is meant by the term innovation. The analysis is carried out by bringing together definitions of innovation from disparate streams of respected academic work in the area, followed by the development of a concept matrix. Then the study describes approximately twenty innovation process frameworks assembled from the innovation literature. The paper argues that that, despite the volume of innovation literature, it's sense-making and progress is severely hampered by the absence of a review of theoretical frameworks. Consequently this work makes a contribution by addressing the gap in the literature.

Introduction

The voluminous and eclectic innovation literature has been recently described Adams *et al.* (2006) as a "fragmented corpus". In an important antecedent paper, Wolfe (1994) concluded that it had made little contribution to the understanding of innovative behavior in organizations and his evaluation of the results as being "inconclusive, inconsistent and characterized by low levels of explanation" was surely a pointed criticism of the field. Slappendel's subsequent (1996) mapping of the literature on innovation in organizations in terms of three theoretical regions: the individualist perspective, the structuralist perspective and the interactive process perspective is highly regarded and has been profitably applied by the IS community to the analysis of software process improvement (SPI) innovations (Kautz & Nielsen, 2004). Recently, there has been some noteworthy attempts to provide a more holistic appreciation of the innovation landscape such as the compilations by Fagerberg *et al.*

(2005) and by Shavinina (2003). However, Fagerberg's (2005) conclusion that "our understanding of how knowledge-and innovation-operates at the organizational level remains fragmentary" and "that further conceptual and applied research is needed" indicates a scarcity of progress in the intervening period. Moving closer to home, Avgerou (2002) comes to the surprising conclusion that "the term innovation is not actually widely used" in the information systems literature. Swanson (2004; 1994; 1997), who has been notable among the IS research community in addressing the subject, argues that the innovative deployment of information technology is "increasingly crucial to competitive survival and success".

This review of seeks to address a number of these issues and is structured as follows. Firstly an overview is provided to address the contentious issue of what is meant by the term innovation. The approach here is to develop a concept-matrix based on important definitions from the literature. Following this there is a brief discussion of innovation as it has debated by the information systems discipline. Then the study describes approximately twenty innovation process frameworks assembled from the innovation and information systems literature.

Innovation: An overview

This section will analyze the term *innovation* by bringing together definitions of innovation from disparate streams of respected academic work in the area through the development of a concept matrix. Then we will present an overview of *innovation* in the IS literature and based on this, argue that the subject is ripe for a new theoretical examination in order to progress research in the area.

What is Innovation?

Many scholars trace the introduction of innovation into the realm of economic and social change to Joseph Schumpeter's seminal work on the "Theory of Economic Development" (Schumpeter, 1934). In this work he classified innovation into five categories: new products (or goods), new methods of production (or processes), new sources of supply (or half-manufactured goods), the exploitation of new markets, and new ways to organize business. In Schumpeter's original schema, innovation is accomplished by "entrepreneurs" who developed new combinations of existing resources (Swedberg, 1991). However, in his later works, he came to regard the large corporation as the innovative firm driving the development of leading economies (Lazonick, 2005). Fagerberg (2005 p 4) makes the fundamental distinction between invention and innovation where the former is regarded as the "first occurrence" while the latter is the "first attempt to carry it out into practice". This is in line with Van de Ven's (1986 p 604) assertion that "an invention or creative idea does not become an innovation until it is implemented or institutionalized".

One of the main challenges of a review of innovation is the range of definitions from a wide body of literature. In their analysis of the terms "innovation" and "innovativeness" from 21 empirical studies in the new product development (NPD) literature, Garcia et al. (2002) discovered that "no less than fifteen constructs and at least 51 distinct scale items" were used leading to a great deal of ambiguity. Now we will describe our analysis of innovation definitions in our quest to answer the question "what is innovation".

Analysis of Innovation Definitions

In the course of his work, McInerney (2004) assembled over thirty author-centric definitions of innovation from publications since 1960. These were based on antecedent work by (Rahmanseresht, 1988) and that of (Zain, 1993) with Schumpeter's earlier definition being added by the authors in recognition of its significance in innovation studies. These definitions are included in Appendix 2 together with some we have added ourselves such as that of Schumpeter.

A content analysis of the innovation definitions was carried out through converting the author-centric definitions in the literature into a concept-centric format in order to identify the most common concepts and also ones that may require further attention (Webster & Watson, 2002). Additional dimensions were also added to the concept matrix, shown in Appendix 1, to facilitate the analysis. The concepts are categorized into whether they are an adjective (for example new, radical): numbering 16, a noun (for example product, market): numbering 33 or a verb (for example implementation, adoption): numbering 18. Another objective was to enable a meta-analysis of the table in order to investigate if the definitions can contribute to the development of theory, for example whether they exhibit *parsimony* or have any *theoretical glue* (Whetten, 1989). The rows show the number of the concepts and where they were used. The sorting order from left to right was not done alphabetically in order to try to indicate chronologically when the concept appeared in the literature. The frequency of use of a particular concept in the definitions is indicated from the number of asterisks in the table columns. For example, while *product* and *process* was used by Schumpeter and many others early on, the idea of "know-how" was introduced by Freeman in 1982. No effort has been made at this stage to apply any *frugality* to an evidently *un-parsimonious* table using, for example synonyms, as it was decided just to use the raw data for this study.

One important initial result of our analysis, we believe is the references to "people" and "resources" that emanate from the work of Andrew Van de Ven *et al.* in the 1980s. This we believe is extremely important as it covers two major areas that are unique to Van de Van: the role of people and resources in the development and implementation of an innovation. The work of Andrew Van de Ven has made a significant contribution to innovation scholarship since the early 1980s. This pioneering work was carried out during the Minnesota Innovation Research Program (MIRP) and its publications are generally known as the Minnesota studies (Van de Ven et al., 2000). A testimony to the enduring quality and wide-regard of these seminal studies is the fact that though the book was originally published in 1989 and subsequently taken out of print, it was re-printed in the year 2000. The MIRP program was carried out by approximately 40 researchers, now scattered among faculty across the globe, who conducted longitudinal studies of 14 innovations during the 1980s. Significantly, Van de Ven and his team "returned to the library" in the 1990s as they considered that if it took 10 years to gather the data, then they "deserved at least ten years to analyze and make sense of the data" (Van de Ven et al., 2000 p xx). As this section of the paper is focused on analysing *definitions* of innovations, it is worth pausing and reflecting here on his definition of the phenomenon (Van de Ven, 1986 p 604) .

> Innovation is defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional context.

As a result four basic factors are implicit in the definition: new ideas, people, transactions and institutional context.

A final comment on the table in Appendix 1: even a cursory look at the cluster of the asterisks and comparing them with Schumpeter's original definition leads to a suspicion: *la plus ça change, la plus c'est la même chose.*

Now that we have discussed the meaning of the term innovation in a concept-centric structure, we will now focus specifically on innovation studies within the information systems literature.

Innovation and Information Systems: an overview

In this section new make a basic distinction which we believe is essential to clarity when approaching the topic "innovation and information systems". The first one we term "innovation in IS[1]" and the second as "IS in innovation". The former we develop from Swanson's (1994) definition of a process innovation to the more generic description of "any new way of developing, implementing and maintaining IS". The latter we express as "the role of IS in supporting innovation". These related concepts are shown in figure 1 as being two sides of the same coin.

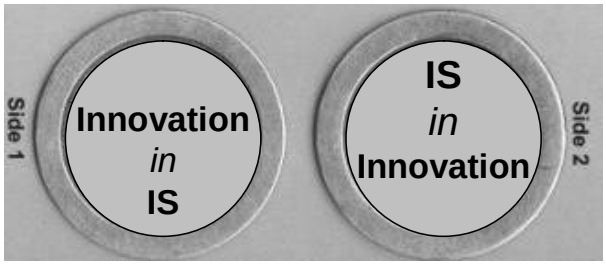

Figure 1. Innovation and IS – two sides of the same coin

In connection with "innovation in IS", Swanson (1994) argued that current innovation theory had done little to explain IS innovation and where it stood within the general debate on organizational innovation. To address this situation he posited the following three types of IS innovation to provide a new theoretical impetus: those confined to the IS task; innovations supporting administration of the business and innovations imbedded in the core technology of the business

To explain the concept, Swanson graphically presented this typology as a tri-core model of IS innovation with the innovation core sandwiched in a swiss-roll arrangement between the inner technical core and the outer administration core. A subsequent empirical testing of the model resulted in "cautious optimism" but suggested a need for further theoretical work to refine, elaborate and extend the system (Grover et al., 1997). Recently, Costello and Donnellan (2007) have argued that the considerable growth of self-service technology and business extends the traditional boundaries of the customer service function and needs to be incorporated into Swanson's tri-core innovation typology. In a subsequent influential paper,

[1] We will follow Swanson (1994, p1072) by including computing, IT and ICT as subsets of IS

Swanson and Ramiller (2004) start by defining IT innovation as the process by which "IT comes to be applied in novel ways" and conclude that the literature on bandwagon phenomena indicate that much supposedly innovative behavior is actually "me too" activities. This leads them to propose the application of the concepts of "mindfulness" and "mindlessness" to IT innovation theory. Their call for an enlarging of the IS academic research to "investigate the cognitive processes of organizations" and to engage with the psychological as well as the organizational literature has relevance for the present study. Fichman (2004) takes the concept of "mindfulness" with six others (innovation configurations, social contagion, management fashion, technological destiny, quality of innovation and performance impacts) and presents them as emerging perspectives that can take IT innovation research beyond its present "dominant paradigm" which he believes is showing signs of exhaustion. He defines the "dominant paradigm", derived from economic-rationalistic models, as positing that an organization with the greater quantity of "Right Stuff "will demonstrate a greater quantity of innovation and illustrates the concept diagrammatically. Recently, a comprehensive analysis of an extensive body of research, based on Fichman's description of the "dominant paradigm" resulted in a revised depiction of the model that differentiated between individual and organizational characteristics and prescribed the best predictors of IT adoption for each characteristic (Jeyaraj et al., 2006). This study concluded with a counter argument that the dominant IT paradigm was alive and well and continues to make significant progress.

Other scholars, albeit a minority, have taken a different approach when viewing innovation and information systems. In this case they have explored its role, both positively and negatively in the area of innovation which we term "IS in innovation". For example, the work of Tarafdar *et al.* (2005) examines how a firm's information technology (IT) capabilities affect its ability to innovate. They explain that the IT capability of the firm has five dimensions: IT Infrastructure, IT Human Resources, IT-related Intangible Resources, IT Coordination and IT governance. Donnellan's (2004) empirical study described how companies such as Analog Devices Inc. (ADI) are using IT systems to support and promote innovation. On a more general level, Pavitt (2005) argues that ICT can support innovation by reducing "costs of search and selection" it has "created opportunities for increasingly complex systems made possible by the digitalization of data". Elsewhere Whelan (2007) examines the relationship between the structural properties of electronic networks of practice and the successful diffusion of innovative knowledge. While the work on both perspectives of information systems and innovation has been commendable in addressing specific topics within the innovation landscape, we propose that the topic is now ripe for a more holistic approach.

The purpose of the opening section of the review was firstly to demonstrate that, despite the volume of innovation literature, its sense-making and progress is severely hampered by the absence of theoretical frameworks. The second objective was to provide evidence that the study of innovation in the information systems literature is under-developed and not without ambiguities. We will address the issue of the lack of innovation theoretical frameworks in the next section.

Statico-Dynamic Definition of an Innovation Process Framework

We take the definition of an innovation process from the work of Schroeder, Van de Ven, Scudder and Polley (2000 p 108) who propose that :

> The process of innovation centers on the temporal sequence of activities that occur over time in developing and implementing new ideas from concept to concrete reality

Building on this definition we propose the following *statico-dynamic* definition of an innovation process framework that synthesizes both the dynamic and static aspects that emerged from the literature review:

> *An innovation process framework is a conceptual structure that describes*:
>
> - the *dynamic* temporal sequence of *actions* that occur over time in *discovering*, developing and implementing new ideas from concept to concrete reality
> - contextualized in the *static* organizational dimensions (or climatic factors) that enable innovation

The term *action* is used in place of *activity* as we suggest that it implies "mental" as well as physical attributes. *Discovery* is added to better suggest that the "idea" may just be new to the adopting unit.

Innovation Process Frameworks: Innovation Literature

Afuah -1: Profit Chain Model

Afuah (1998) developed his Profit Chain Model based on his exploration of static and dynamic innovation models which are discussed in the next section. He summarised these contributions using four questions that he argues "underpins the introduction and exploitation of innovation – the *how*, *who*, *what*, and *when* of innovation". He describes this model as an "integrative dynamic framework".

- **How** different is the new knowledge from the organisations existing knowledge and **how** different is the product (or service) from existing products (or services)?
- **Who** perceives the innovation to be incremental, architectural or radical?
    1. Inside the firm: e.g. do R&D, Manufacturing or Marketing have different perceptions in this regard?
    2. In the value-chain: e.g suppliers, customers, business partners
    3. Global Level: are there different perceptions in diverse regions?
- **What** is it about the organisation that makes it a better innovator than competitors e.g. people, IP, strategies, or local environment?
- **When** in the life-cycle of the innovation are we answering the previous questions e.g. the answers may differ from the "initiation" phase than the "implementation" phase of the innovation?

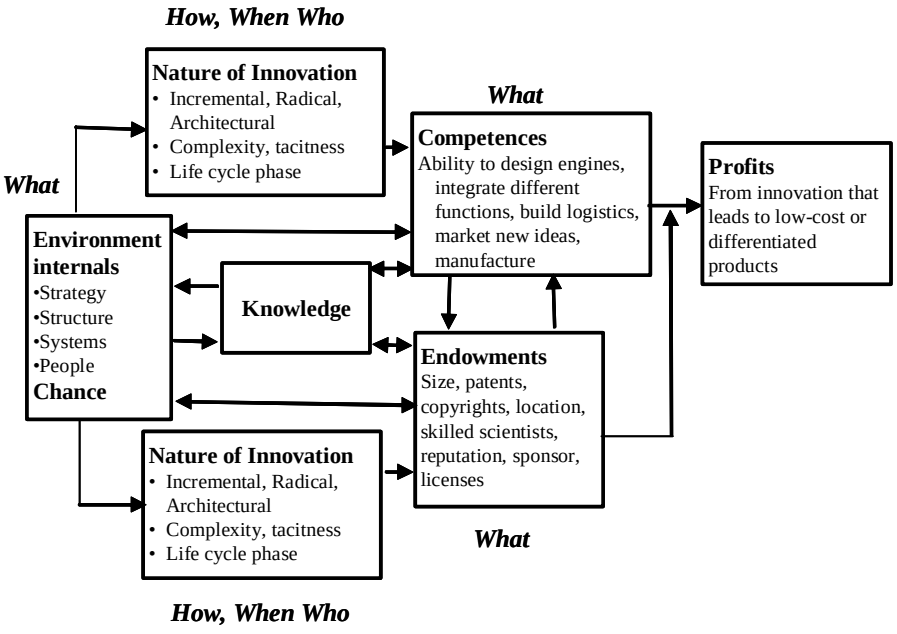

Fig: Integrative model for exploring how to profit from innovation- adapted from Afuah 1998

Afuah -2: Strategic Innovation Process

Afuah (1998) also proposed this second framework as a "systematic process for strategy formulation and implementation that will allow us to profit from innovation". The twelve step process shown in the figure below involved the following phases as described by Afuah:

1. The firm has a mission and some goals.
2. It then scans the environment to identify opportunities and threats.
3. The firm evaluates the capabilities required to exploit the innovation.
4. Then the firm chooses the profit site e.g. whether to be a supplier, manufacturer, complementary innovator, distributor or customer.
5. The business strategy is decided e.g. low cost or differentiated.
6. The innovation strategy involves decisions on whether the firm will be a leader or follower with the innovation.
7. Functional strategy looks at resource allocation along the value-chain.
8. Globalisation strategy provides a road-map on when and how to go global. Steps 5 to 8 combine to determine the organisations strategic direction.
9. This step starts the implementation phase where the firm seeks the best organisational structure for the innovation
10. Here the organisation puts in place information systems and processes to monitor performance.
11. The success of the innovation rest ultimately with the skills, motivation and relationships of the people.
12. The final steps deals with protecting the log-term profitability of the innovation from competitors.

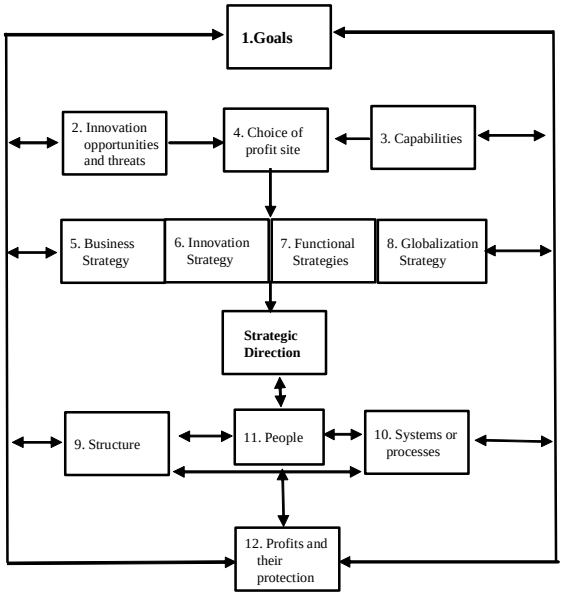

Fig: Strategic Innovation Process Model adapted from Afuah p.335

Afuah –the Antecedent Static models

Incremental –Radical Model

This model views an innovation in terms of its effect on firm capabilities and can be further classified into (Afuah, 1998 p 15) :

- **Radical Innovations**: which require very different knowledge from that already exists in the firm and can be described as *competence destroying*
- **Incremental Innovations** which builds on existing knowledge and can be described as *competence enhancing.*

One implication from this static analysis suggests that new entrants are more likely to seize the initiative when it comes to radical innovations. However, this is not always borne out by evidence from case studies such as IBM's transition from vacuum tubes to transistors and then to integrated circuits (ICs) in their mainframe computers.

Abernathy-Clark Model

The Abernathy-Clark model suggests why incumbents are more likely to do better than new entrants as quoted in the IBM example. According to their framework two kinds of knowledge are important when evaluating an innovation: technological and market. Thus their model classifies an innovation in terms of its impact on both the technological and market knowledge of the organisation.

Henderson-Clark Model

Henderson and Clarke tried to address the rather puzzling phenomenon where incumbent firms seemed to have difficulty with incremental innovations. This led them to propose another classification that of *architectural* knowledge. The point here is that while a firm might have excellent knowledge of components they may not be able to link them together in *architectural* innovations, For example RCA had a dominant position in electronic components but was not able to link them together to develop a portable transistor radio.

Innovation Value-Added Chain Model

This model tried to explain the conundrum why incumbents might win in the case of radical innovations but fail to new entrant in incremental innovations. The answer they proposed required the firm to look outside and review the effects of the innovation of the supplier and customer competitiveness and capabilities.

Afuah –the Antecedent Dynamic models

The following section provides a short review of models that address the issue with the shortcomings of the previous "static frameworks. These model take a longitudinal view of an innovation which consider that technology has both radical and incremental phases that need

to be considered following the introduction of an innovation. The evaluation is taken from Afuah (1998 p 37)

Utterback-Abernathy Dynamic Model of Innovation

This model introduces dynamism into the innovation life-cycle by considering it to be composed of three phases: fluid, transitional and specific.

The concept of dominant design is introduced; emerging from the transition from the fluid phase where a lot of technical and market uncertainties exist to a situation where "major components and underlying core concepts do not vary substantially from one product model to another".

Furthermore, it predicts that industries evolve "in a relatively predictable manner from one phase to the other".

Tushman-Rosenkopf Technology Life-Cycle Model

This model is similar to the previous one and argues that "technological progress depends on factors other than those internal to the technology".

Foster's S Curve

The contribution of Foster's S curve is that it proposes a way of "predicting the end of an existing technology" and as it approaches its physical limit the return on effort is becomes very small. This signals the arrival of a "technological discontinuity".

Amabile: Model for Assessing the Climate for Creativity (KEYS)

Theresa Amabile's research, based in the Harvard Business School, has identified certain characteristics that support creativity in an organisation (Amabile et al., 1996). Furthermore she has developed a framework for assessing the climate for creativity which is known by the acronym KEYS. The instrument is designed to assess "perceived stimulants and obstacles to creativity in organizational work environments".

The figure below shows the five main environmental components of her model on the left-hand side:

- **Encouragement of creativity** *(which encompasses open information flow and support for new ideas at all levels of the organization, from top management, through immediate supervisors, to work groups);*
- **Autonomy** *or freedom (autonomy in the day-to-day conduct of work; a sense of individual ownership of and control over work);*
- **Resources** *(the materials, information, and general resources available for work);*
- **Pressures** *(including both positive challenge and negative workload pressure);*
- **Organizational** *impediments to creativity (including conservatism and internal strife).*

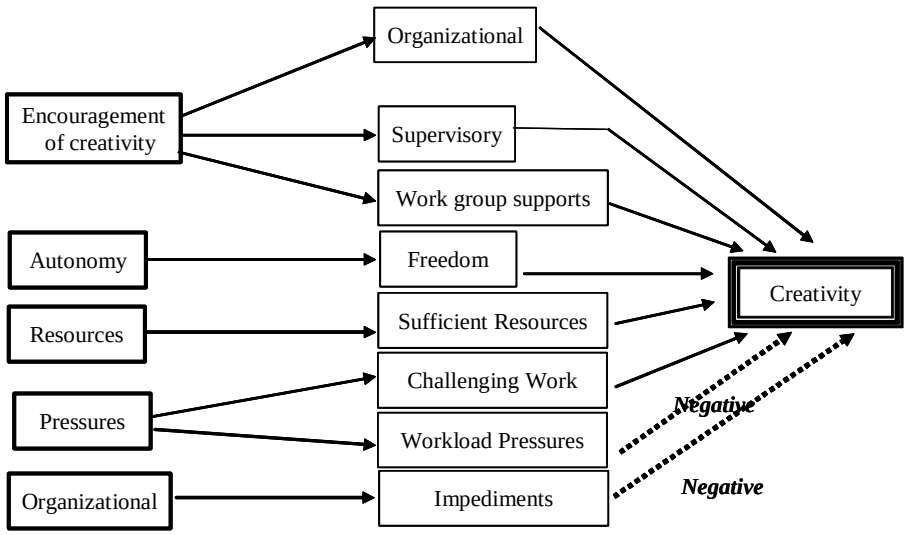

Fig. Model for Assessing the Climate for Creativity (KEYS)

Angle and Van de Ven : Innovation Journey

The Minnesota Innovation Research Program (MIRP) program was carried out by approximately 40 researchers, now scattered among faculty across the globe, who conducted longitudinal studies of 14 innovations during the 1980s. Their work was originally published in 1989. Arising from the research, which involved 10 years of data gathering followed by 10 years of analysis, Angle and Van de Ven (2000) , proposed the framework ,shown in the figure below, to manage the innovation journey. The framework was an extension of a previous front-end "fireworks" model developed by Schroeder, Van de Ven, Scudder and Polley (Schroeder et al., 2000). For the purpose of this review is it interesting to note that while Schroeder *et al.* (2000 pp. 109-112) summarise approximately sixteen "major process model from the literature" covering: Group development models, Decisions process models, Organizational planning models, Organizational change and development models and Innovation Process Models.

Three innovation process model are included: Usher (1954), Abernathy and Utterback (1975) and Rogers (1983). All but Usher are dealt with in this review.

The "innovation journey" partitions the process of innovation into three temporal periods:

- **Initiation Period** involves "setting the stage for launching efforts to develop and innovation. This period includes steps 1 to 4 in the figure.
- **Development Period** which involve committed efforts to "transform the innovative idea into concrete reality". This period includes steps 4 to 11 in the figure.
- **Implementation/Termination Period** after which the innovation is either (a) "adopted and institutionalized as an ongoing program, product or business" *or* (b) "terminated and abandoned". This period includes steps 12 to 15 in the figure.

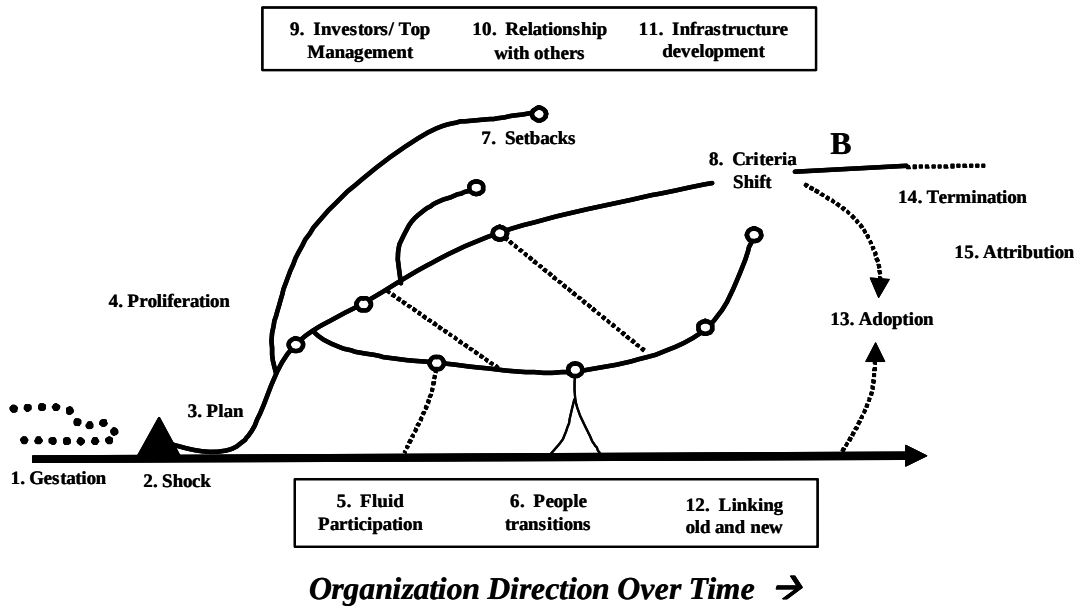

Fig. The Innovation Journey (adapted from Angle and Van de Ven 2000)

The three temporal periods of an innovation that is launched in the direction of point B are shown in the figure above and will now be described in more detail. However the significance of these components will vary from one innovation journey to another.

Initiation Period

1. **Gestation**: Innovations are not normally "spur of the moment" events but tend to gestate (usually over some years) in the organization.
2. **Shocks**: concentrated efforts to kick start an innovation is usually triggered by "shocks" emanating from either inside or outside the organization.
3. **Plan:** Plans are developed to obtain resources (e.g. a business case).

Development Period

4. **Proliferation**: When development begins the initial idea soon develops into several ideas resulting in divergent paths that are complex to manage.
5. **Fluid Participation:** Part-time involvement and high turnover typically results in difficulties maintaining momentum and organizational memory.
6. **People Transitions:** Emotion profile during a project is characteristically: euphoria at start; frustration and pain in the middle; closure at the end.
7. **Setbacks:** mistakes and unforeseen factors can significantly alter the underlying assumptions of the innovation and may result in veering off along a different track.
8. **Criteria Shift:** Success and failure criteria can shift and even diverge in different directions depending on such things as politics, balance of power in the organisation and external pressures.
9. **Investors/ Top management:** Typically these actors take on four roles in the journey: sponsor, critic, mentor and institutional leader.
10. **Relationships with others:** Transactions or relationships with others often produce unintended consequences. Examples include: increased risk; *cosy* relationships resulting in *groupthink*; desertions due to mergers and acquisitions.
11. **Infrastructure development:** In the broader context, managers are usually involved with external actors to develop an innovation infrastructure such as government agencies, academics, trade associations and even competitors.

Implementation/ Termination Period

12. **Linking old and new:** This implies the *new* innovation is usually grafted onto the existing (*old*) organizational arrangements.

13. **Adoption:** This is facilitated when a) the innovation is modified to fit the local situation; b) top management is extensively involved and committed; and c) process facilitators help people understand and apply the innovation.
14. **Termination:** Innovations stop when implemented or when resources run out.
15. **Attribution:** Managers make attributions concerning the success or failure of the innovation which influence both future organizational actions and the careers of the participants in the journey.

Basadur and Gelade: Innovative Thinking Process

Basadur and Gelade (2006) "argue that current concepts of knowledge management and organizational learning are, by themselves, limited in their ability to improve organizational effectiveness". As a result they propose a single framework that combines the "*apprehension* of knowledge (understanding) with the creative utilization of such knowledge". Previous work by Gordon (1956) cited in their paper, had linked learning and inventing as two parts of a continuous process. In this conceptualisation learning was regarded as the process of *gaining knowledge or understanding* while inventing involved *using the knowledge or understanding*. Furthermore they define a thinking organisation as one that:

a) Recognises that value of breaking old and out-dated paradigms with new and better ones

b) Knows how to do so.

Their process model consists of four stages shown in the figure 1a) below:

i) **Generating**: the proactive acquisition and generation of new information, and the sensing of trends, opportunities and problems (opportunistic surveillance)

ii) **Conceptualization**: of new challenges and ideas

iii) **Optimizing**: development and optimization of new solutions

iv) **Implementing**: actions to implement new solutions or ideas

In figure 1b) below, Basadur and Gelade show the Innovation process in terms of 2 dimensions: apprehension of knowledge on the y-axis and utilization of knowledge on the x-axis. They suggest that both individuals and organizations gain knowledge both by doing (experiencing) and by pondering (mental processing). Also utilization of knowledge is a bi-polar process of either creating or evaluating options. In both cases the relative amounts or ratios will differ across the spectrum of individuals and organizations.

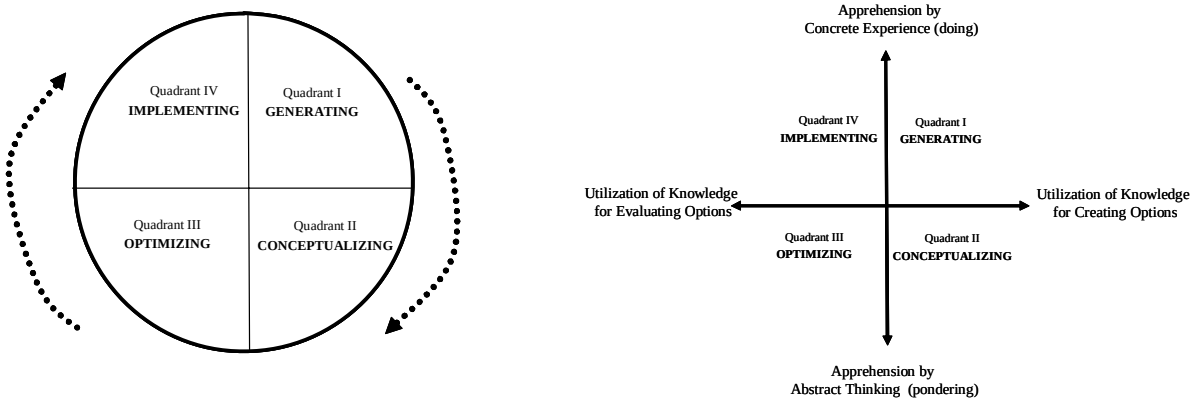

Fig 1: a) 4-stage Innovative Thinking Process and b) 2- Dimensions of the Innovation Process

Chesbrough: Open Innovation Process

Henry Chesbrough (2003) argues that in many industries the centralised approach to R&D which he terms "closed innovation" has become obsolete. This paradigm, he contents, must be replaced by "open innovation" which adopts external ideas and knowledge in conjunction with the internal process. A number of factors are influencing this change such as: the mobility of skilled people; the increasing presence of venture capital, emergent high-tech start-ups and the significant role of university research. Companies such as Cisco and Intel have adopted the new paradigm in contrast to Xerox which has lost many innovators due to its closed systems. One of his principles is that "not all the smart people work for us" and he advocates that the smart people within an organisation connect with the smart people outside. Embracing the ideas and inspiration in these external links, he contends, will actually multiply the advantage of internal efforts. However, connecting external innovation to internal innovation requires a new business model with the following six functions:

- Articulate the value proposition
- Identify a market segment
- Define structure of your value chain
- Specify revenue generation mechanisms and estimate cost structure and target margins
- Describe firms position in value network of suppliers and customers
- Formulate the competitive strategy

Implementation of the business model can be greatly accelerated by buying and selling intellectual property (IP). However, there always remains the hard work of converting research ideas into products and service that solve customer's problems. Interestingly he states that the presence of manufacturing, distribution and brand are assets that help the firm retain some of the value it creates. Chesbrough's original work was seen to be largely aimed practitioner audience and he research suggestions have only recently been subjected to rigorous academic debate (Chesbrough, 2006). An interesting debate, is presented by the recent research of Lester & Piore (2004) in MIT whose defence of the importance of "interpretative spaces", we argue, challenges much of Chesbrough's thesis. However this debate is outside the scope of this review.

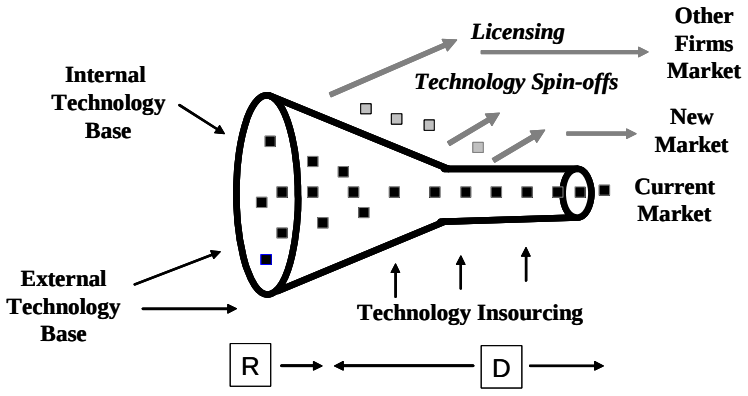

Fig: An open innovation Model - adapted from (Chesbrough, 2006)

Cooper and Kleinschmidt: Stage-Gate Product Innovation Process

The new product development process originated by Robert G. Cooper has been implemented by more than half the US firms involved in product development (Cooper, 2001).

The Stage-Gate process (Cooper & Kleinschmidt, 1993) was first introduced solely in the area of product portfolio management, but the approach is now being extended to other types of projects and has been introduced into companies in Europe and Japan. Cross-functional teams carry out the most successful implementations.

The innovation process provides a road-map that takes an idea through an initial screening, through constructing a business case, the development of the product, testing and validation to the product launch.

Each stage must pass through a gating process, which in effect is a presentation of detailed deliverables (for example, a design specification, a production plan, a marketing strategy) to a decision making body such as a portfolio management team. This team will then provide their assessment whether to commit further resources so that the project can move on to the next stage.

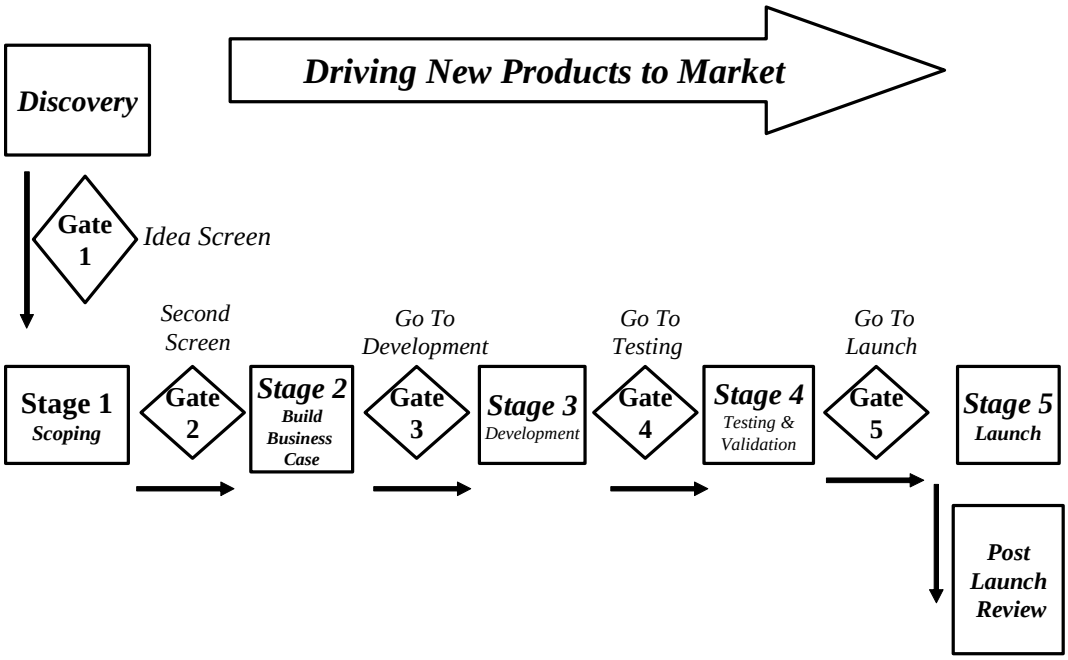

Fig: Stage-Gate Product innovation Process (adapted from Copper 2001)

Dodgson, Gann and Salter: Think, Play, Do- Innovation Schema

Dodgson *et al.* (2005) propose that a range of new technologies such as: simulation and modelling tools, virtual reality, data mining and rapid prototyping have lead to the *intensification of innovation*. They have used an umbrella term – innovation technology (IvT) to describe these new tools and methods. IvT they argue is being increasingly applied to innovation and indeed is dramatically changing the nature of the innovation process. Furthermore they contend that IvT is having a significant influence on the "the creative tasks and the ways knowledge is constructed, shared, and used. They describe their schema of the application of IvT to the innovation process in terms of three characteristics: *thinking, playing* and *doing*.

- **Think**: in that IvT can liberate creative people from mundane tasks and enable them to experiment more freely and widely resulting in the production of a variety of options.
- **Play**: design, prototyping and testing can be carried out more effectively and economically. Also, investment choices can be delayed until market and technology patterns become clearer.
- **Do:** the increasing "digital" integration with other types of technology provides innovators with greater confidence in their ability to transform ideas into products and services.

Furthermore they argue that the IvT enablement of thinking, playing and doing is a major support to organisations in dealing with: *disruptive innovation* (doing things differently) and *incremental innovation* (doing existing things better)

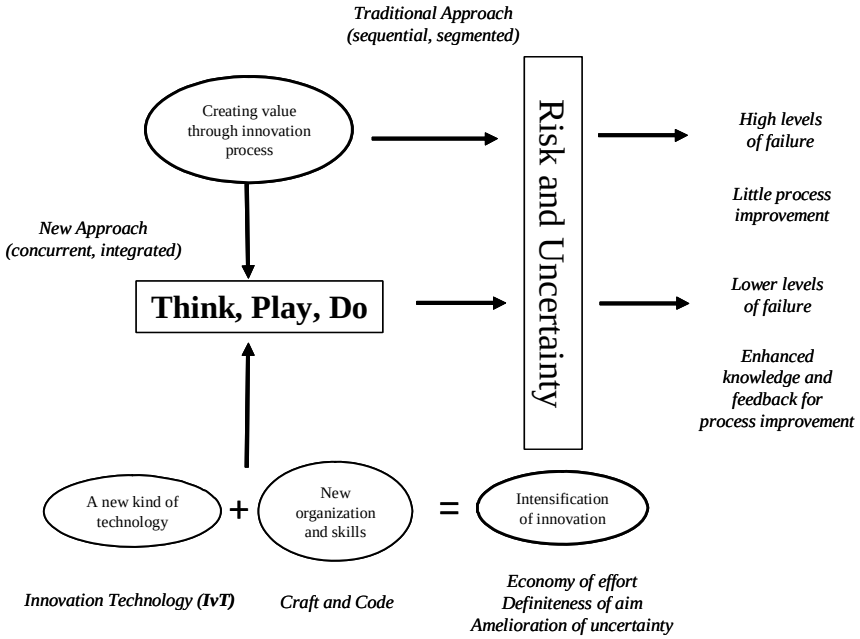

Fig: The intensification of innovation adapted from Dodgson *et al.* (2005)

Ekvall: Organizational Climate for Creativity and Innovation

Göran Ekvall, in his work in the University of Lund, developed an instrument for measuring organizational structure and climate for creativity and innovation (Ekvall, 1996). The instrument evolved from a Swedish research program in the 1980s which investigated conditions that "stimulate or hamper creativity and innovation" in organisations. Significantly, following Schein (1985) he differentiated between climate and culture and argues that climate "should be regarded as a manifestation of culture". Ekvall (p.105) described climate in the following terms:

> … a conglomerate of attitudes, feelings, and behaviours which characterizes life in the organization, and exists independently of the perceptions and understandings of the members of the organization.

The model in the figure below shows Ekvall's conceptualization of climate as an "intervening variable" that affects the organization's operational characteristics.

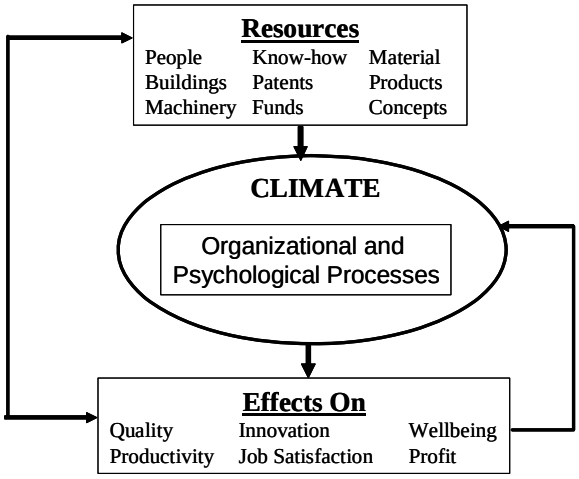

Fig: Organizational climate as an intervening variable –adapted from Ekvall(1996)

He identified ten dimensions from the theoretical literature, field research and consultancy in the area of organizational psychology. These were incorporated in a Creative Climate Questionnaire (CCQ) with five questions in each of the following ten sections.

Challenge	The emotional involvement of the members of the organization in its operations and goals.
Freedom	The independence of behaviour exerted by the people in the organisation. For example, freedom to make contacts and give and receive information.
Idea Support	The ways in which new ideas are treated.
Trust/Openness	The emotional safety in relationships – initiatives can be taken without fear of reprisal or ridicule in case of failure.
Dynamism/Liveliness	The eventfulness of life in the organization.
Playfulness/Humour	The spontaneity and ease that is displayed – relaxed atmosphere with jokes and laughter.
Debates	The occurrence of encounters and clashes between viewpoints, ideas and differing experiences and knowledge.
Conflicts	The presence of personal and emotional tensions (in contrast to conflicts between ideas).
Risk Taking	The tolerance of uncertainty in the organisation.
Idea Time	The amount of time people can use (and do use) for elaborating new ideas.

Flynn,Dooley,O'Sullivan and Cormican: Innovation Funnel

Flynn *et al* (2003) provide their version of the innovation funnel which is a widespread concept used in the innovation literature. Their model consists of a sequence of "stage-gates" (See Copper and Kleinschmidt Framework) that initially screens ideas and then filters any subsequent actions as they flows along the innovation process as shown in the figure below.

Interesting their version of the concept consists of two funnels:

- The Larger Funnel encompasses the totality of the innovation process from initial idea generation, through the project implementation phase to the final step of monitoring the results.
- The Smaller Funnel "focuses on the creativity process". The concept here is to provide an avenue that takes loose "creations" gather from a variety of "stimuli" that are transformed into concrete ideas ready to be fed into the larger funnel. These are then classified as "projects" that require allocation of resources and when implemented the results are compared with the initial goals.

As part of their research this team developed a "Creations Software Tool" to gather and record stimuli from customer, competition, environment, technology and process, socio-cultural and regulatory sources; in order to identify opportunities and facilitate the generation of ideas.

Another feature of their adaptation is that the funnel caters for ideas that they term "quick-wins" which can be fast tracked to implementation without going through the complete larger funnel process. However their interpretation of an innovation as the output (e.g. ideas and problems) from the "creativity process" would seem to be different than most definitions in the literature that require an idea to be implemented before it can be classified as an "innovation".

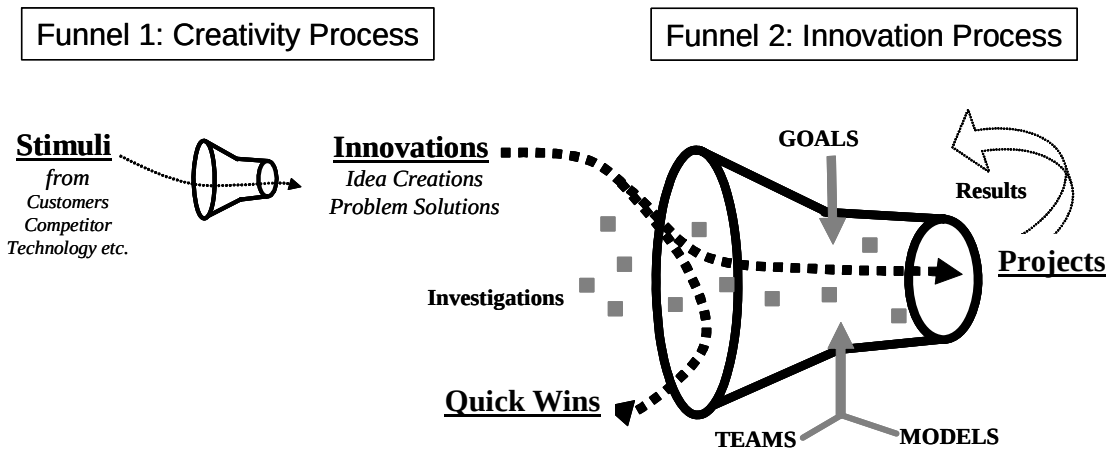

Fig: The innovation Funnel (adapted from Flynn et al.)

Goffin and Mitchell: Pentathlon Framework

Goffin and Mitchell (2005) argue that culture, climate, and the management of innovation and change will influence the person's tendency to innovate. They insist that there are "no 'quick fixes' in a complex field such as innovation management". Consequently they propose the analogy of a "Pentathlon" which consists of five areas: innovation strategy, ideas, prioritization, implementation, people and organisation. Furthermore they seek to address the issue that most research on innovation has focused on products rather than services while developed economies are now largely service-driven. They also stress that innovation management is requires a very different from general management principles and that the discipline is in many ways in its "infancy". Their propose Pentathlon framework identifies, as the name implies, "five main *areas* or *elements* of innovation management". These areas are shown in the figure below.

- **Innovation strategy**: This step involves focusing on a number of areas such as, market trends, role of technology, communication of the role of innovation and matching resources to strategy.
- **Ideas:** they ague are the ram material for innovation and the development of a culture of creativity that should harness knowledge from both inside and outside the organisation. Good ideas they propose "blend technical, customer and market requirements".
- **Prioritization:** This involves setting up an efficient decision-making process to ensure that the optimal ideas are chosen for progression to products, service or a new process. Furthermore the innovation portfolio must be matched to the innovation strategy.
- **Implementation:** This phase requires effective cross functional team that can quickly and efficiently progress the innovation through prototyping and testing to commercialization.
- **People and Organisation:** This section focuses on the human resource requirements and supports needed for effective innovation such as; hiring and training, job design and appropriate organizational structures.

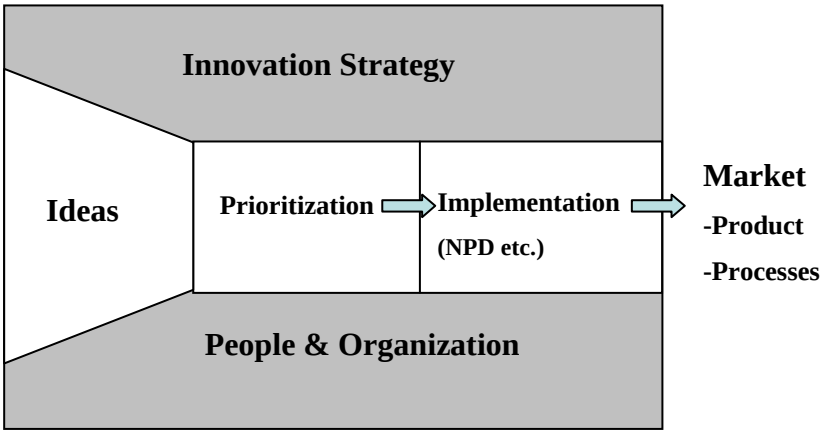

Fig: The Innovation Pentathlon Framework – adapted from Goffin and Mitchell (2005)

Roberts & Fusfeld: Multi-Stage Innovation Process

Roberts & Fusfeld (2004) propose an approach to innovation that is broadly similar to the early theorists who focused on innovation as a production process. The six stages that they identify are shown in the figure below. Their paper examines these stages of a technology-based innovation process in terms of certain *people functions* that they argue are "usually informal" but none the less "critical".

However an examination of the stages seems to indicate that it suffers from some of the worst excesses of "over-the-wall" engineering. For example the market evaluation is only completed at stage 15 while step 16 is "transferring the development to the next un it down the line". It would seem that this process requires some concurrent *engineering* work.

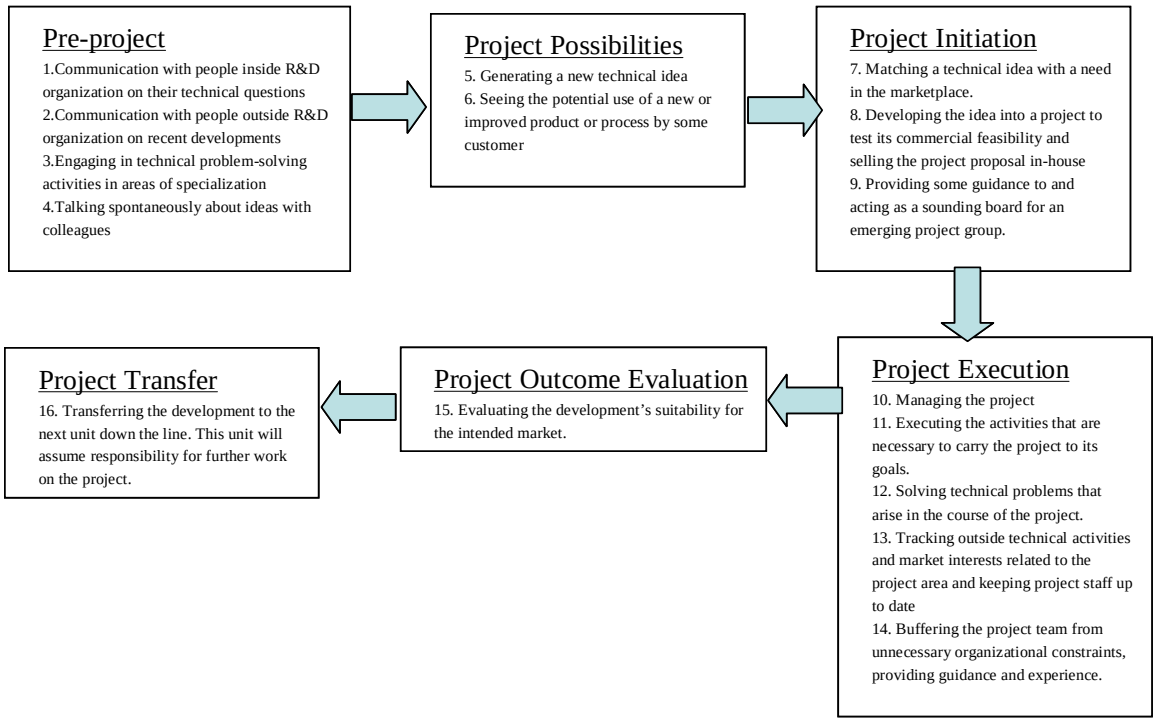

Fig: A multi-stage view of a technical innovation project – adapted from Roberts & Fusfeld (2004)

Rogers: Innovation-Development Process

The innovation-development process as defined by Rogers (2003 p 138) consists of the six steps shown in Figure 1. The methodology includes "all the decisions, activities and their impact" from the initial recognition of a need; followed by research, development and commercialisation through to diffusion and evaluation of the consequences.

The steps are shown in the figure below and consist of:

- **Recognising a problem or need:** this initial stage provides the stimulus to the research and development (R&D) activities to develop an innovation to solve the problem or need. However it must be remembered that some new ideas are a result of serendipity such as SMS (short message service) accidentally evolving into "texting".

- **Basic and Applied Research**: The main area of Roger's research was technological innovation which by and large results from basic scientific research. Applied research usually addresses practical problems.

- **Development**: This stage according to Rogers "is the process of putting a new idea in the form that is expected to meet the needs of an audience of potential adopter".

- **Commercialization**: is defined by Rogers as "the production, manufacturing, packaging, marketing, and distribution of a product that embodies and innovation".

- **Diffusion and Adoption:** Here Rogers emphasises the importance of *innovation gatekeeping:* that is "controlling whether or not an innovation id diffused to an audience of potential adopters".

- **Consequences**: This is defines as the "changes that occur to an individual or to a social system as a result of the adoption or rejection of an innovation".

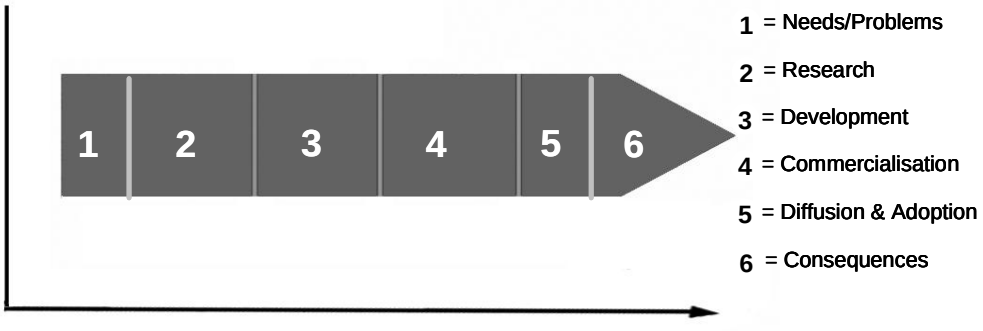

Fig: innovation-development process –adapted from Rogers (2003)

Tidd *et al.* (2005) examine innovation under four broad categories

- Product
- Process
- Position (eg. target market)
- Paradigm (e.g. change in *mental models* such as the move to low cost airlines)

They also analyse innovation based on the degree of novelty involved spanning from incremental to radical changes. Furthermore they differentiate between the innovation dimensions: whether they occurs at a component level or a system level. This concept is captured in the following figures.

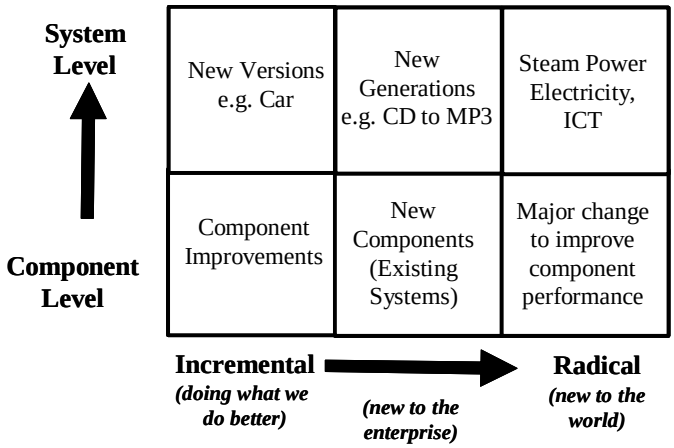

Fig a: Dimensions of Innovation -adapted from Tidd et al. (2005)

The next figure takes the 4Ps and maps them in an "innovation space" where an enterprise can operate. Whether an organisation "explores and exploits" this space is very much dependant on the innovation strategy.

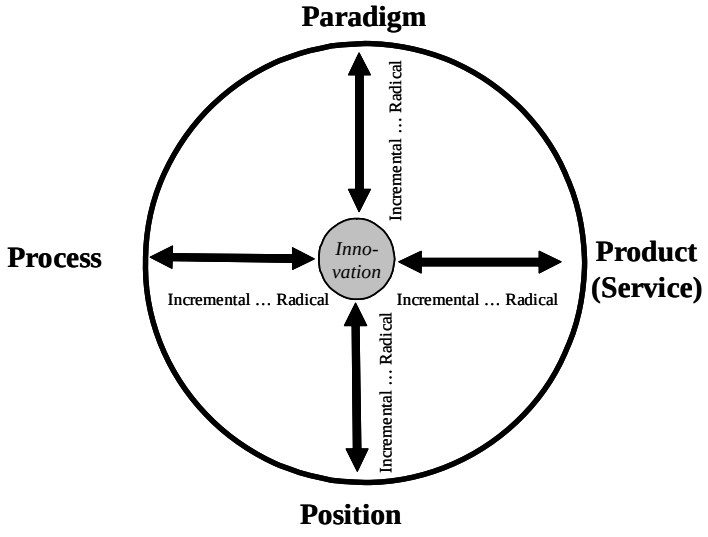

Fig 1b: Map of the Innovation Space-adapted from Tidd et al. (2005)

They then provide their conceptualisation of the core innovation process which they argue is generic to all businesses. The process involves the following attributes taken from Tidd et al. (2005 p 67):

- **Searching**: scanning the environment (internal and external) for, and processing relevant signals about, threats and opportunities for change.

- **Selecting**: deciding (on the basis of a strategic view of how the enterprise can best develop) which of these signals to respond to.

- **Implementing:** translating the potential trigger idea into something new and launching it in an internal or external market. This involves a number of subsets:

    - **Acquiring:** the knowledge and resources

    - **Executing:** the project under conditions of uncertainty which require extensive problem-solving

    - **Launching:** the innovation and managing the process of initial adoption

    - **Sustaining:** the adoption and use in the long term –or revisiting the original idea and modifying it – re-innovation

- **Learning**: enterprises have to (but may not always take) the opportunity to learn from progressing through this cycle so that they can build their knowledge base and can improve the ways in which the process is managed.

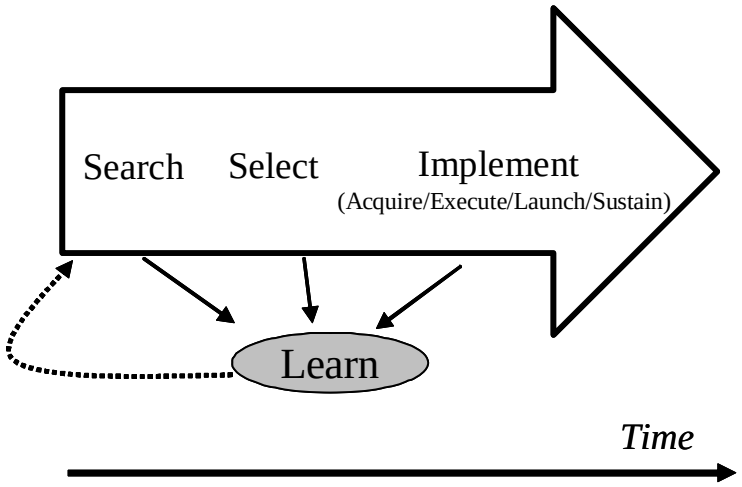

Fig: Generic Innovation Business Process-adapted from Tidd et al. (2005)

Zaltman Duncan, Holbek Innovation Model

The work of Zaltman *et al.* (1973) , we argue is important when attempting to link innovation to organisational change. In this work the authors define innovation as "any idea, practice or material artifact perceived as new by the relevant unit of adoption". This perception of newness, moreover serves to differentiate innovation from change and they go on to comment that while all innovations imply changes the converse is not always the case since "not everything that an organisation adopts is perceived as new". In this work they developed their contingency theory of innovation which predicts that the effect of structural variables will be contingent on their two main sub-divisions of the innovation process: the "initiation" stage and the "implementation" stage. Their proposed stages of the innovation process are shown in the table below:

Table: Stages of Innovation-Adoption Process adapted from Zaltman et al. (1973) p 158

Stage:	**Initiation**	**Implementation**
Sub-Stages:	1. Knowledge Awareness 2. Formation of attitude toward innovation 3. Decision	1. Initial implementation 2. Continued-sustained implementation

Furthermore they develop, according to Slappendel (1996) , "arguably the best known contingency theory of innovation". In this theory they postulate, based on their analysis of the relationship between organizational structure and innovation, that there is "no one best form for structuring organizations" (Zaltman et al., 1973 p 134). They then identify three main characteristics of organisations which they argue facilitate both the initiation and implementation stages of the innovation-adoption process: *complexity, formalization and centralization*. According to their theory, the gathering and processing of information at the initiation is facilitated by higher levels of complexity and lower levels of formalization and centralization. However the converse pertains during the implementation stages which are facilitated by lower levels of complexity and higher levels of formalization and centralization. Additionally they introduce two "mediating factors" to assist organisations ability to differentiate the degrees of *complexity, formalization and centralization* for each of the two main stages: firstly a "high capability for effective interpersonal relations" and secondly "a high capability for dealing with conflict". Their conclusion is that organisation must be able to adapt their structures while moving through the innovation stages. The earlier stage will require a more-organic and less-bureaucratic arrangement while in the later stage a more mechanistic structure is called for. These characteristics, structural variable and mediating factors are summarised in the following table.

Table: Structural Variable and Mediating factors adapted from Zaltman et al. (1973) p 159

Initiation Stage	← Mediating Factors →	Implementation stage
Higher Complexity	High capability for effective interpersonal relations	Lower Complexity
Lower Formalization	High capability for dealing with conflict	High Formalization
Lower Centralization		High Centralization

The Innovation Dilemma

According to Zaltman *et al.* the most important contribution by James Wilson as part of his theoretical work on innovation in the 1960s was the identification of the *innovation dilemma* which organisations face during the process of innovation. Wilson had concluded that it is easier to initiate than implement innovations by stating that it is "easier to increase the organizations capacity to generate new proposals than it is to increase its capacity to ratify any given proposal" Wilson (1966b) cited in Zaltman *et al.* p. 178. Wilson had taken into account the characteristic of *complexity* but however did not consider *formalization and centralization.*

We have attempted to conceptualise the second generation innovation dilemma proposed by Zaltman *et al.* in the figure below.

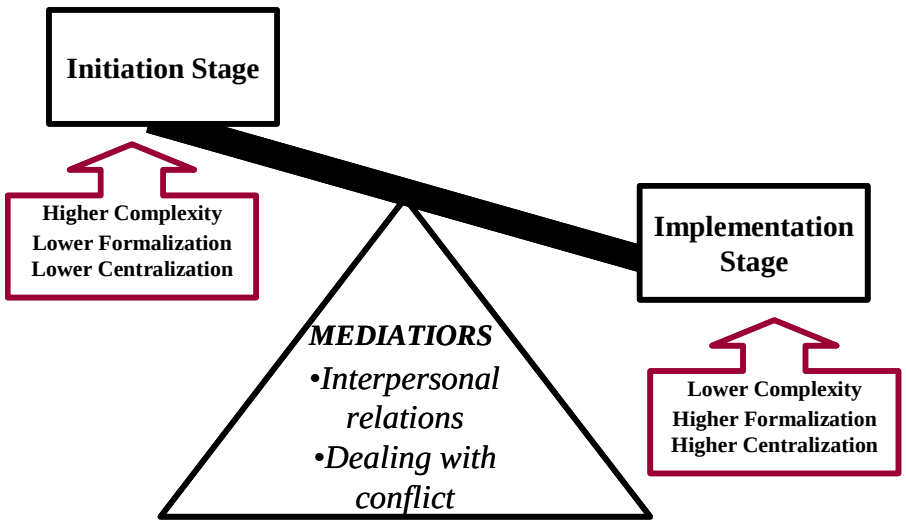

Fig: Conceptualisation of the Zaltman *et al* Innovation Dilemma

Innovation Process Frameworks: Information Systems Literature

Swanson's Tri-core Model

Swanson (1994) argued that current innovation theory had done little to explain IS innovation and where it stood within the general debate on organisational innovation. To address this situation he posited the following three types of IS innovation to provide a new theoretical impetus:

Type I : innovations confined to the IS task

Type II: innovations supporting administration of the business

Type III : innovations imbedded in the core technology of the business

To explain the concept, Swanson graphically presented this typology as a tri-core model of IS innovation with the innovation core sandwiched in a swiss-roll arrangement between the inner technical core and the outer administration core. A number of points in the model are important for this study. Firstly, the Type III category is further divided into three areas: Type IIIa-core technology process innovation such as Computer Integrated manufacturing (CIM) : Type IIIb - core technology product innovation such as Remote Customer Order Entry and Type IIIc- core technology integration innovation such as Electronic Data Interchange (EDI). These IS innovation types are summarised in the table in the next section.

This begs the suggestion whether speech-enabled self-service systems could be accommodated within an additional Type IIId classification due to relatively recent diffusion of this technological innovation (see next section). Secondly, the point is made that the cascading consequences of new technological developments can have far-reaching implications for IS innovations. Thirdly, he argues that it may not be sufficient to study IS innovations individually but bundled with associated innovations. Fourthly, the conclusion that there is a need for longitudinal studies that give due consideration to the institutional supports and constraints of the technological process is noteworthy. A subsequent empirical testing of the model resulted in "cautious optimism" but suggested a need for further theoretical work to refine, elaborate and extend the system (Grover et al., 1997). The implications for the emerging areas of self-service business on this typology of innovation types will be discussed later.

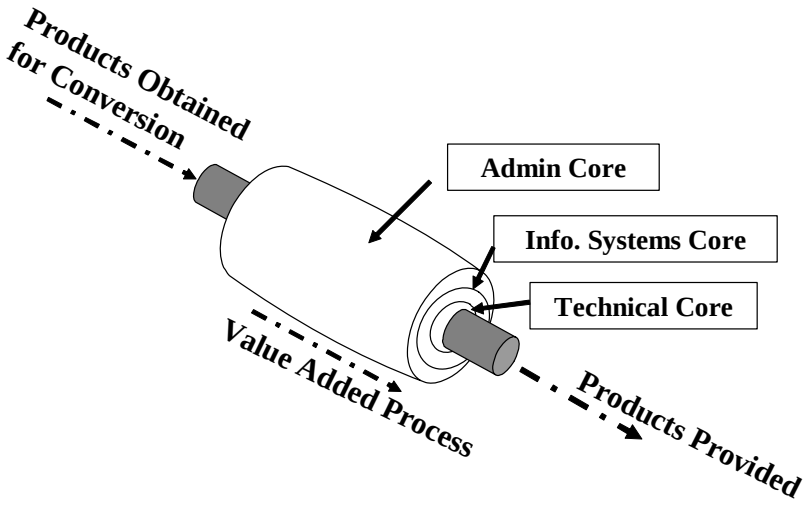

Fig: A Tri-core representation of IS Innovations in Organizations -adapted from Swanson (1994)

Table: Swanson's Innovation Types : from page 1076 of Swanson (1994)

Innovation Types	**Description**	**Examples**
Type Ia	IS Administrative Process Innovation	Maintenance departmentalization, CIO
Type Ib	IS Technological Process Innovation	Systems programming, data administration, prototyping
Type II	IS Product and Business Administrative Process Innovation	Accounting systems, EIS
Type IIIa	IS Product and Business Technological Process Innovation	Material Requirements Planning (1950s and 1960s) Computer Integrated Manufacturing (1980s and 1990s)
Type IIIb	IS Product and Business Technological Product Innovation	Airline Reservation Systems (1970s and 1980s) Remote Customer Order Entry and Follow-on Customer Service systems (1980s)
Type IIIc	IS Product and Business Technological Integration Innovation	Inter-organizational Information Systems (1990s) Electronic Data Interchange (1980s and 1990s)

Tri-core add-on: Rose and **Lyytinen's Quad Core**

Rose and Lyytinen (2001) proposed an extension of Swanson's Tri-core model "in order to account for observed radical changes in systems development and IS service due to Internet induced innovations".

Table : Classification of Innovations in Table 1 within Swanson's Tri-Core Model

Innovation Types	**Classification of Propositions**
Type Ia	ISD1, ISD2, ISD3, ISD5
Type Ib	ISD4
Type II	Non-strategic intranets, routine data and information delivery, document management
Type IIIa	Strategic intranets, R&D related knowledge management, business intelligence
Type IIIb	B2C order entry applications
Type IIIc	Extranet service applications, electronic market places

THE QUAD-CORE MODEL

A fourth level was developed by Rose and Lyytinen's to address "how diffusion and adoption of IT innovations in organizations takes place. *This level includes: (IVa) fundamental changes to the base technology capability in terms of functionality, speed, reliability, or architectural principles; (IVb) IS development modality innovations, i.e., innovations dealing with generic features of ISD; and (IVc) IS service modality innovation i.e. innovations dealing with generic features of IS services. We will refer to this core level with its three subsets as the* ***base IT innovation core.***

Table 4. Classification of Internet Technology Frame Innovations within the Base IT Innovation Core

Base IT Innovation Types	**Classification of Propositions**
Type IVa	TF1, FC1, FC2, FC3, FC4, FC5, FC6, FC7, FC8, FC9
Type IVb	ISS2, ISS4
Type IVc	ISS1, ISS3, ISS5

The key to the acronyms are given in the next table.

Table : Internet Induced Innovation Characteristics in IS

TF1	New Technology Frame - the Internet induced Technological Frame
FC1	Uniform clients (browser) with multimedia and platform independence (Java, Java Scripts, Java Beans)
FC2	Clients will have the same look and feel as traditional clients.
FC3	Readable scripts and metadata in HMTL /XML code complement traditional compiled code
FC4	Importance of the middleware to glue components, new services, and legacy systems together. Uniform service interfaces allow single-user, workflow, and group-level services configured into the same client interface
FC5	Highly functional telecommunication services, including wireless become widely available and part of the design space.
FC6	Component-based capability allows for granular, configurable, market driven software and cross platform distribution and wrapping
FC7	Data of any kind can reside anywhere on the network and be posted dynamically with a Web interface
FC8	Borderlines between structured and unstructured data will become blurred at interface and database levels
FC9	Separation of User Interface and Application Logic
ISS1	Ubiquitous services available anytime and anywhere.
ISS2	New technologies and skills for development needed and many made obsolete at record pace
ISS3	New services provided for end users at a record pace
ISS4	Mainstreaming will create software component market

ISS5	IS service will change from computation-oriented to media-oriented.
ISD1	Telecommunication skills to become more critical
ISD2	User interface design skills are broadened
ISD3	Organizational design and change management skills are broadened
ISD4	ISD complexity profoundly increased
ISD5	ISD managerial skills need to be broadened to incorporate and manage new services and their heterogeneity

Tri-core add-on: Costello and Donnellan's SST addition

Costello & Donnellan (2007) proposed an extension of Swanson's typology of innovation types to include a Type IIId classification that is shown in the table below. The paper argued that the growing importance of self-service technology (SST) and self-service business has implications for IS innovation research.

The increased deployment of self-service technology (SST) in business transactions is being driven by the diffusion of information and communications technology (ICT) and the demand to move from high-cost manual transactions to low-cost automated self-service in enterprises and the public service.

Table : Proposed addition to table of innovation types –ref.

Innovation Type	Description	Illustrations
Type IIId	**IS Product and Business Technology Product and Process innovation**	**Self-service business systems (1990s)** **Speech-enabled business systems (1990s and 2000s)**

The paper also addressed the implications for the development of concepts and hypothesis related to IT and IS innovations. It argued that the present tri-core typology of IS innovations in organisations must re-align its focus outside of the host organisation itself due to increasing *ether-shoring* of customer interactions to self-service systems. This proposed extension of Swanson's typology re-fashions the present triangle of technology, information systems and administration to a diamond which captures the requirement for IS to develop an extra-organisational focus which, like Janus, also faces outwards to the very customer transaction itself which is now instantaneously transported to the enterprises digital front-door.

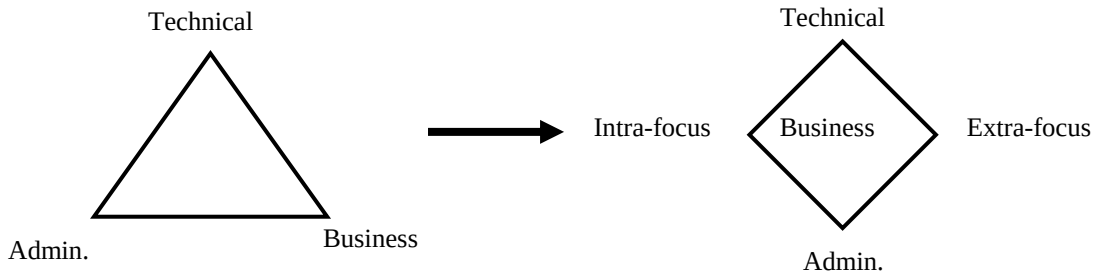

Fig: Expanding focus of IS Innovation types

Costello, Conboy, Donnellan & Rochford: Dolmen Framework (based on Tidd et al. audit framework)

Tidd *et al.* (2005 p 138) proposed that innovation must not be seen as a lottery but as a continuous improvement process and point out that, based on recent research on innovation successes and failures, a number of models have been developed to help assess innovation management performance. In order provide some initial reference point on innovation management, they have developed an assessment tool and audit framework. Such self-assessment tools have been widely used in the area of total quality management (TQM) in order to benchmark an enterprise against best in class, for example, the Malcolm Baldrige National Quality Award. The audit proposed five dimensions under which innovation management are to be assessed and profiled: strategy, process, organisation, linkages and learning (Tidd et al., 2005 p 568).

These dimensions were conceptualised and built on by Costello, Conboy, Donnellan and Rochford (2008) in the form of a *Dolmen* framework. A new dimension "environmental performance", was added based on the alignment analysis carried out as during the case study in which the framework was developed. The framework was proposed to the information systems development (ISD) community to facilitate the early stages of the development an *innovation IS* using the Multiview2 approach (Avison & Fitzgerald, 2003). The paper argued that the innovation "Dolmen[2]" followed Avison and Fitzgerald's argument that such frameworks can "more usefully be seen as a metaphor which is interpreted and developed in a particular situation". This conceptualization aimed to take a number of factors into account:

- cultural context: the "Dolmen" analogy is familiar in the West of Ireland and it gives the message of putting in place a system that will endure. A "Dolmen" (from the Breton for "stone table") is an ancient monument, found in many areas of Europe, consisting of two or more upright large stones that support a horizontal capstone.
- the concept seeks to impart the message that the innovation "culture/climate" is supported by a number of critical dimensions.
- some dimensions are more important than others e.g. strategy and processes being critical.
- some attributes closely depended on each other e.g. strategy and organization.

It was also considered significant that developing the "Dolmen" was aligned with Mintzberg's idea of "strategy as craft" and consistent with his identification of the multiple facets of strategy (Mintzberg, 1987).

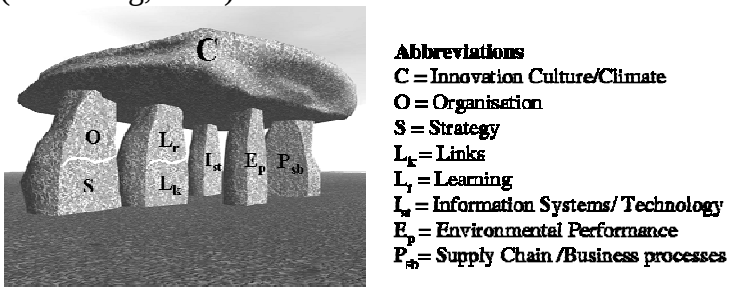

Fig. A representation of the innovation "Dolmen"

[2] A well-known Irish example is found in Poulnabrone, Co.Clare which dates from the Neolithic period, about 3,000 B.C.

A Statico-Dynamic Innovation Process Framework

The review of the literature identified that innovation process models and framework can be classified into two main groups: Static models and Dynamic models. The figure below attempts to synthesise these two concepts into a single framework. The idea here is that an organisation must: firstly put in place the static structural enablers that will create an innovation climate; and secondly put in place a dynamic process that can turn ideas into reality. Furthermore we argue that such a framework must take into account the innovation dilemma which organizations face during the innovation process. We will now outline the concepts in relation to the definition of an innovation process framework introduced earlier in this review.

- **Dynamic Process:** This is represented in the form of the classic innovation funnel that captures the *dynamic* temporal sequence of *actions* that occur over time in *discovering*, developing and implementing new ideas from concept to concrete reality Furthermore, building on the work of Flynn et *al.* we propose that an organisation can have a number of smaller funnels. For example, the creativity process may have a minor funnel and in the context of this work a specific sub-funnel for *agile work practices*.
- **Static Framework:** This is represented using the Dolmen concept and proposes that an organisation put in place the *static* structural dimensions (or climatic factors) that enable innovation. Furthermore these should be contextualized and tailored to suit the organizational milieu.
- **Innovation Dilemma**: This posits, following Zatlman *et al.*, that the organizational alignment must be balanced between the initiation and implementation stages in the areas of *complexity, formalization and centralization*.

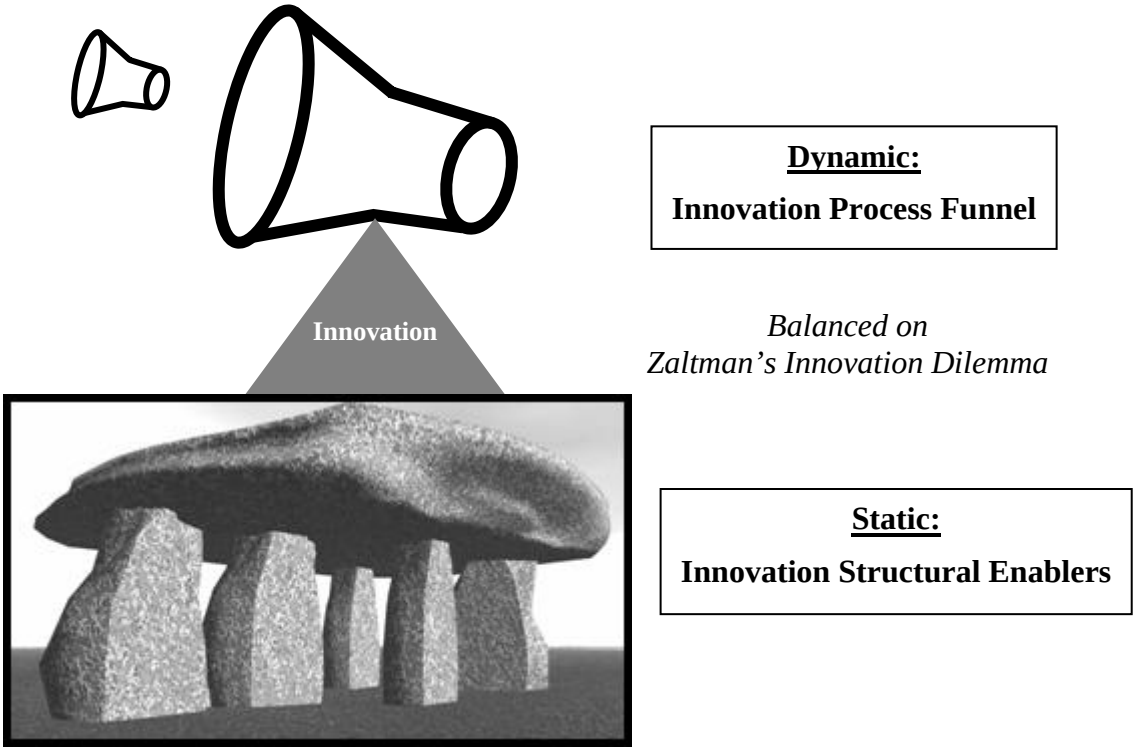

Fig: A conceptual view of the statico-dynamic innovation framework

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Appendix 1: Innovation Definitions Concept Matrix

APPENDIX 1: A CONCEPT MATRIX OF INNOVATION DEFINITIONS - DEVELOPED FROM McINERNEY (2004)

		CONCEPT: Adjective																CONCEPT: Noun																											CONCEPT: Verb																	OTHER	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Publication Year	**Author (s)**	**New**	**Novel**	**New to org.**	**Early Use**	**Portmanteau**	**First**	**Symbolisation**	**Departure**	**Radical**	**Incremental**	**Alternative**	**Technical**	**Competitive Advantage**	**Combination**	**Successful**	**Matching**	**Product**	**Process**	**Supply**	**Market**	**Organization**	**Idea**	**Service**	**Tasks**	**Procedure**	**Practice**	**Invention**	**Discovery**	**Object**	**Program**	**Artefact**	**System**	**Technique**	**Information**	**Equipment**	**Commercial Activity**	**Entrepreneurial Tool**	**Know-how**	**Business**	**Outcome**	**Industry**	**Budgeting System**	**Technology**	**Way of doing things**	**Enterprise**	**Materials**	**Method**	**Delivery system**	**Production System**	**Generation**	**Acceptance**	**Implementation**	**Change**	**Adoption**	**Introduction**	**Evolve**	**Design**	**Manufacture**	**Management**	**Commercialization**	**Learning**	**Development**	**Realize**	**Exploit**	**Interaction**	**Creation**	**Making things happen**	**Resources**	**PEOPLE**
1934	Schumpeter	*																	*	*	*	*	*																																								
1965	Thompson																		*	*				*	*		*																								*	*														
1967	Wilson																									*																											*												
1967	Becker & Whistler					*																		*																													*	*											
1967	Knight				*																																																														
1967	Evan and Black			*															*					*			*																																							
1971	Rogers & Shoemaker			*																				*				*			*																																		
1973	Rowe & Bowsie.			*															*	*											*																																		
1973	Zaltman *et al.*			*																				*				*				*																																
1977	Nelson & Winter						*													*				*																																								
1977	Yin *et al.*								*															*				*				*		*																													
1979	Down & Mohr																																																																		
1981	Kimberly																	*	*												*				*	*																												
1982	Freeman																			*																		*	*																								
1985	Rickards																																																																
1985	Rothwell & Gardiner										*							*																																																
1985	Drucker																							*			*										*																										
1986	Van de Ven			*																			*																																									
1988	Rahmanseresccht											*															*																																					
1988	Davies	*																*	*	*	*	*																																										
1988	Roberts																						*				*																																					
1989	Angle & Van de Ven		*										*									*	*																																									
1990	Nonaka																																																																	
1990	Nystrom																	*	*				*											*				*																										
1990	Vrakking																																																															
1990	Porter	*											*																																						*														
1990	Hyvarinen	*													*						*		*																										*							*												
1991	Rickards & Moger																																																														
1992	Elam		*												*																																																	
1993	Zin																*																																															
1994	DTI	*														*							*																																								
1996	Burgleman *et al.*	*													*			*						*																																									

Appendix 2: Definitions of Innovation

Main source of the definitions is the work of (McInerney, 2004) which was developed from antecedent studies by (Rahmanseresht, 1988) and (Zain, 1993).

Innovation Definition	Author
New products, new methods of production, new sources of supply, the exploitation of new markets and new ways to organize business	**Schumpeter (1934)**
Generation, acceptance, and implementation of new ideas, processes, products and services.	**Thompson (1965 p 2)**
An innovation or more precisely a major innovation is a fundamental" change in a "significant" number of –tasks.	**Wilson (1966a p 196)**
The first or early use of an idea by one of a set of organizations with similar goals	**Becker & Whistler (1967 p 463)**
An innovation is the adoption of a change which is new to an organization and to the relevant environment.	**Knight (1967 p 478)**
The implementation of new procedures or ideas s whether a product of invention or discovery, will be referred to as 'innovation'	**Evan & Black (1967 p 519)**
When an organization learns to something it did .not do before and it proceeds to do it in a sustained way a process of innovation has occurred	**Shepard (1967 p 470)**
The successful introduction into an applied situation of means or cods that are new to the situation	**Mohr (1969 p 112)**
An innovation is an idea, practice, or object perceived as new by an individual. It matters little, as far as human behaviour is concerned whether or not an idea is objectively new as measured by the lapse. of time since its first uses or discovery....if the idea seems new and different to the individual, it is innovation	**Rogers & Shoemaker (1971 p 19)**
The successful utilization of processes, programs, or products which arc new to an organization and which are introduced as a result of decisions within that organization.	**Rowe & Boise (1974 p 6)**
New idea, practice, or material artefact perceived to be new by the relevant adopting unit.	**Zaltman *et al.* (1973)**
Innovation is defined as the earliness or extent of use by a given organization of a given new idea, where new means only now to the adopting agent, and not necessarily to the world in general.	**Down & Mohr (1976)**
A portmanteau to cover the wide range of variegated processes by which man's technologies evolve over time.	**Nelson & Winter (1977)**

Innovation includes any discrete idea, practice or material artefact that is introduced for the first time…and is seemingly discontinuous with past practice, The term technological innovation moreover, refers to those innovations that consist of (1) an. artefact or material. (2) a computer system or (3) an analytic idea or practice that lends itself to quantitative symbolization.	**Yin *et al.* (1977)**
A managerial innovation is any program product or technique which represents a significant departure from the state of the art of management at the time it first appears and which affects the nature, location, quality or quantity of information that is available in the decision making progress	**Kimberly (1981 p 86)**
Industrial innovation includes the technical design, manufacturing, management, and commercial activities invoked in the marketing of a new (or improved) process or equipment.	**Freeman (1982)**
Commercialization of invention	**Rickards (1985)**
Innovation does not necessarily imply the commercialization of only a major advance in the technological state of the art (radical innovation) but it includes also the utilization of even small-scale changes in technological know-how (incremental innovation).	**Rothwell and Gardiner (1985)**
Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or service. It is capable of being: presented as a discipline, capable of being learned, capable of being practiced.	**Drucker (1985)**
The process of development and implementation of new ideas by people who over time engage in transactions with others within an institutional context.	**Van de Ven (1986)**
The process whereby an adoption unit chooses a significant alternative that is perceived as superior to and/or different from some current practice or outcome and attempts to realise it so that a deficiency in the practice or outcome can be corrected or so that either/or both can be improved.	**Rahmanseresht (1988)**
Innovation includes the opening up of markets, the conquest of new sources of supply of materials, new forms of organisation of an industry, including the creation or breaking up of monopoly positions as well as process and product innovations.	**Davies (1988 p 195)**
The generation of an idea while innovation incorporates both invention and exploitation.	**Roberts (1988)**
A purposeful, concentrated effort to develop and implement a novel idea that is of substantial technical, organisational and market uncertainty that entails a collective effort of considerable duration and that requires greater resources than are held by the people undertaking the effort.	**Angle & Van de Van (1989)**

Innovation is a product of the interaction between necessity and chance, order or disorder, continuity and discontinuity.	**Nonaka (1990)**
Any renewal designed and realised, that strengthens organisation's competitiveness.	**Vrakking (1990)**
Companies achieve competitive advantage through acts of innovation. They approach innovation in its broadest sense, including both new technologies and new ways of doing things.	**Porter (1990)**
The creation of the future – the process of bringing new ideas (products, processes, know-how, budgeting systems, management techniques, etc.) into use.	**Nystrom (1990)**
Innovativeness is a combination of technological, enterprise and market and other environmental dimensions by which means that a small and medium sized industrial enterprise develops and adopts new ideas, also other than technical ones, for industrial use or for markets earlier than other corresponding enterprises.	**Hyvärinen (1990)**
The 'process of making things happen'.	**Rickards and Moger (1991)**
The combining of materials in a novel fashion to produce other things or the same things by a different method.	**Elam (1993)**
The process of matching organisational and environmental means and needs.	**Zain (1993)**
Successful exploitation of new ideas.	**DTI UK (1994)**
The 'combined activities leading to new marketable products and services and/or new production and delivery systems'.	**Burgelman *et al.* (1996)**
IT innovation is the process of creatively developing intelligent combinations of new and existing technology and knowledge to deliver new business solutions that can add new value or perform an existing function better faster or cheaper.	**Curley (2004 p 156)**

Appendix 3: Static Concepts from Process Framework Review (1 of 2)

APPENDIX: A CONCEPT MATRIX OF INNOVATION PROCESS FRAMEWORK -FROM LITERATURE REVIEW

Sheet 1 of 2

CONCEPT: STATIC

V 1.0 01/04/2008

	Static or Dynamic	Publication Year	Author (s)	1 Incremental	2 Radical	3 Strategy	4 Structure (Organizational)	5 Systems	6 Environment	7 Chance Events	9 Architectural	10 Competences (Ability or skills)	11 Endowments (e.g. reputation, brand, patents)	12 Knowledge (Technical)	13 Knowledge (Market)	Knowledge Architectural	15 Low-Cost	16 Differentiation	17 Profits	18 Goals	19 Opportunities	20 Threats	21 Capabilities	22 Information Systems	23 Processes	24 Protection 0f long-term profitability	25 Profit Site (what business should firm be in)	26 Dominant Design	27 Technological Discontinuity	28 Encouragement of Creativity	29 Autonomy	30 Resources	31 Pressures (positive)	32 Pressures (negative)	33 Impediments (Organizational)	34 Open	35 IvT (Innovation Technology)	36 Climate	37 Culture	38 Resources	39 Challenge	40 Freedom	41 Idea Support	42 Trust/Openness	43 Dynamism/ Liveliness	44 Playfulness/Humour	45 Debates	46 Conflicts (negative)	47 Risk Taking	48 Idea Time	49 Communication (inside)	50 Problem-Solving	51 Ideas -talking spontaneously	52 Product	53 Service	54 Paradigm (Mental model)	55 Complexity	56 Formalization	57 Centralization	58 IS innovation	59 Administration Innovation	60 Technology (Core) Innovation	61 Base IT Innovation Core	62 Self-Service Technology	63 Intra-focus	64 Extra-focus	65 Links	66 Learning	67 Environmental Performance	68 Business Process
1		1998	Afuah-1: Profit Chain Model	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*																																																				
2		1998	Afuah-2: Strategic Innovation Process			*	*													*	*	*	*	*	*	*																																												
3		1972	Freeman	*	*																																																																	
4		1978	Abernathy-Clarke											*	*																																																							
5		1990	Henderson Clarke																																																																				
6		1978	Utterback-Abernathy																									*																																											
7			S-Curve (Foster)																										*																																										
8		1996	Amabile																											*	*	*	*	*																																				
9		1989	Angle & Van de Ven : Innovation Journey																																																																				
10		2006	Basadur & Gelade: Thinking Process																																																																				
11		2003	Chesbrough																																	*																																				
12		1993	Copper -Stage gate																																																																				
13		2005	Dodgson et al. : Think, Play, Do																																		*																																			
14		1996	Ekvall: Climate for Innovation																																			*	*	*	*	*	*	*	*	*	*	*	*	*																						
15		2003	Flynn et al. : Innovation Funnel																																																																				
16		2005	Goggin & Mitchell: Pentathlon			*	*																																																																	
17		2004	Roberts & Fusfield: Multi-stage																																															*	*	*																			
18			Rogers																																																																				
19		2005	Tidd et al.																						*																													*	*	*																
20		1973	Zaltman																																																					*	*	*													
			IS/IT Literature																																																																				
21		1994	Swanson: Tri-core																																																									*	*	*									
22		2001	Rose & Lyytinen: Quad Core																																																									*	*	*	*								
23		2007	Costello & Donnellan: Ti-core add on																																																													*	*	*				
24		2008	Costello et al.: Dolmen				*																															*	*																					*								*	*	*	*
25		2007	Baldwin & Curley																																																																				

Appendix 4: Dynamic and People Concepts from Process Framework Review (2 of 2)

APPENDIX: A CONCEPT MATRIX OF INNOVATION PROCESS FRAMEWORK -FROM LITERATURE REVIEW

Sheet 2 of 2

V 1.0 01/04/2008

CONCEPT: TYPES OF PEOPLE

Static or Dynamic	Publication Year	Author (s)	1 People	2 Idea generators	3 Gatekeepers	4 Boundary Spanners	5 Champions	6 Project Managers	7 Sponsor	8 Critic	9 Mentor	10 Institutional Leader	11 Groupthink	12 Deserters
	1998	Afuah-1: Profit Chain Model		*	*	*	*	*						
	1998	Afuah-2: Strategic Innovation Process												
	1972	Freeman												
	1978	Abernathy-Clarke												
	1990	Henderson Clarke												
	1978	Utterback-Abernathy												
		S-Curve (Foster)												
	1996	Amabile												
	1989	Angle & Van de Ven : Innovation Journey							*	*	*	*	*	*
	2006	Basadur & Gelade: Thinking Process												
	2003	Chesbrough												
	1993	Copper -Stage gate												
	2005	Dodgson et al. : Think, Play, Do												
	1996	Ekvall: Climate for Innovation												
	2003	Flynn et al. : Innovation Funnel												
	2005	Goggin & Mitchell: Pentathlon	*											
	2004	Roberts & Fusfield: Multi-stage												
		Rogers												
	2005	Tidd et al.												
	1973	Zaltman												
		IS/IT Literature												
	1994	Swanson: Tri-core												
	2001	Rose & Lyytinen: Quad Core												
	2007	Costello & Donnellan: Ti-core add on												
	2008	Costello et al.: Dolmen												
	2007	Baldwin & Curley												

CONCEPT: DYNAMIC — Initiation Phase

Publication Year	Author (s)	1 Gestation	2 Shock	3 Plan	4 Proliferation	5 Participation (fluid)	6 Transitions (people)	7 Setbacks	8 Criteria Shift	9 Infrastructure (e.g. gov, agencies, trade assoc)	10 Generating	11 Conceptualization	12 Optimizing	13 Knowledge Apprehension	14 Knowledge Utilization	15 Knowledge Awareness	16 Insourcing Technology	17 Licensing	18 Discovery	19 Ideas (Screening of)	20 Scoping	21 Business Case Building	22 Development	23 Test & Validation	24 Think	25 Play	26 Do	27 Stimuli	28 Creations	29 Investigations	30 Prioritization	31 Matching with Market	32 Guidance	33 Managing	34 Executing	35 Keeping up-to-date	36 Recognising problem/need	37 Research (Basic)	38 Research Applied	39 Search	40 Select	41 Formation of Attitude	42 Decision	43 Fluid Phase (Tech & Market Uncertainties)	44 Transitional Phase (interaction - standardization)	45 Specific Phase (proliferation of dominant design)
1998	Afuah-1: Profit Chain Model																																													
1998	Afuah-2: Strategic Innovation Process																																													
1972	Freeman																																													
1978	Abernathy-Clarke																																													
1990	Henderson Clarke																																													
1978	Utterback-Abernathy																																											*	*	*
	S-Curve (Foster)																																													
1996	Amabile																																													
1989	Angle & Van de Ven : Innovation Journey	*	*	*	*	*	*	*	*	*																																				
2006	Basadur & Gelade: Thinking Process										*	*	*	*	*																															
2003	Chesbrough																*	*																												
1993	Copper -Stage gate																		*	*	*	*	*	*																						
2005	Dodgson et al. : Think, Play, Do																								*	*	*																			
1996	Ekvall: Climate for Innovation																																													
2003	Flynn et al. : Innovation Funnel																											*	*	*																
2005	Goggin & Mitchell: Pentathlon																			*											*															
2004	Roberts & Fusfield: Multi-stage										*												*									*	*	*	*	*										
	Rogers																						*														*	*	*							
2005	Tidd et al.																																							*	*	*	*			
1973	Zaltman															*																														
	IS/IT Literature																																													
1994	Swanson: Tri-core																																													
2001	Rose & Lyytinen: Quad Core																																													
2007	Costello & Donnellan: Ti-core add on																																													
2008	Costello et al.: Dolmen																																													
2007	Baldwin & Curley																																													

CONCEPT: DYNAMIC — Implementation Phase

Publication Year	Author (s)	1 Linking (Old and new)	2 Adoption	3 Termination	4 Implementing	5 Launch	6 Review (Post-Launch)	7 Quick Wins	8 Projects	9 Teams	10 Results	11 Transferring	12 Evaluating	13 Commercialization	14 Diffusion	15 Consequences	16 Execute	17 Sustain	18 Learn	19 Implementation (initial)	20 Implementation (continued-sustained)
1998	Afuah-1: Profit Chain Model																				
1998	Afuah-2: Strategic Innovation Process																				
1972	Freeman																				
1978	Abernathy-Clarke																				
1990	Henderson Clarke																				
1978	Utterback-Abernathy																				
	S-Curve (Foster)																				
1996	Amabile																				
1989	Angle & Van de Ven : Innovation Journey	*	*	*																	
2006	Basadur & Gelade: Thinking Process				*																
2003	Chesbrough																				
1993	Copper -Stage gate					*	*														
2005	Dodgson et al. : Think, Play, Do																				
1996	Ekvall: Climate for Innovation																				
2003	Flynn et al. : Innovation Funnel							*	*	*	*										
2005	Goggin & Mitchell: Pentathlon				*																
2004	Roberts & Fusfield: Multi-stage																				
	Rogers		*											*	*	*					
2005	Tidd et al.				*	*											*	*	*		
1973	Zaltman																			*	*
	IS/IT Literature																				
1994	Swanson: Tri-core																				
2001	Rose & Lyytinen: Quad Core		*												*						
2007	Costello & Donnellan: Ti-core add on																				
2008	Costello et al.: Dolmen																				
2007	Baldwin & Curley																				

Appendix 5: Static-Dynamic Topology