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Conflict between Radical and Incremental innovation: Perceptions and behaviours of actors caught in the cross fire

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Technology Management

to the

National University *of* Ireland, Galway

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Location: College of Engineering, National University of Ireland, Galway

Date Submitted: August, 2007

Statement

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of Master of Science in Technology Management is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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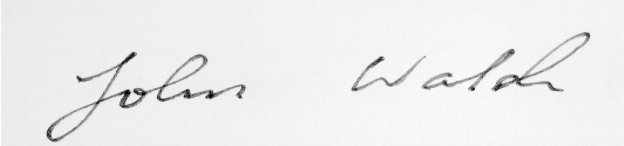

Dedication

For Deirdre, Ronan and many other unsung heroes

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Acknowledgements

I would like to thank Dr. Kathryn Cormican who supervised this thesis and whose experience and encouragement were greatly appreciated.

Thanks to all the people in Hewlett Packard who gratefully responded to the questionnaire and helped with feedback, interviews, helpful comments and encouragement.

Abstract

The ‘great fear’ is according to Ansoff (1998) is that the organizational decision makers who fail to anticipate the trends and discontinuities in the wider environment will be ‘left behind’. Innovation and new product development is the lifeblood for commercial success and survival. However, innovation is extremely difficult to predict and to manage successfully. Enterprises find themselves attempting to improve existing products , process and services in conjunction with and in competition to alternate efforts to replace them. This classic dichotomy between incremental and radical innovation is at the heart of this research study. This study looks at the behaviours and attitudes of software engineers within an R+D LAB in Hewlett Packard (HP) within the context of large organizational transformations and re-positioning to a more ‘mechanistic’ control structure. These engineers are chartered and goaled on development of new ‘innovative’ solution for HP customers. They now find them selves in an ‘ambiguous’, conflicting situation, the academic literature suggests that innovation will be stifled under such conditions. The research question posed is:

> HP R+D Managers and Engineers feel that radical innovation is increasingly stifled in a more ‘mechanistic ‘organization.

This research by way of an online survey examines if there has been a change in behaviours and attitudes by engineers and managers in the R+D organization relating to innovation in such an environment. This attempts to validate and measure such changes in attitudes and behaviours by R+D actors as the organizational context changes over time

The survey and analysis concludes that an organizational shift to a more mechanistic perspective has occurred and that user behaviours and attitudes have changed. Notably, ‘risk taking’, ‘internal and external communication’ were adversely impacted. The results were broadly inline with the expected theoretical outcome. Variances concerning ‘individual motivation’ ; and openness to ‘new skills‘ were observed and discussed.

The research concludes with a discussion on the findings, reviews implications for HP and enumerates additional possible research areas.

Chapter 1: Research Introduction

Conflict between Radical and Incremental innovation: Perceptions and behaviours of actors caught in the cross fire

1.1 Forewarned

This research deals with the behaviours and attitudes of software engineers within an R+D LAB in Hewlett Packard (HP) within the context of large organizational transformations and re-positioning within a more 'mechanistic' control structure. Mechanistic forms are classed as rigid, tight and highly bureaucratic. In contrast to the 'organic form' which is described as loose, adaptable, highly autonomous and flexible.

These engineers are chartered and goaled on development of new 'innovative' solution for HP customers. They now find them selves in an 'ambiguous', conflicting situation, the academic literature suggests that innovation will be stifled and inhibited under such 'mechanistic' conditions. This research will examine if there has been a change in behaviours and attitudes with regard to innovation under such an eco-system.

This chapter maps out at a high level the overall research effort, it will discuss the importance of innovation and outline the HP organization changes that have taken place. The organization contexts and transformations will be characterized using an adapted IDEF0 systems approach. This framework will be explained and will provide the backdrop to the research activity.

This chapter will detail a testable hypothesis, identify related problems and opportunities. It will also define the scope of the study and outline how the research will be carried out. The stakeholders for work are identified, they are primarily internal HP managers and engineers but this study / research should also assist future researchers in this field, it is an area rich in potential and aim is to enrich academic knowledge relating to innovation conflict , perceptions and 'sense making' of actors within such a system.

1.2 Introduction

The great pyramid of Giza is noted as one of the 'seven wonders of the world', it was built in 2560BC and was 145.75 m (481 ft) high and construction lasted 20 years. It ranked as the tallest structure on Earth for more than 43 centuries, only to be surpassed in height in the nineteenth century by advances in structural steel, materials and incremental advances in construction techniques. Even today people marvel at it's size, construction and still theorize on how it was built and how many people were involved.. It's sheer physicality still mark it as notable and a recognizable icon for design, effort, organization, management skill and perseverance.

In today's world many managers and CEO's would yearn for such a 'Giza' project; clarity of end goal, unchanging and clear specifications (geometrical consistency) , guaranteed user acceptance (tomb) , unchanging product requirement, abundance of labour and resources , guaranteed payment, no competition, guaranteed immortality.

Today's commercial world is so different, rapidly changing customers, products and requirements. Intense global competition, changing technology, accelerating rules and mechanisms of competition, multiple stakeholders, constrained resources. Massive advances are routinely made in the largest and micro of things; new 'wonders' and technological advancement are the norm.

All commercial organizations are in a relentless struggle for competitive advantage, new business opportunities and seeking to maximize position for future profits.

> In modern economic thinking, innovation is ascribed a central role in the evolution of industries. In a turbulent environment characterized by powerful forces of 'creative destruction', firms can nonetheless increase their chances of success by being more innovative than their competitors.
>
> Coad and Rao (2006)

Innovation is a fundamental determinant of longer-term productivity performance providing international competitiveness, living standards and improved quality of life.

Cooper (2001) talks about importance of new product introductions and quest to achieve competitive advantage through product differentiation. Innovation plays a key part in this activity as firms need to continually develop new products and services. Companies are relentlessly seeking to successfully commercialize new products and services. Thus Innovation, development, technological advancement is viewed as essential determinants of economic success.

Organizations can be viewed in terms of an 'open systems' approach, which Cummings and Worley (2005, p85), describe as "*systems are viewed as unitary wholes composed of parts or subsystems*". Outside environments have variable influences on such organizations as '*Open systems such as organizations and people exchange information and resources with their environments"*.

The Organization as an Open System

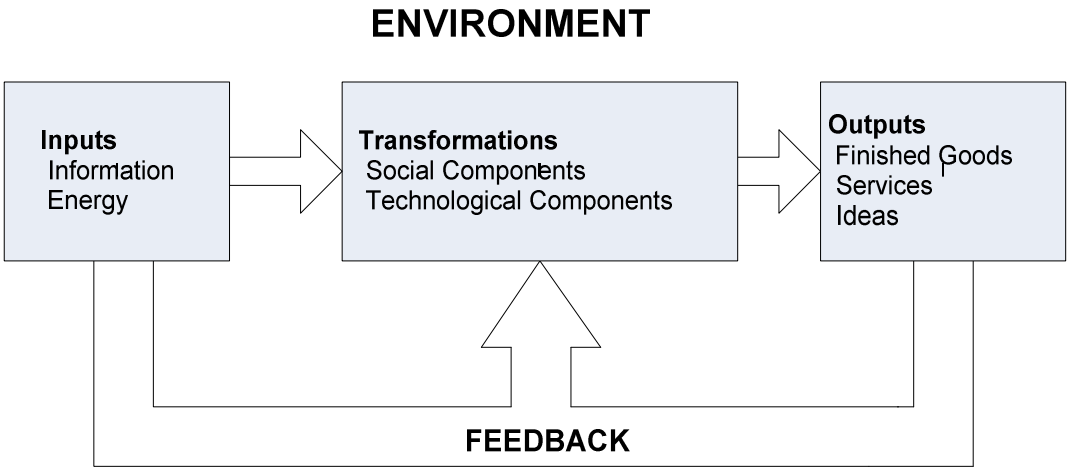

Diagram 1.1 The organization as an Open System

Innovation is viewed and managed as a transformation within such a system, academics and practitioners are concerned with developing robust and applicable theories and prescriptive practises to optimize this and increase innovation.

West and Farr's (1990) definition of innovation is "the intentional introduction and application within a job, work team or organisation of ideas, processes, products or procedures which are new to that job, work team or organisation and which are designed to benefit the job, the work team or the organisation"

People are at the heart of innovation and as such it is a complex business. People's perceptions and behaviours are critical determinants of innovation. It is a bye-product of complex social interactions by the various actors and stakeholders within the system. Green (2004,p1) comments that '*human connections are the enduring thread that knits these complex processes together;*

1.3 Aims and Objectives

Many companies don't innovate well, they fail to change or adopt to changing customer needs or fail to capitalize on their own innovate efforts. These companies eventually fail or are taken over. Recent economic history is peppered with extremely successful companies who were overtaken by new competitors and or new technologies. (Canon v Xerox, Digital v IBM etc). So innovation management is not an exact science, it's impossible by definition to achieve perfection and many innovative companies stumble, fall and loose their way. Hansen (2007) also notes that innovation challenges differ from firm to firm, remedies applied in one situation may be harmful in another. Even the returns from innovative efforts cannot be guaranteed, Teece (2007,p2) notes that the challenge to capture value from innovation is an '*enduring question'*.

Globalization, increased competition, rapid advances in technology advancement is driving many multi-national organizations to undergo immense transformational change activities. Re-configurations to focus on core competences, outsourcing, vertical and horizontal integration are changing the shape and structure of many organizations. Some commentators such as Lambert and Cooper (2000) argue that firms are now longer competing individually as of old; but that entire supply chains are now the new basis of competition.

Technological advances allow closer co-operation between enterprises, suppliers and customers; yet the challenge to innovate successfully seem as high as ever. Against this backdrop of perpetual motion, organizations and teams are re-configuring, adopting new designs to improve overall innovation process, seeking to reduce overall costs and improvements in operational efficiency.

One manifestation of this process is the conflict between technical and administrative innovation mapped across organizational layers. Hewlett Packard (HP) is undergoing such a transformation and it's impact is felt across entire organization.
Some engineering and research groups now find themselves 'at odds' and in a new organizational structure which is more 'mechanistic' in nature and is a change of emphasis of focus from past activities, beliefs and norms. Change management and successful implementation and adoption of change is the subject of much literature and debate. Bessant, de Weerd-Nederhof, et al. (2006, p2) note that organizations must change and by nature must also innovate , "*unless organizations change what they offer the world and the ways they create and deliver it, they could well find themselves in trouble.*"

Ramirez and Kramer (2007,p3) note that ' *majority of creative activity within firms takes place through formal research and development (R&D) efforts*.
HP is large organization and the scope of this research looks at innovation within an R+D subsystem and concerning in particular , the attitudes and behaviours of various actors within the system (managers and engineers) .

1.4 Key Stakeholders for this Research

Key stakeholders for this research work include, Senior Management within HP, Engineering Development managers, software development and systems engineers. The key goals or output of the study will be used by managers within HP as an informational aid and hopefully as a decision support aid. It is not classed as 'Action Research', there is no expectation that findings or recommendations will or should be acted upon.

The study / research should also assist future researchers in this field, it is an area rich in potential and aim is to enrich academic knowledge relating to innovation conflict , perceptions and 'sense making' of actors within such a system. The study obviously should be accurate from an academic and scientific sense, in that the observation and analysis, should be repeatable in similar contexts.

The research objective also has a personal educational aspect in that the 'journey is as important as the destination'. It presents a challenge of rationalizing the introspective view with observation. This isn't a new problem:

> "Observe always that everything is the result of a change, and get used to thinking that there is nothing Nature loves so well as to change existing forms and to make new ones like them"
>
> *Marcus Aurelius (AD 180)*

1.5 Study Background

This concerns a global software tools development group within HP. This engineering group is called 'Services Tools' (ST) and is globally dispersed. The ST group has 220 software engineers in 4 world wide locations. It is chartered with the development of software tools and software solutions to underpin delivery of existing and new HP Mission Critical services. The technology set includes system management tools, diagnostic tools, performance and security analysis tools.

Customer needs in this field are constantly evolving as Customers deploy new product technology sets and seek to utilize and link their technology investments in new ways. Supply Chain Integration, Mobile Solutions, Internet + web services, Virtualization are some examples. HP must constantly innovate and evolve it's service offerings and it's toolkits to meet new evolving customer needs. The ST organization is charted to innovate and develop these new technologies. The scope of this research deals with perceptions and behaviors of various actors within ST as overall organization deals with large transformational change.

Organizations and sub-groups can be broadly classed on a continuum of between ' Organic' and 'Mechanistic ' in nature based on Burns and Stalker (1961) seminal work. In Diagram 1.2 , the ST organization was originally positioned within a product engineering group that was organic in nature.

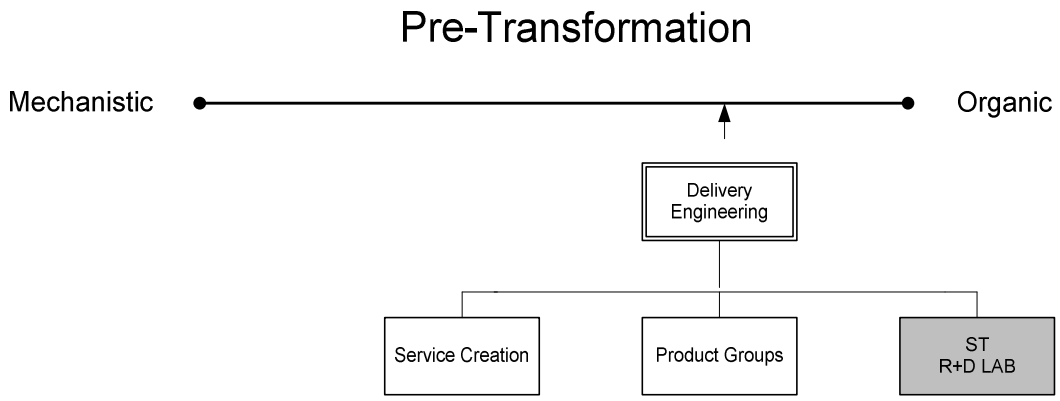

Diagram 1.2 Pre-Transformation

As a result of internal organizational changes within HP, the ST R+D group was re-positioned within the HP hierarchy to a new organization called HP Information Technology. (HP-IT) function.

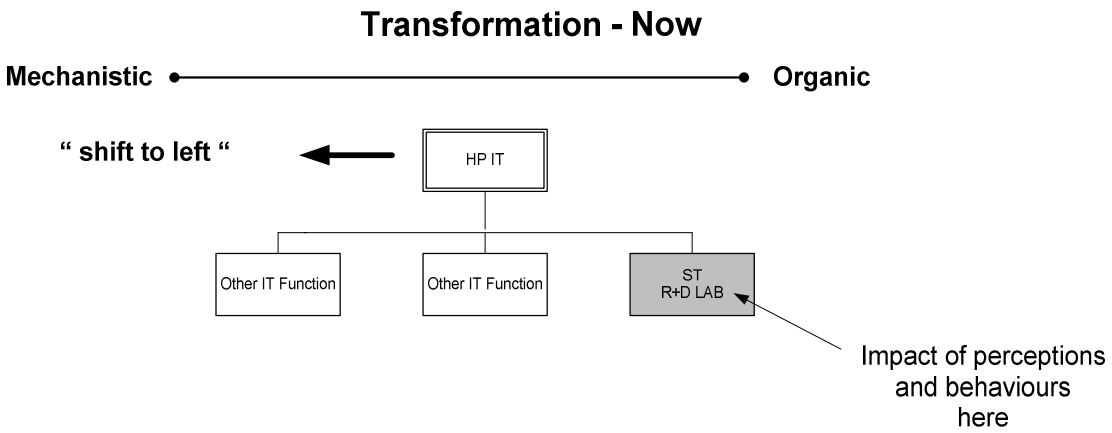

Diagram 1.3 Transformation - Now

The IT organization is by default more 'mechanistic' in nature and is currently undergoing a large transformation activity to become more so. This can be represented as a 'shift to the left' in Diagram 1.3. The new context is one of increasing central control, rigidity, rules based with highly formalized structures.

The scope of the research is to examine perceptions and behaviors of actors within ST as this background contextual realignment occurs. There is also an external perspective , this is the competitive environment of the marketplace, with it's associated technical, competitor and customer perspectives.

The IT organization faces major structural challenges. The guiding tactical strategy within IT has been to invest management efforts in process and administrative improvements, re-enforcing high centralization, high formalization. This is driving the 'shift to the left '. This may be described loosely described as 'administrative innovation' based on Dammanpour (1995) definitions.

A systems modeling approach will enable analysis of the 'before' and 'now' contexts as outlined above. IDEFØ is a method designed to model the decisions, actions, and activities of an organization or system. Ang et All (1997,p2) describe IDEFØ as a '*powerful modeling technique*' and useful as a '*means of examining the relationship between activities in order to evaluate how a modification in an activity may impact on other activities to influence the performance of the overall system*.

HP as an organization can be modelled using such techniques within a hierarchical model structure, the top level functional representation can be decomposed into subsequent lower layers.

IDEFØ Definition

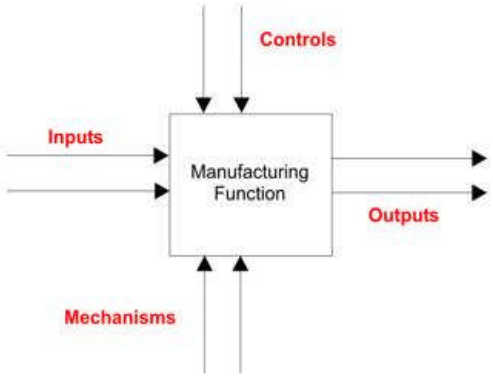

Diagram 1.4 IDEF0 Definition

Using an adapted IDEFØ based modelling framework from Cormican and 0'Sullivan (2004), we can characterize the product innovation process within ST as in Diagram 3.

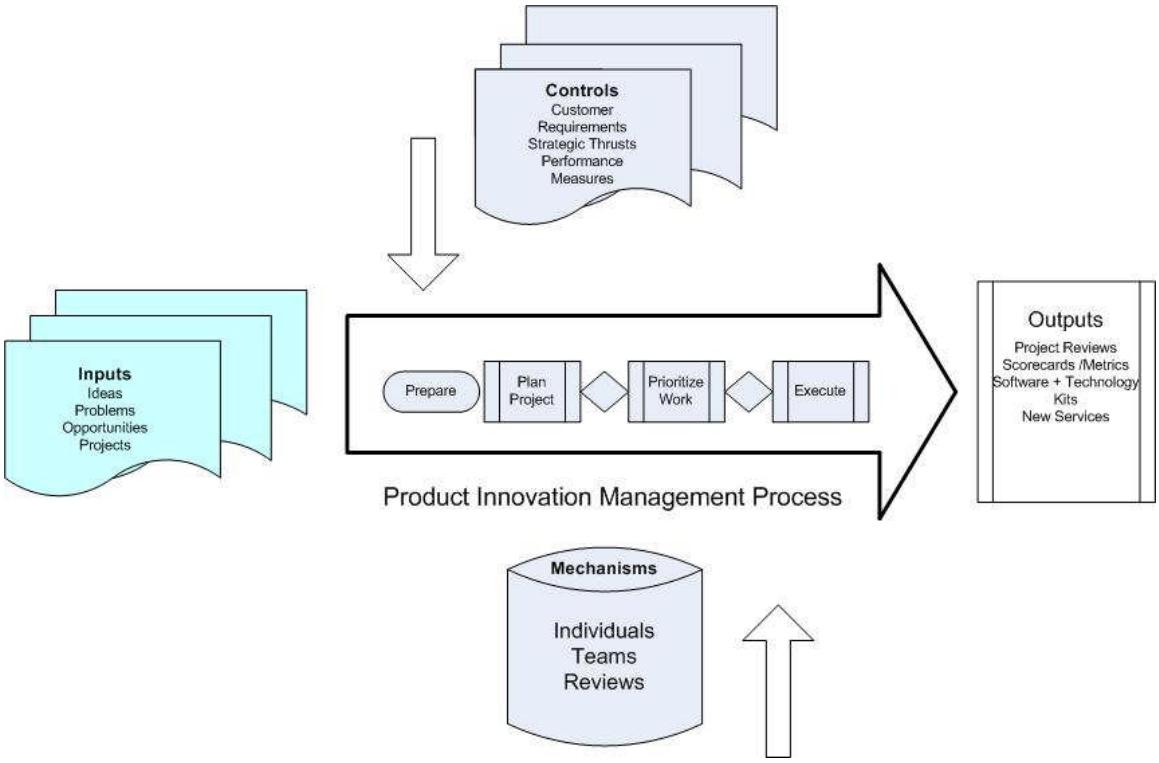

Diagram 1.5 ST Innovation Management Process Framework

Controls: These assist or constrain the activity within ST at many levels, the most obvious control is financial, budgets increasing or decreasing will govern the level of ST activity , other controls will define the 'content' of this activity. Examples include; customer requirements, market timing requirements, strategic initiatives, legal and statutory conformance, policy decisions and metrics. These controls can be viewed in terms of restricting or enabling forces; from various stakeholders which govern ST outputs. One key stakeholder is the IT organization and this study will examine the impact that IT policies, behaviors and management approach will have within this model.

There are many frameworks including best practices proposed in literature which are determinants of innovation, these variables can also be viewed as part of the control mechanism and will naturally be directly influenced by IT management policies, performance metrics and strategic management approach.

Mechanisms: These define the various 'Actors' within ST that essentially 'do the work'. They are the performing entities. This covers how the organization is organized in terms of individuals and teams . They can also constrain the output in that the process will both require efficiently aligned teams and resources. Innovation is a 'people' centered business so individual motivation and creativity are also mechanism factors.

Inputs: These are the initial stimuli for ST work, they can be viewed as ideas and problems, opportunities, customer requirements, internal requirements, competitor activity, market directions, technological advances, market pull and new product group introductions. These all create competing requests for investigation, project or product development. Budget , resource constraints and other path dependencies and constraints set finite limits on number of inputs that are eventually acted upon. The concept of input prioritization and portfolio management is practiced, not all inputs are acted upon. It is assumed and hoped that input filtering is 'hopefully' continually self-optimizing.

Outputs: This is an aggregation of result of ST's efforts, it includes such items as new software products, new technologies, new technology enablers for new service offerings, performance and evaluation metrics that monitor ST's objectives. It includes metrics and feedback loops which evaluate the actual innovation process, project and team behaviors. It will include a quality dimension where both successful projects and also failed activities will be captured for future organization learning's. Output metrics will be used by IT for management and control purposes.

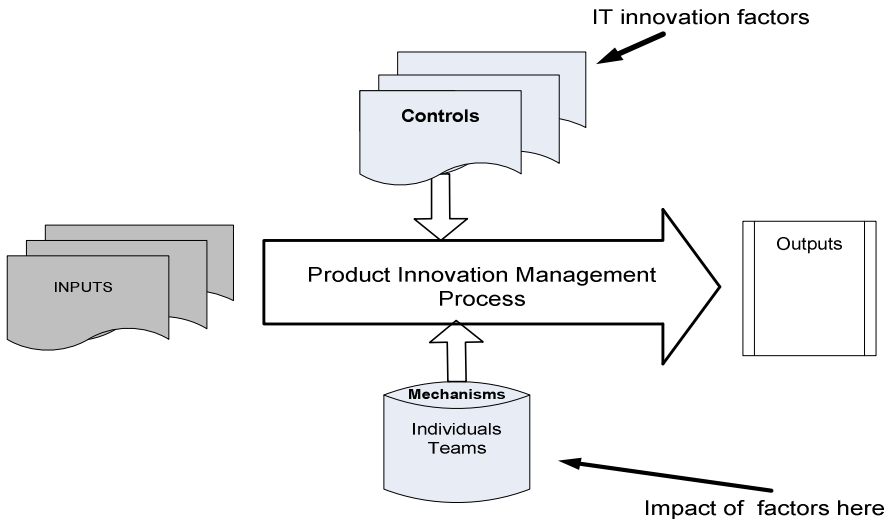

Diagram 1.6 Controls and Mechanisms

1.6 Scope

Looking at this system which is undergoing re-alignment due to these organization changes, it will be useful to determine what impact these factors will have on innovation and on the 'entrepreneurial orientation ' as described by Lumpkin and Dess (1996,p152) Can we understand the impact of the IT controls upon the scope and perception of these individuals and teams. What are the real behaviours, attitudes and work practises in this new environment? Is there a dilution between perspectives over time as the IT organization 'shifts to the left'?

Using our framework, this study will examine various IT policies and actions and how the represent control factors into the innovation process, see Diagram 1.6. It will map the corresponding responses from the actors within 'Mechanisms' and examine how these reflect at the Output stage. An underlying theme of many academic theories relating to innovation notes the dichotomy between radical and incremental innovation. Incremental innovation is the process where the system optimizes it's configuration to maximize outputs. Radical or technical innovation requires a phase change of approach, a completely new way of doing things.

The theory postulates that technical or radical innovation is more difficult in such mechanistic environments, if this is so it should reflect on the attitudes and work behaviours of managers and engineers within ST, they should find it increasingly difficult to sustain 'technical' innovation and deliver innovative work outputs.

The key hypothesis of this study is:

H0: ST Managers and ST engineers feel that 'radical innovation' is stifled in a more 'mechanistic' organization.

1.7 Problems Identified

Daft (1978) points out the contrast between technical and administrative innovations. He notes that they potentially imply different decision making processes. For example, ST are looking at technology trajectories and market directions 1-3 years out. IT are looking at projects and returns within 6 month time frames. An underlying theme of many academic theories relating to innovation notes the dichotomy between radical and incremental innovation. Incremental innovation is the process where the system optimizes it's configuration to maximize outputs. Radical innovation defines a phase change of approach, a completely new way of doing things. This 'creative destruction' as Schumpeter (1934) coins this can be brutal and fatal to the existing system and inherent status quo. Thus managing incremental or radical innovation calls for different approaches.

The IT " shift to the left "transformation initiative calls for standardization on singular tool sets and development methodologies and to implement strict top down budget and project management controls. IT is internally focused and focused only on immediate short term horizon. It is concerned primarily with operating process efficiency and driving improvements in same. ST needs to be more organic, flexible in nature, it requires a different management approach with differing metrics and performance evaluation behaviors.

This opens up a number of additional interesting questions:

a) Can you argue that ST has been subjected to a ‘hostile’ take over in a M&A sense, (wring operational improvements, squeeze $), yet the ‘new owners’ has same flag over door with similar cultural values and existing norms.

b) Is this transformation really driving conflict between ‘technical’ and ‘administrative’ innovation when viewed from ST’s perspective. Can these orthogonal directions be-resolved, academic literature suggest otherwise, yet ongoing process improvements have providence and value in practice. Is this conflict symptomatic of why large companies historically find it difficult to innovate.

c) Have other companies implemented such transformations and what impact has that had on innovative capacity within their organizations.

d) Are all areas of ST impacted to same fashion, are there always pockets of innovation?. Does a top down policy approach really reach all areas of an organization, many of the worlds most successful innovations have arisen from ‘skunk works’, and hidden projects. Is ST in same boat, or will information management tools and mechanistic approach inhibit such ‘under the radar ‘ work ?

e) Can this transformational activity be viewed in terms of an industry in consolidation and in maturity phase of the S curve lifecycle, is ST innovation perspective myopic and focusing on wrong targets, the IT approach may be mimicking external customer attitudes and practices and ‘administrative innovation’ may be optimum survival and growth strategy.

This research study given limited size and scope constraints will only formally address the stated hypothesis but is expected to comment on such additional relevant questions within overall analysis.

1.8 Research Methodology

The research methodology will follow the following deductive approach:

A) Establish if ST is really operating within a 'mechanistic' environment. This will be demonstrated by way of literature analysis and direct observation of management policies and metrics. Can the 'shift to the left' be confirmed using empirical methods.

B) Establish from the literature, the factors, variables and determinants of technical innovation. These represent controls within our innovation process model.

C) Develop an observation approach to validate the hypothesis. It is expected to use a Qualitative research approach using on line surveys, questionnaires and targeted interviews. It is also expected that some actors within the IT organization will be observed to 'sanity check' research output and to provide a complementary commentary to aid analysis.

D) The observation results will be subjected to analysis and the hypothesis will be validated or not.

1.9 Research Significance

The study / research should also assist future researchers in this field, it is an area rich in potential and aim is to enrich academic knowledge relating to innovation conflict , perceptions and 'sense making' of actors within such a system. The context for this research is unique in that ST is a large entity in it's own right within a larger enterprise. It is not restricted to a single national or regional cultural perspective, although it could be argued that HP has unique 'corporate 'cultural attributes.

There is also a temporal aspect to this study, it is set against background of a large organizational transformation underway and behaviours and attitudes may be easier to observe by comparing current with old. Not withstanding obvious 'memory effects' which may come into play, the narrow focus and overall breadth of study should provide satisfactory results.

Chapter 2: Literature Review Part One

2.1 Part One Contents

- Wandering Preamble
- Part one introduction
- Definition of Innovation
- Value of Innovation
- Innovation Management
- Radical and Incremental
- Innovation Theories
- Innovation Typology
- Organizational Structure
- Concluding remarks and introduction to chapter 3

2.2 Wandering Preamble

When the native people of the south pacific first set eyes on western white explorers, they uttered PALANGI', this was the native word for a 'spaceman' or alien. Western science had not even contemplated life outside earth yet these uneducated '*primitives'* by our definitions had this vocabulary defined. Consider how the natives and explorers rationalized the concept or 'made sense' of the other. After 300 + years of contact, integration, trans-cultural activity. This description is still used today, some would argue, it's more true than ever. This sense of quasi orthogonal perspectives is useful by way of introducing the 'innovation' question.

Here we have an obvious duality of perspectives, the paradoxical balloon where both sides of the fence are correct, where both sides of the argument hold plenty of water. Rationality is in plain view but sometimes oscillates between clarity and mud.

The trouble is the human context for all this; perspectives, perception, position can jump freely between rationality and confusion, the innovation literature, and there is plenty of it does not reduce to neat bundles.
Contingency and ambiguity abound. The old adage; "*it all depends* " is a common theme.

2.3 Literature review part one introduction

This chapter will review academic literature on innovation and innovation management and attempt to pull together these varying perspectives and threads into a coherent line of reasoning. The much discussed ‘chestnut’ of radical versus incremental innovation is the main area of focus.

Complex individual and group social behaviours, attitudes and linkages are at the heart of innovation; this chapter will review the literature and establish what the expected behaviours and attitudes should be. This review will be developed within the framing lens of our area of interest.

Lam (2004) concludes that the ‘innovation literature’ can be broadly classed into three streams of research with associated sub-domain interrogation and analysis as follows:

1. Organizational design theories focus predominantly on the link between structural forms and the propensity of an organization to innovate

2. Theories of Organizational cognition and learning. Focus on How organizations develop new ideas for problem solving. They emphasise the cognitive foundations of organizational innovation which is seen to relate to the learning and organizational knowledge creation process.

3. Organizational Change and adaptation and the mechanisms underlying the creation of new organizational forms. Can organizations overcome inertia and adapt in the face of radical external environmental shifts and technology changes.

Adapted from (Lam 2004)

This literature review will primarily focus on stream one, the organizational structural construct and the propensity of the organization to innovate.

Innovation is easy to 'pin up' but hard to 'pin down' so it may be useful to pick a point in the past to see where we have travelled from.

It's exactly 46 years since Burns and Stalkers (1961) seminal work on innovation and organizational management where they coined the concept of organic and mechanistic organizational structures. 46 years represents two human generations but this time period has seen many immense changes in technology, societal and political structures, the very nature of business and commerce has been redefined within the internet age and other widespread environmental changes.

2.4 Definition of Innovation

One enduring vein of management conscientious through this time is the love affair with innovation and all topics related to innovation and 'creativity'. The new and the unique are now highly prized, the latest must have product is driving a frenzy of competition, brand recognition is all, companies are competing within ever shorter development cycles Cooper (2001). Innovation is a prime key and is easily recognisable within a universal sense when it occurs.

Recent examples such as Cell Phones, Lettuce in Bag, Disposable contact lens are unrelated products but just a few immediately recognizable innovative items. The human condition is one of continual adaptation; we assimilate these new technologies, social patterns, and new perspectives. Innovation has touched all aspects of life.

It's clear that momentous innovations have occurred and it underpins much commercial success, but the process or stuff of innovation is elusive, it's hard to do. It is the subject of incredible management and academic focus and the objective of many company transformation projects. Yet, a detached observer could liken current innovation and management of 'creativity' more to alchemy than science. We can't touch it, feel it, smell it, accurately prescribe how and where it will occur, we even have multiple definitions for it but every body wants it anyway, every firm claims to have it.

Venture capital firms boast on how well they manage their portfolio, they expect a failure percentage. Surely such a system would self optimize over time, 'bad innovators' would

die out leaving stronger incumbents, this is not what happens, many leading players holding ‘dominant designs’ are eventually overturned or re-factored according to Tushman and O Reilly (1997) .

You could argue that innovation is sometimes more Art than Science; it offers a mix of ‘hope’ and ‘fear’ to all concerned. The first step is to define what we mean by innovation.

Rickards (1985) calls out the distinction between invention and innovation, he argues that often the terms are used interchangeably within media and notes that even academic researchers used such descriptions until late 1960’s. Invention is now taken to mean a discovery of some sort, a ‘eureka’ moment and is closely allied with concept of creativity. Something non-obvious is recognized or discovered. Innovation is defined as a process whereby ‘*new ideas are put into practise’* Rickards (1985,p10).

Foxall (1984) discusses innovation in terms of a process linking behaviours of producers and consumers, Cooper (2001) also speaks of innovation as a process and notes the migration from an idea into widespread use of a product or diffusion of new process.

Storey(2005) aligns with Rickards (1985) observations and notes that a definition of innovation is problematic and the term is used interchangeable with such terms as ‘creativity’, ‘change’ and ‘invention’. Storey (2005, Vol. 1, p16)) notes that one of most ‘*frequently used academic definitions suggests that innovation refers to any idea, practice or material artefact perceived to be new by the relevant unit of adoption’* quoting (Zaltman et all. 1973)

The concept of a process and some form of deliberate exploitation is taken up by West and Farr (1990) where they define innovation as:

> The intentional introduction and application within a job, work team or organisation of ideas, processes, products or procedures which are new to that job, work team or organisation and which are designed to benefit the job, the work team or the organisation”
>
> West and Farr (1990)

It's clear that innovation covers a broad spectrum, in academic literature the concept of a innovation as a 'process' is well defined, given to mean some form of a deliberate sequence of activities which is performed. It covers also the concept of commercialization of an idea and behaviour or 'adoption' by the receivers or consumers of the innovation. There is the notion or intent to change behaviours. The definition also encompasses the concept of process and product innovation.

Van de Ven et All (1986) refer to a process or sequence of events as people interact with each other to bring ideas into commercial reality. Damanpour (1991) also uses a broad definition of innovation in terms of adoption of new process, product, technologies, device, policy, and program that is new to the adopting organization.

(Claver, Llopis et al. 1998) note that innovation is a "*change in the economic and social atmosphere, a change in the behaviour of individuals as consumers or producers, as citizens, etc. Innovation creates new wealth or new potential for action.*"

In short the scope of innovation involves various stakeholders that interact, it's more than pure invention, it can be product or process orientated and leads to behavioural changes within the 'adopting' system.

2.5 Value of Innovation

Innovation is seen as a critical determinant of ongoing commercial success, it is viewed as a prime attribute for increasing social, economic well being. Foxall (1984,p17) notes that innovation and change are "*highly valued components of modern industrial societies*", often simply for themselves for the "*intrinsic variety and interest they afford*." (Foxall 1984; Coad and Rao 2000; Ketels 2003) all note that innovation is a determinant of economic success as it is a critical component for enhancements in productivity.

> Innovation is the specific instrument of entrepreneurship... the act that endows resources with a new capacity to create wealth.
>
> Drucker (1985)

Innovation is seen as extending the frontier of world knowledge underpinning technological progress. (Salomo & Gemunden et al. 2007) highlight the importance of radical innovation commenting that ' *Radical innovation has entered into the hearts and minds of academics and corporate executives in a big way in the past 10 years'*.
Ulku (2007) concurs by examining innovation and output per capita in 41 OECD countries and establishes positive link between innovation and economic growth. Segerstrom (1991) indicates that economic growth is fuelled by both innovation and imitation.

Firms are engaged in a race to imitate or innovate in selected industries. The incentive to commercial firms is obvious, innovation offers a mechanism to share in an increasing opportunity pie, however Innovative firms thus can't remain static, competitors and imitators are also in the same race. This creates perpetual momentum as advantage may shift from one to other over time. Innovation is the means by which firms achieve competitive advantage, reap economic rewards, the theme of change, momentum, changing and adaptive environments is common within literature, thus innovation is often equated with change and movement.

2.6 Innovation Management

The economic imperative for innovation by commercial firms is obvious but innovation is a fraught endeavour, (Cooper 1981; Booze Allen and Hamilton 1982; Foxall 1984) all call out that most new products and innovations fail, most of this research pertains to consumer innovation but is applicable across a wider domain.

Van de Van (1986) argues that innovation is a very difficult management task. The management effort at a strategic and operational level to guide and craft how an individual firm innovates is often termed 'innovation management'. Innovation is viewed as a process within the firms portfolio of activities, the view is that it should be managed, harnessed and tamed.

Van De Ven (1986,p4) notes that innovation management is to '*understand the process of innovation and to understand the actors that facilitate and inhibit the development of innovations. These factors include ideas, people transactions, and context over time.*

Thus, innovation management is a complex, wide ranging brief involving many related actors and players.

Executives and managers must look within firm and also into the wider environment for data points to assist with 'sense making' and decision analysis. According to (Tucker 2001; Tidd et al. 2005), an organization structure must be designed to support innovation.

2.7 Radical and Incremental Innovation

Incremental innovation is defined as refinements or improvements to existing technology. (Aberney and Clarke 1985; Banbury and Mitchel 1995; Dewar and Dutton 1986; Ettlie, Bridges and O Keefe 1984; Nord and Tucker 1987), define radical innovation in terms of ground breaking, discontinuous, disruptive changes in technology, product and process. Koberg et al (2003) define Radical innovations in terms of higher order effects causing profound organizational and market change.

The importance of Radical innovation was discussed by (Christensen 1997; Herman et all 2007; Tushman and Anderson 1986) who argue that radical or breakthrough innovation is critical to long-term organizational success. Kobeg et all (2003) define radical innovation as:

> Strategic change in products / services, markets served, and technological breakthroughs used to produce a product or render a service based in significant innovation

Yet, the impact of radical innovations is also in the eye of the beholder, Damanpour (1991,p562) notes that "*the importance of the distinction between radical and incremental innovations also lies in the probable differential contributions of the two types to the effectiveness of the adopting organization.*" .

Tom Peters within the quality movement of the 80's advised that to improve 1000 percent, American companies should improve one percent at a time. This is analogous to Japanese 'Kaizen' approach. Damanpour (1991) also contrasts Japanese using incremental versus American companies using radical approach. Womac and Jones (1991) famously illustrated how Japanese motor industry pioneer (Toyota) overtook American auto-makers using such incremental techniques.

Foster (1986) and Utterback (1994) argue that Incremental innovation is critical to keep companies competitive but ultimately; future survival depends on Radical Innovation. Kanter (1989) notes that firms should mange both approaches. Henderson and Clarke (1990) indicate that often it is difficult to differentiate between incremental and radical innovation, as an incremental capability on an existing product, function or practise may have profound effects. Refining on Henderson and Clarke (1990), Herbig (1994) describes three types of incremental or lower order innovations: continuous, modified, and process.

Continuous innovations constitute augmented changes to products (e.g., product line extensions). Modified innovations comprise slightly more disruptive innovations such as the introduction of a new technology that performs the same basic functions as the old one (e.g., updated computer software). Process innovations consist of improvements in the way an existing product is produce.

It's clear that firms face complex decisions, (Foxall 1984; Rickards 1985; Mohr et all 2005) on how to balance investment between developing incremental improvements (cost reductions, process improvements) and radical, ground breaking, more risky initiatives.

(O'Connor and DeMartino 2006) note that

> Despite the documented challenges associated with commercializing radical innovations, many firms seeking renewal and growth have only a limited number of strategic choices. Downsizing, cost cutting, acquisition, and globalization have presented their own challenges Given the limited options, many firms view the commercialization of radical innovation as an increasingly critical path for growth, renewal, and rejuvenation.

Christensen (1997) coins this as the 'innovators dilemma'. It is also an organizational management dilemma, Tushmann and O'Reilly (1997,p20) note that different kinds of innovation require different kinds of '*organizational hardware, structure, systems and rewards and different kinds of software – human resources, networks and culture*";

This struggle requires different management styles and operational approaches. This struggle / conflict / opposing perspective is core to this research study.

2.8 Innovation Theories

Shumpeter (1934) is widely acknowledged as one of the modern founders of innovation theory, he argued that economic change was governed by discrete major inventions and this spawned periods of strong economic growth, followed by a slower growth phase when competitors and maturity saturate and neutralize initial technical advantage. This then opens gates for next entrepreneurial idea or invention.

Schumpeter (1934) theorized that economic growth can be stimulated through invention. Economic returns flow to the inventor and the organization that exploits the invention, this drives market demand, and increased profits for entrepreneurs. This causality relationship of invention and economic growth has spawned the initial 'technology push' versus the 'market pull' debate. Later in depth studies have revealed that 'technology' push does not account for all observed innovations. Consumers and users are also an important source of innovation per Von Hippel (2007).

Various studies (Mansfield 1961;Rogers 2003) have contributed to the pull / push debate. Mansfield (1961) distinguished between initial invention (creativity element) and subsequent adoption or diffusion of the invention. Rogers (2003) looked at the behaviour of consumers and how consumers responded to new innovations. Rogers (2003) initiated research on the 'diffusion theory' of innovation. This area has introduced; now common marketing phrases such as 'early adopters, 'mass market', maturity, critical mass' and such concepts as 'crossing the chasm' as identified by Moore (1991).

The importance of the 'voice of the customer' is also widely acknowledged by academics and practitioners within the innovation process. (Cooper 1995;Alam 2006)

Teece at All. (2006) have since demonstrated that 'technology push' as advocated by Shumpeter (1934) was not a universal fit. A single 'killer idea' was not enough, there were other factors which gated success,(external environment, consumers etc.) these factors varied from study to study but it was becoming clear that a single universal technology driven model of innovation was untenable. (Rickards 1985; Rothwell et all 1974).

Additional research was undertaken to understand the determinants of innovation, what is the 'magic' recipe that could be prescribed for management. (Kimberely and Evinsko 1981; Germain, 1996; Nystrom et all, 2002). Reviews of these research results have been much criticized (Nelson at all 1982; Downs and Mohr 1976; Wolfe 1994) as being inconsistent.

The central issue concerns aggregation and interpretation of the various factors. It's difficult to cross calibrate one organization responses with another. It's the old apples to pears discussion.

Researchers also focused on various contingency multi-factor models. (Damanpour (2006), within an organization dimension. This spawned various theories of organizational innovation based on innovation type. They theorized that innovation success depends on certain factors, but these factors may be different for each situation.

2.9 Innovation Typology

In academic circles it is generally accepted that no single ' Factory model ' of innovation exists, one outcome of this academic investigation was general recognition of innovation as a process contingent on various factors. This also opened up a systems view of innovation in an attempt to manage the obvious complexities surrounding the 'innovation question'. Attempts are ongoing to develop a unified approach, thus various typologies and categorizations of innovation types and of organizational approaches have been proposed within the literature.

One key research theme according to Damanpour (1991) is that innovation types are segmented into 'pairs of types' namely, Administrative and Technical, Incremental and Radical, Process and Product.

Daft and Becker (1978) and Duchesneau (1991) outline the importance of the distinction between incremental and radical innovation and distinguish that each type leverages different organizational capabilities. Incremental and Radical activities have also been essentially recently labelled 'exploitation' and exploration within the literature, see Jansen et all (2006). Exploration is functionally similar to radical innovation, this label

attempts to convey sense of ‘prospecting’, ‘entrepreneurial’ out of organizational conventional bounds activity.

2.10 Organizational Types

The focus of many research efforts concerned the ‘innovativeness’ of various organizational types. The focus evolved from the one ‘best fit’ based on early scientific management theory into a myriad of new perspectives. In Burns and Stalkers (1961) seminal work on innovation and organizational management they coined the concept of ‘organic’ and ‘mechanistic’ organizational structures. The rate of change in external market and technological conditions influenced the development of organizational type. Stable conditions gave rise to mechanistic organizations while converse reinforced organic. They theorized that organic was more suited to radical type innovations where as mechanistic are more suited to incremental efforts.

In addition various studies have attempted to distinguish ‘organizational innovativeness’ based on organizational attributes such as:

- Size of Organization
- Technological Capability
- Linkages to other stakeholders
- External environment
- Tenure of Management
- Strategic perspectives

Daft (1978) also called out the theory of the ‘dual core’ model of organizational innovation where ‘technical’ and ‘administrative’ innovation occur within organizations in ‘bottoms up’ and top down approach. Depending on the degree of coupling between organizational cores; the output would be incremental or radical developments. Deschamps (2005) distinguish between ‘front end’ and ‘back end’ innovation leaders.

Tushman and O’Reilly (1997) have developed the term the ‘ambidextrous organizations’ where firms should organize to tackle both innovation types concurrently. Problems persist with attempting these classifications in a general sense. Incremental efforts

sometimes leads to dramatic business outcomes, radical to one organization could be incremental to another.

In an effort to rationalize various empirical results of innovation success by organizational type Damanpour and Wischnevsky (2006) distinguish organizations into innovation generating and innovating adopting organizations.

Connor and Ayers (2005) have commented that some firms are developing experimental internal management models to nurture and commercialize radical innovation. They comment that these are connected into the mainstream of firms operations and are not 'skunk' work activities.

Cambell (2003) disagrees and suggests that firms should not attempt to develop these radical innovation competencies totally in-house but should adopt 'corporate venturing' with dedicated separate units singularly tasked with radical innovation.

Getz and Robinson (2003) argue that incremental, highly centralized , mechanistic organization are instrumental for long term competitive success and coin radical innovation in terms of 'self delusion' as the probability for success with new radical innovations is so low that companies get them selves into trouble seeking this holy grail, they do concede however that ' innovations' can be acquired via external acquisition but real focus for companies should be on continuous improvement lead by front line empowered employees.

Organizational structures that encompass high efficiency, centralized structure, pre-defined engineered work processes with formalized roles and co-coordinating mechanisms facilitate incremental innovation. (Eisenhardt and Tabrizi, 1995;Tushman and Smith 2002). Yet, Cardinal (2001) posits that centralized, formalized organizations are better for certain industrial sectors, for example centralized knowledge management, lower formalization, was beneficial in drug enhancement projects he studied

Concerning radical innovation, (McGrath and MacMillan 2000; Tushman and Smith 2002; Madanmohan 2005) state that radical innovations are associated with organizations that have experimental cultures, entrepreneurial climate, loose, decentralized structure, flexible work processes, heterogeneous human resource profiles, and strong technical competencies. In contrast Hage (1980) argues that organizations with organic structures drive incremental innovations because they have more democratic values and power is shared, whereas organizations with mechanistic structures may be a fertile ground for radical change. Does a 'new brush sweep clean' in such a conjecture.

Woodman et All (1993) points out that probability of creative output may be highest when leadership is democratic and collaborative and where structure is organic rather than mechanistic

Mintzberg (1979) aggregated much of the research work on organizational structure concerning innovation. He proposed a series of archetypes that provides the basic structural configurations of firms operating within such differing environments and contexts. He argues that firms are likely to be dominated by one of the five pure archetypes. Each type will contain inherent 'innovation potential as follows:

1) Simple
2) Machine Bureaucracy
3) Professional Bureaucracy
4) Divisionalised Form
4) Adhocracy

Essentially, Mintzberg (1979) argues that that bureaucratic structures work well in stable environments but they are not innovative and cannot cope with novelty or change. Adhocracies, by contrast, are highly organic and flexible forms of organization capable of radical innovation in a volatile environment.

2.11 Concluding remarks on Organizational Structure

One theme which is evident from literature is that a single optimized structural model does not exist. Tidd (2001) summarized that after 40 years of research into innovation has not provided compatible theories that can guide management. Lam (2004) concurs saying that '*the existing literature on organizational innovation is indeed very diverse and not well integrated into a coherent theoretical framework*'

Indeed many of the larger firms in the various empirical studies seem to 'flirt' with all structures and positions. In essence, firms adopt or strive to the best organizational type based on it's own sense making within own contextual environment.
The prescriptions for management are also varied and entirely contingent based, for example one line of reasoning suggests that 'radical' is best and yet another suggests that 'incremental' is best.

As with innovation classifications, there is much subjectivity, however some key generalizations can be made from the literature on organizational form. Organizations are configured in many different modes of operation. Management want / must purse a dual mandate of incremental and radical innovation (assuming the loosest definitions of this). Academic and practitioner opinions differ on how to approach this. Radical innovation is viewed generally as ground breaking, as introducing new capabilities and knowledge. It is game changing in the broadest business sense.

The differing approaches calls for different organizational modes of operation, differing management styles, and differing behaviors of the all actors within that subsystem. As Radical innovation is the key area of interest, such related behaviors and attitudes should be identifiable within our research activities in the 'real world'.

Chapter three will examine the literature concerning the various factors that stimulate radical innovation. It will identify what attributes or parameters can be tested within such a system.

Chapter three will also deal with the attributes of mechanistic and organist structural types with a view to developing test criteria to establish where the ST organization fits on this continuum.

Chapter 3: Literature Review Part Two

3.1 Chapter Three -Contents

3.2 Chapter Three Introduction

This chapter will focus in more depth on the specific unit of analysis. We are primarily interested in how ST will develop and drive radical innovations. In the previous chapter, the synthesis of literature posits that certain organizational structure (organic) is best suited for radical innovation.

Essentially we need to determine a theoretical understanding on two questions.

Q1: What distinguishes Mechanistic and Organic structural types ?

Q2: What are the various factors or variables that stimulate radical innovation from the literature ?

Hence, it will enumerate the attributes of mechanistic and organist structural types with a view to developing test criteria to establish where the ST organization fits on this continuum. Whilst this is not a 'longitudinal 'study; we can seek to understand what trends are occurring by looking at changes and revising attitudes over time.

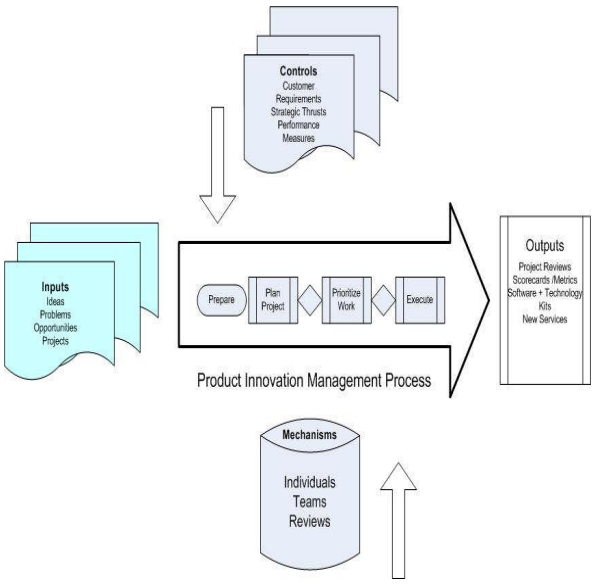

Diagram 3.1 Analysis Framework

These attributes can be mapped into the 'Controls' domain within our analysis framework. These organizational structural attributes will have a corresponding effect on the actors within the system in the 'Mechanisms' domain. In addition, we need to consider the variables that stimulate radical innovation that have an impact at the individual and group level.

3.3 Attributes of a organic / mechanistic structure

Burns and Stalker (1961) proposed the continuum of organizational types from mechanistic to organic. They broadly defined the following characteristics of organic and mechanistic firms under the following headings:

Distribution of Tasks

Nature of Individual tasks

Definition owner of tasks
Task Scope
Task Conformance
Structure of control
Location of knowledge
Communication between members
Operations governance and working behaviour
Values
Prestige

In a wide ranging literature review, Damanpour (1991,p579) rationalized and aggregated some of these descriptions and categorized mechanistic within the following headings: Lower Complexity, Higher formalization and higher centralization, lower internal and external communication.

He classified Organic orientation as structures organized for creativity namely, low centralization, flexibility, slack resources, low formalization, management support (long tenure, positive attitude to change), high technical knowledge.

In addition, Kalanaganam (1999) summarized the definition of organic and mechanistic structural forms as follows:

Mechanistic

Centralization of control and authority
High degree of task specialization
Standardization
Formal communication channels (mostly vertical)
Vertical reporting paths
Decisions, rewards and punishments flow down
Information often in the form of exceptions flows upwards
Line management primarily concerned with operation of established norms, practices, and existing systems
Highly bureaucracy and rigid

Organic

- Looser structures
- Deeper decentralization of control and authority
- More reliance on group process (teamwork)
- Adaptive and Flexible
- Network pattern of Authority
- Vertical communication pattern mostly abandoned, horizontal and vertical communication
- Communication flows through within and without enterprise
- Consultation, information-sharing, advice giving

In summary, we can classify organic as 'loose and flexible'. Mechanistic is 'highly bureaucratic and rigid'. Mintzberg (1979) coins the term "machine bureaucracy" to distinguish such rigid organizational forms. Using these definitions we can develop a table (Table 3.1) to synopsize the literature perspective into key structural variables.

Structural Variable	**Organic**	**Mechanistic**	**Description / Notes**
Formalization	Low	High	This reflects the emphasis on members following rules and conformance. What controls how members are punished or praised. Madanmohan (2005) defines this as extend to which an organization has written rules and procedures for manufacturing and other processes and strict enforcement of written rules. Bodewes (2002) criticizes the existing literature on how formalization is measured across an entire organizational span, he notes that researchers should consider formalization within context of sub groups as these may differ from parent.
Centralization	Low	High	This refers to location and span of authority. Is authority condensed within a single tier. Madanmohan (2005) define centralization in terms of how the firm delegates decision making authority.

Slack Resources	High	Low	This is defined by Damanpour (1991) as the extra resources within an organization available for non routine operations. It can be both financial and human resources
Internal Communication	High	Low	This is a measure of the extent of communication among wider organizational units or groups. Measures include number of face to face meetings, integration activities (# committees)
External Communication	High	Low	Damanpour (1991) defines this as members ability to interact with external environment in a professional capacity. Membership of professional organizations, wider industry groups etc
Specialization	High	Low	Greater variety of subject matter experts indicates that greater knowledge bank available for idea sharing and creativity.
Bureaucracy	Low	High	This is a measure of organization control of activities, is it easy to get things done in a timely fashion. Note that this is related to formalization, however this encompasses a time and attitudinal dimension. To what extent is organizational obstructive by design.
Managerial Attitude to change	High	Low	To what extent are managers open to innovation, are there 'idea' champions.

Table 3.1 Structural Variables

It's important to note that these attributes represents polar positions on a scale. These variables are relative values. Damanpour and Wischevnsky (2006) comment that organizations may be moving forwards and back along this scale overtime as they respond to changing business and environments. Storey and Salaman (2006,p170) report that some firms advocated a *'ongoing moving balance between the two''* This may be a useful perspective for our study. We have postulated that the ST organization is changing based on adoption into a new macro environment.

3.4 Innovation Variables

The remaining discussions focuses on the stimulants upon actors within the organization, (individuals, teams, managers) that 'produce' innovation when looking at the conditions that reinforce innovative output. These stimulants don't exist or have any value on their own right outside of the organizational context. Individuals interact with their environment, which interacts with the individual. In the previous section, we have considered the environmental context, now we consider the problem from the individual and team perspective.

3.5 Creativity and Culture

All innovation begins with some invention, discovery or an idea according to Hansen and Birkenshaw (2007). At the start, it is thus entirely conceptual in nature which is codified in some fashion that can be interpreted. This initial process is generally classified as 'creativity' and is the 'raw material' for the innovation process. Innovative organizations contain positive 'cultural' characteristics'. Culture and Creativity are much discussed topics within the academic literature on innovation. Cumming (1998,p22) notes that '*without creativity, innovation cannot take place'* Storey and Salaman (2006,p164) in their studies note that '*culture was seen to play a pivotal role in the encouragement or discouragement of innovation in organizations'*.

Organizations are often viewed in terms of their 'culture' , that is a specific culture that supports creativity. Cormican and O Sullivan (2004) note that organization culture is 'difficult to define' but can be described in terms of organizational values, norms and beliefs. Innovative organizations tend to have unique identifiable cultures, the particular culture in any one organization may be difficult to characterize or describe but they tend to share some common traits. Nonaka & Kenney (1991) use an example of Apple and Canon where they note that "*innovation is an information creation process that arises out of social interaction. In effect, the firm provides a structure within which the creative process is located. These highly interactive project development teams were composed of personnel drawn from varying backgrounds and operated in an atmosphere of intense daily communication*."

Cumming (2002) noted that within such innovative organizations; there is an acceptance of ambiguity, risk taking and management expect some failures, but there is also an expectation that the group and member individuals will learn from such from failures and over time, organization knowledge will increase. Cormican (2002,p1) notes that '*knowledge management is particularly relevant for knowledge intensive processes such as research and development"*

Thus innovation crucially depends on knowledgeable, creative, motivated people. All companies now see the need to foster and create knowledge based, self learning organizations. Woodman et All (2004) develop a model which argues that individual creativity contributes to creativity in groups which aids overall organizational creativity.

Creative people like to operate in a stimulating, energetic environment where open discussion and investigation of new ideas and solutions are the norm. New ideas and exposure to groups and other team members with different skills and different knowledge backgrounds is critically important. Team members should rotate to various job roles within the organization to gain different perspectives. For example, In CANON all R+D engineers must spend 20% of their time working within one of the product divisions.

Roberts (2007) identifies 'critical behavioural roles' not just technical competences as essential for innovation, he focuses on 'idea generators' and notes that heightened 'idea creativity' arise from management influences. Storey and Salaman (2006,p164) in their studies note that '*culture was seen to play a pivotal role in the encouragement or discouragement of innovation in organizations'*.

Robins and Coulter (2002) describe the following cultural variables in Table 3.3 that stimulate innovation:

Cultural Variable	Description
Acceptance of Ambiguity	Too much emphasis on objectivity may stifle creativity
Tolerance of the impractical	People not penalized for foolish or whacky ideas.
Low External Controls	Similar to formalization
Tolerance of risks	Mistakes are treated as learning opportunities.
Focus on ends	Clear goals are identified, the means are not defined, they have yet to be discovered
Open-Systems Focus	Management outward viewing and responding to environmental stimuli

Table 3.3 Cultural Variables

3.6 The Individual and Innovation culture

People are at the heart of 'organizational' culture and various authors (Ahmed 1998; Woodman and Schoenfeldt 1990) have defined certain personality traits of creative individuals. Research also has shown Ahmed (1998) that a link between cognitive factors and innovation \ idea creation exists. Enhancing and developing cognitive capability is a theme within management practise and research, the concept of 'mentoring', 'Lateral thinking' per De Bono (1975), all play to this theme.

Ahmed (2007,p35) synopsises available literatures and defines personality traits for innovation as follow:

3.7 Personality Traits for Innovation

- High Valuation of aesthetic qualities in experience
- Broad interests
- Attraction to complexity
- High energy
- Independence of judgement
- Intuition
- Self confidence
- Ability to accommodate opposites

- Firm sense of self as creative
- Persistence
- Intellectual honesty
- Internal locus of control

However as with the 'trait' theory of leadership, this shopping list is not a magic recipe for innovation success. Hence attempting to measure these general personality attributes in our study will yield little value.

Cognitive factors also appear to be associated with the ability to innovate, Ahmed (2007) summarizes cognitive factors relating to the individual and how the affect idea production as follows:

3.8 Cognitive Parameters affecting idea production

- Associative fluency
- Fluency of expression
- Figural fluency
- Ideational fluency
- Speech fluency
- Word Fluency
- Practical ideational fluency
- Originality
- Fluency
- Flexibility
- Elaboration

However, testing for these will yield little in the way of analysis for our study; the objective is not to develop an 'innovation capability audit' but to capture actors actual behaviours and attitudes over time. These attributes above identify 'the potential' , in Newtonian mechanical terms; we are more interested in 'kinetic' energy than the potential. To that end we need to examine the motivational forces that drive and shape the individual.

3.9 Motivation

Various personal motivation factors effecting innovation have been identified namely:

- Intrinsic versus Extrinsic Motivation
- Challenging Individuals
- Skills and Knowledge

Intrinsic motivational factors have been identified as a key driver of creativity (Amabile 1988; Woodman et all 1993). Some research has shown that inappropriate extrinsic rewards, interventions and evaluation stifle innovation. Job or task design appears to be a key personal motivational factor, if people are challenged for solutions and provided scope (resources) , they respond positively. Obviously creativity and innovation is also affected by the skills and talents and technical smarts that the individual possesses.

It's clear that innovation requires motivated, highly committed ,energetic people, Gunnigle and Flood (1990,p133) indicate that "*motivation is only one factor affecting performance , other factors such as technology, training and individual ability have a major influence on performance levels"* Woodman and Sawer and Griffin (1995) also agree that motivational factors are one important element of many governing individual creativity.

George and Jones (2001) define three elements of work motivation:

- Direction of Behaviour
- Level of Effort
- Level of Persistence

Element	Definition	Example
Direction of Behaviour	Which behaviours does a person choose to perform	Does an engineer spend time and effort convincing sceptical supervisors of need to change design specification to achieve lower production costs or does he just go with the flow
Level of Effort	How hard does a person choose to perform a chosen behaviour	Does the engineer go the extra distance to document an issue with resolution proposals or casually mention it to supervisor?
Level of Persistence	When faced with roadblocks and obstacles, how hard does the engineer keep trying to perform the chosen behaviour successfully?	Will the engineer give up strong beliefs when faced with disagreement of supervisors and peers?

Table 3.4 Work Motivation

The key aspect of motivation outline above, is the concept of 'actual content' and a level of 'discretionary output'. This has special relevance for organizational learning. Knowledge sharing, competence building are largely driven by social and cognitive interactions and depend on networks and active communities of practise. The spread and sharing of information may be moderated by individual motivations. Weick (2001) notes that three conditions are necessary for behavioural commitment: choice, an irreversible action and public awareness. Much focus is placed within literature surrounding individual motivation and high performance work places. Management strive to optimize output from internal resources but at it's heart; people exercise choices and "vote with their feet" or in this case with their "mental aces ".

Prahalad and Hammel (1990) discuss that firms contain 'core competencies' that are allied to the products and services that they are capable of developing. These competences provide mechanism for firms to achieve competitive advantage. Coyne,

Hall, and Clifford (1997) proposed that a core competence is a combination of complementary skills and knowledge bases embedded in a group or team that results in the ability to execute one or more critical processes.

3.10 Skills and Knowledge

Innovative organizations tend to have strong inter-group member communication systematic knowledge sharing and transfer. This 'information flow' was described by Paoilli and Brown (1978) as having a positive impact on innovation.

Amabile (1996) distinguished between '*domain-relevant skills'*, abilities relevant to a specific domain context and '*creative-thinking skills'*, which is divergent thinking and association abilities. Knowledge acquisition by individual and wider team is very important for the organization.

However individual domain related skills is both a blessing and a curse, it can lead to 'rigid' thinking. For example; '*Not invented here syndrome*' , see Hansen and Birkenshaw (2007, p123) who discuss how 'Sony's engineers in the 1990's started to believe outside ideas and technologies were not as good as those inside Sony'. Herman et all (2007) signal that organizations must be open to "competence destroying" developments if they are to avoid this "rigidity".

This has an obvious impact on individual actors within the system, they must be willing and able to participate in this skills and knowledge renewal activities. In essence, this is the individual willingness to drop existing specializations for new competencies. The organization also must encompass the capability to re-generate new knowledge and skills to transform from within. Herman et all (2007,p100) discuss organization learning as either "adaptive" or "generative". Generative learning is frame breaking and allied to radical innovation.

> However , generative learning is not as natural as learning for improvement and must be encouraged by management. A learning organization must encourage it's employees to give up existing knowledge and to find new ways of learning.
>
> Adapted from Herman et all (2007)

Kalling (2007,p69) also notes that "*social interaction and individual autonomy drives learning and that organizations are build up by communities of practise, and that individuals only truly learn by active participation"*. Human behaviour from Ahmed (1998)) adopts to the organizational context based on observation, active two way interaction with the environment and from what they infer as organizational priorities.

Knowledge acquisition by individual and wider team is very important for organization. Green (2004,p1) notes that '*humans working together must find effective ways to create and sustain the flow of ideas, information, decisions and tasks that are innovation'*

Thus we would expect to see strong focus on organizational learning, knowledge management and active engagement from actors within such an organization. Individuals would be pro-active in terms of self development and open to spread and sharing of new ideas, knowledge and also be active within various communities of knowledge practice,

3.11 Management Perspective

(Lumpkin et All 1996; Kanter 1987) propose that entrepreneurial organizations are pro-active and posses competitive aggressiveness. These organizations are outward looking and seeking to obtain competitive advantage in new or extend existing markets. Miles and Snow (1978) coin the term ' prospector' to describe an organization ability to find and exploit market opportunities. An underlying theme is that this involves risk, there may be 'no gold' in the seam. Miller and Friesens (1982) define 'risk taking' as the degree to which managers will commit large resources to risky ventures where there is a reasonable chance of costly failures. Lumpkin at all (1996) also equate 'entrepreneurship' with 'risk taking'.

A focus on human resources practises has also been identified by (Oke 2007; Davilla et all 2007; Robinson and Coulter 2002) as important innovation variables. These encompass such management practises as appropriate reward systems, congruent goal definition mechanisms, high job security and high commitment to training. Davilla et all (2007,p188) also indicate that organizations that seek radical innovations should adopt

"*inspirational, qualitative, stretch goals*" to stimulate appropriate frame-breaking behaviour.

Team composition is also important, Woodman et all (1993 p:302) point out that "*groups composed of individuals drawn from diverse fields or functional backgrounds*" have a positive impact on flow of information and ideas and will positively influence innovation.

Cummings and O'Connel (1978) suggested that information exchange with external environment influence idea generation which is widely accepted as the primer for innovation. Cooper (2001), indicates that new product and service development require a large input funnel of new ideas. The ability of an organization to recognize, use and absorb external information which Cohen and Levitnthal (1990) termed 'absorbitive capacity' may be a crucial attribute of innovation.

The extent to which the actors within unit of analysis actively engage with outside environment is a data point of note. Is there evidence of risk taking and engagement with outside environment? We would expect to see evidence of entrepreneurial behaviour at management and also at individual level within an organization engaged in radical prospecting and development. We would expect to see that individuals are regenerating skills base and have a 'heads up' outward facing perspective. Are individuals sensing the wider technological, social and business environment. In a radical innovative organization, we would expect to see such activities.

3.12 Literature Review Summary

This literature review summary has two parts.

Part 1 reviewed the broader perspective of innovation and focused on organizational design theories and the link between structural forms and the ‘innovativeness” of the organization. The literature was reviewed under the following headings:

1. Definition of Innovation
2. Value of Innovation
3. Innovation Management
4. Radical and Incremental
5. Innovation Theories
6. Innovation Typology
7. Organizational Structure
8. Concluding remarks

Part 2 reviewed the narrower perspective of innovation theory as it relates to the two specific research questions on what distinguishes the mechanistic and organic structural type and also reviewed innovation variables from the innovative agent’s perspective. This was reviewed under the following headings:

1. Roadmap
2. Creativity and Culture
3. The Individual and Culture
4. Motivation
5. Skills and Knowledge
6. Management Perspectives

Literature Review Summary Part 1

Definition of Innovation

Innovation has driven incredible technological and social changes in recent times but it is more than just invention and more than just creativity. It is complex multi faceted and multi disciplined. Various definitions from the literature are reviewed. There are many broad definitions of innovation and it relies on social interactions. The business of innovating can be viewed in terms of a process from the birth of an idea to successful development and to successful application. The concept of exploitation is important, companies must be able to realise tangible benefits from innovative efforts.

Value of Innovation

Innovation is viewed as critical for business survival and sustaining growth, it also contributes to wider societal benefits and well being by nature of improvements in knowledge, technology and productivity. The productivity enhancements delivered by innovation has fuelled economic growth. Not all companies innovate, some imitate. Growing and changing markets offer rewards but also competition, innovation is a key mechanism but it does not remain static or of lasting value for ever. Firms are in a perpetual race to innovate and to innovate at a faster pace.

Innovation Management

Innovation is a complex, risky business. Most new products and services fail hence it is difficult for firms to successfully manage innovation. Management focus at an operational and strategic level to promote and harness innovation is known as innovation management. It is a complex management discipline involving many related actors inside and outside the organizations environment. Organizations need to develop appropriate organizational structures that support innovation efforts.

Radical and Incremental Innovation

Incremental innovation is refinements or improvements to existing technologies or process. Radical innovation is ground breaking, frame breaking, discontinuous, disruptive changes in technology, product or process. These cause profound organizational and market changes. Radical innovation is seen my many as critical future success of organizations. Others view incremental innovation as equally important. Radical and Incremental innovation require different sets of competences and different management approaches. How companies organize and structure to do both at the same time is a dilemma. This dilemma and the effects it has on individuals is at the heart of our research area.

Innovation Theories

Early theory suggested that economic growth was stimulated solely by technical invention, this was discounted as both market pull and technology push were shown to be important. Consumer behaviour was also shown to be a critical factor. Much research has been carried out to understand the determinants of innovation, could academics provide a unified theory which could guide practitioners. To date this has not happened, research results have been both complementary and contradictory in many respects. Recent research activity has focused on various contingency models of innovation.

Innovation Typology

The various complexities of the 'innovation' question have resulted in no single prescriptive cook book on how to do it. Theory has focused on the various complexities associated with contingency models and this has yielded a number of typologies. These include Administrative and Technical, Incremental and Radical, Product and Process, Exploitation and Exploratory.

Organizational Types

Researchers looked at how organizations innovate based on unique attributes of the organization or how they were configured. Theory attempted to distinguish ability to innovate based on such factors as organizational size, technical capabilities, tenure of management. Many organizational types have been identified, Mechanistic, Organic, dual-core configuration, ambidextrous, innovation generating, innovation adopting and ranges of organizational types from Simple to Adhocracy. The majority theory view posits that Mechanistic organizational configurations are deemed to be better at incremental innovations; while organic organizations are better suited for radical innovations. Mechanistic forms are rigid, by nature tight. Organic is flexible, loose.
A dialectic perspective is also discussed, some authors claim that firms should only focus on incremental innovation and by inference reinforce mechanistic tendencies, others claim that organic forms are better suited to incremental innovation. There are obvious contradictions and differences of opinion in the literature. Academics offer differing advice on how organizations should manage both incremental and radical innovation within the firm, some advocate 'in house' others advocate 'corporate venturing'. One recurring theme from literature is that there is no single optimized structural model that can guide management on their innovative quest. Organizations appear to be configured in a variety of operational forms as firms attempt to resolve 'best fit' to match their needs.

The varying dimensions of mechanistic and organic structural form will be used as the back drop within our research study.

Literature Review Summary Part 2

Roadmap

This sets out the key questions that we need to understand from the literature, namely can we distinguish between mechanistic and organic organizational types and what are the factors that stimulate innovation in individuals and teams. This work will identify attributes and parameters for later development within our research methods using the analysis model.

Attributes of an organic / mechanistic structure

These tags represent opposite ends of a continuum of organizational types, various authors have called out differing attributes within organic and mechanistic types. Organic is classed as loose and flexible, mechanistic is classed as highly bureaucratic and rigid" . Various structural variables have been defined within literature and are synopsized and enumerated. It's also theorized that some organizations oscillate over time between mechanistic and organic.

Creativity and Culture

All innovation begins with some invention or discovery, creativity is a key component of this. This is much discussed in the literature. Culture is pivotal in the reinforcement or dampening of innovation in organizations. Culture is difficult to define but highly innovative organizations have uniquely discernable atmospheres that share common traits. This positive culture fosters knowledgeable, creative, motivated people. All companies now see the need to develop and create knowledge based, self learning organizations. Such organizations need an idea generation capability. Creative people like to operate in a stimulating, energetic environment where open discussion and investigation of new ideas and solutions are the norm. Several cultural variables are identified which support innovation, these include; tolerance for failure, high communication, open systems focus.

The Individual and Innovation culture

People are at the core of innovation, it is an individual and wider social process . Research has identified links between cognitive factors and innovation and creativity. These personality traits and cognitive parameters affecting idea production have been

enumerated. These include intuition, self-confidence and fluency of expression to name but a few. However these traits don't guarantee success, they are general perspectives of on individual's inherent potential to be creative and innovate. Auditing these capabilities within our unit of analysis will not yield useful data. The focus will be more on user behaviour and attitudes rather than intrinsic capabilities.

Motivation

Individual motivation is a critical component of innovative organizations. Personal motivation factors have been identified: Intrinsic versus Extrinsic Motivation; Challenging Individuals; Skills and Knowledge.

Intrinsic motivation has been identified in much literature as a critical determinant but other factors such as technology and training are important. Three elements of work motivation have been defined namely: Direction of Behaviour; Level of Effort; Level of Persistence. Individuals have a discretionary element of work output and social engagement within their control. These behaviours will be of interest to our research on the ST organization. Innovative organizations must be learning organizations, dissemination and sharing of knowledge is critical to develop core competences. Individuals within organization must be committed and engage in such social interactions in the fullest possible way.

Skills and Knowledge

Information sharing and knowledge acquisition are the lifeblood of creativity and innovation. Individuals can posses 'domain relevant skills' or 'creative thinking skills'. Solely focusing on domain relevant skills can be a blessing and a curse, it reinforces optimization and specialization which are relevant to incremental improvements. These competences are valuable; however it can lead to 'rigidities', and rejection of new ideas and technologies. Organizations and individuals must be open to 'competence destroying' influences. This is difficult. Organizational learning is defined as either 'adaptive' or 'generative'. Generative learning is linked to ground breaking radical innovation. Knowledge acquisition by individual and wider team is very important, active communities of knowledge management practice reinforce this. Individuals must be open and committed to such regenerative learning, behaviors should reflect this.

Management Perspective

Radical innovation developing organizations are entrepreneurial in nature, this requires a distinctive management approach. It involves risk taking and an acceptance of failure. Human resource practices are allied to management strategies; these are important considerations for innovative organizations. Appropriate reward systems, congruent goals, high job security and high commitment to training are viewed are prime examples. Team composition is also important, greater diversity within teams supports creativity and innovation. Organizations also must be both outwards and inwards focused, the wider environmental context must be continually sensed and 'prospected'. Our research study should look for evidence of entrepreneurial behaviour at management and also at individual level.

3.13 Literature Review post note

We have identified various structural attributes and expected behaviours that we would expect to see echoed within a Radical Innovative organization. The research proposal in chapter 5 will flesh these out in greater detail into specific questions.

Chapter 4: Company Background

4.1 Hewlett Packard (HP) Background

Hewlett-Packard Company (HP), incorporated in 1947, is a provider of products, technologies, solutions and services to individual consumers, small and medium-sized businesses (SMB's) and large enterprises. Its offerings span personal computing and other access devices, imaging and printing-related products and services, enterprise information technology infrastructure (including enterprise storage and server technology, enterprise system and network management software) and multi-vendor customer services.

In 2003 HP merged with it's main competitor in the PC and server business (Compaq). The deal cost approximately 19B $. This was and still is the largest merger or acquisition in the IT industry. The deal was headed by Carly Fiorina, the HP CEO at the time. The deal was marred by major controversy and objections by many shareholders. After the merger, quarterly results were inconsistent, leading to several sharp sell-offs in the shares. It was this, and her failure to hit HP's profits targets, which led to her dispute with the company's board and subsequent departure.

In March 2005, HP appointed Mark Hurd as CEO. Hurd's stated aim was to improve overall efficiency of organization and restore growth and profit. After a period of a few months, Hurd started to implement fundamental restructuring of the company. This included 15,000 job losses. (10% of workforce).This transformation program is on going and sets the larger organizational backdrop for our research study.

During the fiscal year ended October 31, 2006, HP's operations were organized into seven business segments: Enterprise Storage and Servers (ESS), HP Services (HPS), Software, the Personal Systems Group (PSG), the Imaging and Printing Group (PG), HP Financial Services (HPFS) and Corporate Investments. ESS, HPS and Software are structured beneath a Technology Solutions Group (TSG).

Enterprise Storage and Servers

ESS provides storage and server products in a number of categories. Industry standard servers include primarily entry-level and mid-range ProLiant servers, which run primarily the Windows, Linux and Novell operating systems. The business spans a range of product lines that include pedestal-tower servers, density-optimized servers and HP's Blade System family of blade servers. Business critical servers include itanium-based integrity servers running on the HP-UX, Windows, Linux and OpenVMS operating systems, including the high-end Superdome servers and fault-tolerant Integrity NonStop servers. Business critical systems also include the reduced instruction set computing (RISC)-based servers with the HP 9000 line running on the HP-UX operating system, HP AlphaServers running on both Tru64 UNIX and OpenVMS, and machine interface processor (MIPs)-based NonStop servers. HP's StorageWorks offerings include entry-level, mid-range and high-end arrays, storage area networks, network attached storage, storage management software and virtualization technologies, as well as tape drives, tape libraries and optical archival storage.

HP Services

HPS provides a portfolio of multi-vendor IT services, including technology services, consulting and integration, and managed services. HPS also offers a variety of services tailored to particular industries, such as media and entertainment, manufacturing and distribution, financial services and the public sector, including government and education services. HPS provides a range of technology services from standalone product support to high-availability services for global, networked, multi-vendor environments. This business also manages the delivery of product warranty support through its own service organization, as well as through authorized partners.

HPS provides consulting and integration services to architect, design and implement technology, and industry-specific solutions for customers. Consulting and integration also provides cross-industry solutions in the areas of architecture and governance, infrastructure, applications and packaged applications, security, IT service management, information management and enterprise Microsoft solutions. HPS offers IT management services, including outsourcing, transformational infrastructure services, client computing

managed services, managed Web services, application services and business process outsourcing.

Software

Software provides management software solutions, including support that allows enterprise customers to manage their IT infrastructure, operations, applications, IT services and business processes under the HP OpenView brand. This segment also delivers a suite of carrier-grade platforms for developing and deploying next-generation voice, data and converged services to network and service providers under the HP OpenCall brand.

Personal Systems Group

PSG provides commercial personal computers (PCs), consumer PCs, workstations, handheld computing devices, digital entertainment systems, calculators and other related accessories, software and services for the commercial and consumer markets.

Imaging and Printing Group

IPG is an imaging and printing systems provider for consumer and commercial printer hardware, printing supplies, printing media and scanning devices. IPG is also focused on imaging solutions in the commercial markets. IPG's offerings include inkjet systems, which include desktop single function and inkjet all-in-one printers, including photo, productivity and business inkjet printers and scanners; digital imaging products and services.

HP Financial Services

HPFS supports HP's global product and service solutions, providing a range of value-added financial life cycle management services. HPFS enables the Company's customers to acquire IT solutions, including hardware, software and services. The Company offers leasing, financing, utility programs and asset recovery services, as well as financial asset management services for global and enterprise customers.

Adapted from Reuters 2007

4.2 PEST Analysis of HP

PEST analysis is an often used; strategic tool for understanding market growth or decline, business position, potential and guidance for operations. PEST are external factors which effect all firms and exist within the external environment. These factors are usually beyond the firms control and shape how firms compete, configure and respond.

Many macro environmental factors are country specific, however for the purpose of this analysis of HP, as these constraints also apply to HP's enterprise competitors; they are called out in a global perspective.

Using the PEST analysis tool to understand the strategic and operational positioning of HP yields the following analysis:

4.2.1 Political Analysis

HP operates as a global business within 145 countries world wide. It is organized into three global business groups which roughly correspond to Americas (north and south) , Europe and Africa and Asia. HP is subject to various regional regulations and policies within the associated trading blocks. The key factors at play include trade regulations and tariffs, legal framework for Intellectual property and contract enforcement.

The advent of globalization has mitigated against the more adverse impacts of such policies, Europe to America and Visa Versa. In addition, Japan and China and Korea are large important markets for HP and general movement to free markets has encouraged expanding trade here. HP is subject to anti-trust laws in most jurisdictions, and recent events (Enron, WorldCom) within United States have led to tighter financial corporate controls. European community directives in terms of product packaging, and industrial safety requirements mimic in most part US and Japanese standards and many global enterprises including HP have developed successful competences to market, manufacture and sell products and services in such diverse regions. HP does have cost and flexibility exposure due to European labor laws which are different in perspective and philosophy to US and other regions however Europe is HP's largest market and withdrawal due to such local regulation is highly unlikely. Political stability and risk of military invasion are not major strategic factors that impact HP, most units of production and markets are located within stable regions.

4.2.2 Economic Analysis

The advent of GATT and collapse of communism has resulted in global migration to free open market economies. For example, China and Russia are moving to market based economies. Old style protectionism or singular government intervention in free markets is on the decline. Trading agreements prevent such unilateral moves. Increasing energy costs are a concern, HP is a large manufacturer and materials and transport costs will overtime; impact production unit costs.
Currency stability is an issue for HP, the historically weak dollar compared to Euro, Sterling and the Yen are reflected in lower actual European profits and appearance of higher operating expenses in these regions.

HP is directly impacted by general economic trends. The Server, PC and storage business are barometers of general business economic climate, for example the 2001 technology crash impacted various areas of these business units. Also the mobile PC business, printer and ink business are directly tied to consumer spending and sentiment. The back to school consumer market is a very large component of the HP sales in summer months. HP is a mature company and with lower than average employee attrition rates, particularly within the United States, this aging workforce has negative financial implications for pension and downstream Medicare costs.

In the ICT industry, many competitors have relocated to lower cost economies such as India and China. There is a visible trend to move many software jobs and entire business operations to these locations. The objective is to gain competitive cost advantage. HP has relocated many positions to India, China and other lower wage cost economies. This obviously has impacts in originating countries , (job losses, morale, social impacts) but also on the destination economies. Witness pollution now emerging in China.

Globalization and global competition have resulted in increased focus in branding and marketing. Global brands now compete and are universally recognized. HP must maintain it’s strong brand leadership in the various competitive business segments. Bad press or poor consumer sentiment in one particular region now have spill over effects in multiple regions.

Another outcome of globalization, general availability of credit and efficient financial markets; has been industry convergence. The ICT industry has seen many large scale acquisitions and mergers. Notably, Compaq purchased Digital and HP subsequently acquired Compaq. The ability to successfully merge and acquire new companies is a key determinant of success. This trend is expected to continue. Modern enterprises must be proficient at integrating potential competitors into it's own infrastructure and culture.

4.2.3 Social Analysis

HP is subject to a number of macro social trends. One key trend is the market and political focus on green issues. HP as a large ink and printer manufacturer, people use a lot of paper and ink with HP products so it's indirect carbon footprint is large.
Also as the worlds largest PC and laptop manufacturer, HP will have to address potentially stricter environmental policies in the coming years. We already have seen recent European legislation concerning 'end of life disposal' for consumer white goods.
There is a large change in social interaction with technology, wireless and mobility are now key product and user demanded attributes. Peoples expectations relating to technology are accelerating. People are also using technology in new ways, HP must map and maintain coherence with these social trends to be successful.
Mass customization is now generally accepted as an ongoing social trend, the initial Ipods were all white, now consumers expect various colours, flavours. Cell phones , Laptops can be ordered and configured in different colours and with multiple options. This increases supply chain and manufacturing complexity. HP must have an internal technology infrastructure which supports this trend. In the realm of education, information technology is becoming increasing important for delivery of education content. HP must track this trend and seek to configure appropriate products and offerings to be successful.

4.2.4 Technological Analysis

As HP is a technology enterprise, there are many macro factors at play in this category. The most salient are discussed here:

Emergence of Linux

This impacts HP's core enterprise platform business, HP has invested and developed over many years it's own enterprise version of Unix called HP-UX. Many customers are moving away from proprietary operating unix systems and using linux. This is also facilitated by lower cost higher performance hardware. This move away from higher margin, higher profit hardware impacts net revenue.

Convergence of standards and technologies

Computing infrastructure is now viewed as a utility by many large enterprise customers, an intel based platform running windows is practically identical in terms of price /performance from any vendor. HP must differentiate it's self in the market using other means. Designs are now standardized for many elements of the infrastructure so HP has to be

price competitive , standardized but also unique. This implies need for large economies of scale allied to flexibility.

Scale of Technological Advancement

The price /performance scalar for computing platforms is well documented but this rapid advancement has large impacts on how enterprises configure supply chains and routes to markets. Product obsolescence is a major concern for HP, accurate forecasting and build to order are required to minimize ageing inventory but also on other hand to ensure that customers can get the next hot product early where maximum profits can be obtained. HP has traditionally competed against DELL's direct model with a hybrid route to market, the success of this strategy varies from region to region. For example, HP is very strong in retail in United States but very poor with direct sales in Northern Europe. HP requires very efficient and very flexible technological infrastructure to support such a diverse supply chain.

Lower Cost Computing

Improvements in technology have led to rapid advances in mobile technologies and lower cost have yielded large price /performance gains for consumers. For example, Laptop sales are increasingly important to HP. One aspect of this is that unit sell out costs and unit sell out margins are decreasing. HP must manufacture, distribute and sell more physical units to stand still. This has scale impacts on HP's internal infrastructure as this trend leads to more transactions, more SKU's to track etc. In addition, these products all require warranty and associated support. This creates an increasing challenge of scale, how can HP successfully scale it's service offerings efficiently. Currently HP allocates 4% of annual sales to cover warranty costs and accruals, this is a 4B$ annual cost. HP's strategic response is to move services from manual to automated and is investing heavily in remote support technologies. The IT infrastructure must support this trend.

Service revenues mix changing

The advent of new technologies such as virtualization, standardization of the platforms and lower cost of hardware / software is changing the way customers now purchase value added services from HP. Contract costs are reducing in line with hardware pricing, Customer no longer need break fix type contracts as hardware infrastructure is increasingly more fault tolerant and more reliable. Many customers no longer take out maintenance contracts and only seek specialized, customized contacts.

Saturation of the Laser and Inkjet Market

HP has a dominant position within the personal inkjet and enterprise laser printer world wide market. The emergence of digital photography is a key trend, HP does not have a market winning story in this category, HP fears that customers who purchase Canon cameras are also more likely to purchase Canon photo printers. HP is also extending it's laser printer offerings to higher volume, wider format specialized print solutions. There are well entrenched competitors in this market such as Xerox Inc, Heidleberg GMBH. Future success in these new markets is not guaranteed.

Mobility and Wireless

The advent of the cell phone and PDA is a new computing platform. Cell phones now integrate cameras, PDA's, mp3 players. Next wave technologies promise TV on your cell phone. HP is not a leading player in this area, the risk is that these devices as they develop and mature will impact HP's lower end PDA and Laptop markets. HP must ensure that new products and offerings align with this trend.

4.3 PEST Summary

Using PEST output and applying this to HP Information Technology Function gives the following operational objectives:

- Infrastructure and process must support a large enterprise and achieve economies of scale.
- Infrastructure must enable business flexibility, HP competes in many markets using different approaches.
- Ensure worldwide conformance to regulations and statutory mandates.
- Products and offerings are refreshing rapidly, the HP IT infrastructure must enable this by delivering sustained business innovation.
- Infrastructure must enable the transition from manual support to increasingly automated remote support technologies.
- Ongoing costs must be aggressively managed as competitive environment dictates this.
- Flexibility to support future mergers and acquisitions.
- Enable development of new product and service offerings; align investment with promising social and technological trends.

4.4 HP Information Technology (HP-IT)

In summer 2006, Randy Mott was appointed CIO. HP at the time had a high cost (3.5B$ in 2005) sprawling information technology infrastructure. This infrastructure had evolved over many years and included disparate elements from all the acquired and merged companies over the years, For example, the supply chain solution encompassed elements from Digital, Compaq and HP. Over 70% of IT development time was spent supporting and sustaining legacy systems, this was impacting ability to develop new business application in new promising areas.

Mott's objective was to rationalize this and reduce spending by half within 4 years. He quickly hired a dozen IT executives from external companies to help drive and lead this massive transformation.

The new IT management structure implemented plans to reduce IT workforce by 50% and focused immediately on cost reduction. The guiding tactical strategy within IT has been to invest management efforts in process and administrative improvements, re-enforcing high centralization, high formalization. The number of projects was reduced from 1,200 to 500. HP had 785 individual databases supporting data analysis needs for the various business lines, the new IT model called for this to be reduced to one large central warehouse. The strategic corporate objective has been to reduce IT spending from 4% of Sales to 1.8% over a two year period

The transformation plan calls for standardization on singular tool sets and development methodologies and to implement strict top down budget and project management controls. HP IT is internally focused and focused on immediate short term horizon and focused on process efficiency and driving improvements in process.

In 2006, HP announced plans to consolidate 85 worldwide data centers into 6 super datacenters in the United States, the aim is to reduce telephony, network and people support costs.

4.5 ST R+D LAB

As part of this organizational restructuring, the ST engineering group which had traditionally been part of the HP Services organization has now has been relocated as a sub-ordinate of the IT group under Randy Mott.

Part of the rationale in doing this is that the ST organization touches HP's internal IT infrastructure in many points. As new solutions are developed within ST, these are productized and installed within HP IT data centers and delivered to customers via HP Services. However, the IT function is in midst of a large transformational change as mentioned above, with a major emphasis on operational cost control and IT service and capital infrastructure cost reductions..

This organizational repositioning potentially creates the contextual dilemma for the ST group. The incremental optimizing approach is suitable for the IT structural problem at hand but creates a dilemma for the ST sub group. It will benefit from process improvements and cost reductions in IT as this will provide them with better platforms and infrastructure. However in contrast to this 'administrative innovation / incremental '; ST needs to drive largely 'radical innovations'. For example, ST are looking at technology trajectories and market directions 1-3 years out. IT are looking at projects and returns within 6-12 month time frames. The 'new flag' over the door may constrain how ST goes about it's business.

4.6 New ST Operating model

The day to day operating model for ST management has changed significantly. New IT wide management information tools track all project activities; each project must show and demonstrate short term business returns. All ST engineers have time sheets to fill in and record all their work activity against a valid approved project.

The tools and technologies that ST engineering teams work with have been dramatically reduced, they must follow IT architecture directives. Business travel and overall budgets have been dramatically reduced, the ST organization have also lost key engineers through various redundancy programs and early retirement programs.

The cost reduction program has resulted in large scale job losses within the IT group and to a lesser extent job losses within the ST group. The IT group has defined rigid centralized controls over budgeting, spending restrictions and architecture. The IT group have defined centralized standards for data modeling, data tools and a one size fit's all development methodology in order to reduce costs. There are strong central administrative controls over all spending, including personal development and training.

Overall budgets are reviewed on a six monthly cycle and budgets are decreasing, cycle on cycle. ST management have limited discretionary spending powers, the central IT procurement function governs all.

The new ST alignment is also disadvantaged in terms of communications and linkages with external stakeholders, customers and other groups. In the past ST operated within a horizontal context, now it operates within the IT vertical tower. The external sensing and business engagement is now handled by a central IT group. The voice of the customer is now filtered heavily via the 'IT' lens.

IT management have defined a large metrics and performance reporting framework and are rolling this out across all IT. Each project is tracked for on time delivery and also compliance with a singular waterfall development methodology. For example, all projects in IT must now have 25% calendar duration for the 'Planning phase', exceptions are punished. This is in contrast with many 'research' type projects where much work is spent in exploratory or investigation phases. This singular mandated approach to all project development is 'new' to the ST organization; who use a mix of such traditional methods plus various 'agile' and 'fuzzy' development processes.

4.7 Setting the scene for the research

This is the changing organizational context that sets the scene for the research activities. The IT transformation is ongoing but has accelerated significantly from mid 2006. The operating environment for ST on face value is changing to a more centralized, mechanistic structure and openly advertises it's self as so.

Chapter 5: Research Methodology

5.1 The Research Objective

This research deals with the behaviours and attitudes of software engineers within an R+D LAB in HP within context of large organizational transformations to a more 'mechanistic' control structure.

These engineers are chartered and goaled on development of new 'innovative' solution for HP customers. They now find them selves in an 'ambiguous', conflicting situation, the academic literature suggests that innovation will be stifled under such conditions. This research by way of a survey will examine if there has been a change in behaviours and attitudes by engineers and managers in the ST organization relating to innovation in such an environment. We are attempting to validate and measure changes in attitudes and behaviours by these actors as the organizational context changes over time.

5.2 Research Chapter Roadmap

This chapter will detail how the research activity was undertaken; it discusses the questions that are posed at the outset which form the basis of the research. It reviews the various strategies and methodologies available to conduct the research and sets out the reasoning for choosing a particular method. Also the detailed 'mechanics' of the data gathering are discussed. In additional, limitations of the proposed research method are reviewed and commented upon.

5.3 Research Question

The hypothesis under test is:

> ST Managers and Engineers feel that radical innovation is stifled in a more 'mechanistic 'organization.

In the literature review we developed a theoretical understanding of innovation and an understanding of the theoretical output in terms of behaviour and attitudes of actors within various organization structures.

This decomposed into the following research questions:

Q1: What distinguishes Mechanistic and Organic structural types?

Q2: What are the various factors or variables that stimulate radical innovation?

Framing these questions against the higher level research question on how actors behave and how they feel, we are in essence looking to measure opinions and behaviours within the test population. The data gathering phase will probe the population environment along these two tracks to determine what actual perception and behaviours are exhibited. These outputs will be gauged within a time perspective; we aim to understand what trends are occurring by looking at changes and such revising attitudes over time.

This is explanatory or analytic research as described by Saunders et all (2007), Gill and Johnson (2002), which enables analysis of cause and effect relationship. The independent variable in this case is the organizational structural type (Mechanistic to Organic) and the dependent variable is the organizational propensity to Radical or Incremental Innovation. Looking at these variables within a trending perspective allows us to develop 'a barometer' effect, we can sense which way the needle is going.

5.4 Unit of Analysis

The unit of analysis is the ST tools group, also known as the R+D LAB. This group is diverse in geographical nature, composed of 220 engineers in 5 time zones. These teams operate in a virtual development environment assigned to multiple projects. Some of these projects overlap, in that differing teams are developing and creating components for a particular framework or encompassing structure.

5.5 Research Approach

The deductive approach to research was chosen for the following reasons:

1. The deductive approach emphasises moving from theory to data, there is a large body of research and theory available on innovation and on the social sciences.

2. It is possible to select samples of sufficient size which will aid development of acceptable conclusions.

3. The audience for this research are more likely to be familiar with deductive approach as Saunders et all (2007,p121) note that ‘’*managers are more likely to put faith in conclusions from such an approach’’*.

5.6 Research Strategy

A Survey strategy was adopted for this work as opposed to Case Study, Action Research or Experiment. (Saunders et all 2007; Gill and Robinson 2002) note that survey strategy supports deductive approach and is popular with business and management research. Action Research was rejected on basis that organizational co-operation (access and agreement) would be difficult to obtain. Case Study was rejected on basis that this approach more suited to answering the ‘why’ questions and also potential difficulty to obtain ‘triangulation’ data points in such a dispersed unit of analysis.

5.7 Data Gathering Method

Various methods of data gathering were considered as outlined in table 5.1 below with appropriate reason why these were accepted or rejected.

Data collection methods	Reason for Rejection / Acceptance
Examination of secondary sources	Rejection on grounds that such pertinent data is not readily available for my research. HP conducts regular surveys and organizational sensing relating to job satisfaction and attitudes of entire workforce, however these studies are very broad in scope and also aggregate across entire company divisions and would not uniquely cover the unit of analysis.

Observation	This approach was rejected on the basis that research activity would be very time consuming and also would pose a potential ethical dilemma in that researcher would be also a work colleague in many cases. Also, observation of ‘virtual‘’ behaviours would be difficult.
Semi-Structured / Unstructured interviews	Rejected as the primary mechanism because of concerns over logistical issue with a widespread dispersed population. Arguably , telephone interviews would mitigate against this, however a larger concern related to interviewer and interviewee or response bias. (Saunders et all , 2007,p318) note that this results in interviewees only providing a ‘’partial picture’ or ‘’reflecting the organization in a more positive or negative light’. However, data gathering via interview was used as secondary mechanism as needed to ‘’sanity check’ questionnaire content and to validate key findings.
Questionnaires	This was selected as the primary data gathering technique for the following reasons: • Suitable for a deductive approach • Suitable for analytic analysis • Organizational familiarization with surveys, HP surveys all employees regularly. • It is possible to conduct a survey with anonymity for respondents hence reducing potential for bias. • Target population is easily reachable with a questionnaire. Dillman (2000) distinguishes three types of data that can be collected through questionnaires as follows: • Opinion • Behaviour • Attribute Opinion and Behaviour are key data points that we need to measure

Table 5.1 Data gathering methods

5.8 Sampling Considerations

The target population for the questionnaire was 220 engineers and 25 various project and people managers. The measurement scope also should ensure statistically relevant results this equates to 25 engineers and at least 5 managers within ST

The graphical dispersion of the population requires that an appropriate mix of responses for various regions is obtained.

5.9 Data Gathering Mechanics

A web based survey tool (www.surveymonkey.com) was used gather the survey data from respondents. An email with a covering note was sent to the target population with an embedded url which ran the questionnaire tool. Corporate email distribution lists were used to identify the target population, this ensured good coverage as these email lists are proactively managed by ST group administrators.

All responses were anonymous save only that it was possible to determine which region the respondent was from. This did not prove an ethical issue as it was only possible to determine responses in terms of America, Europe Middle east and Africa and the Asia Pacific region.

The survey was closed after sufficient responses were obtained. Respondents could only take the questionnaire once.

5.10 What questions were asked and why?

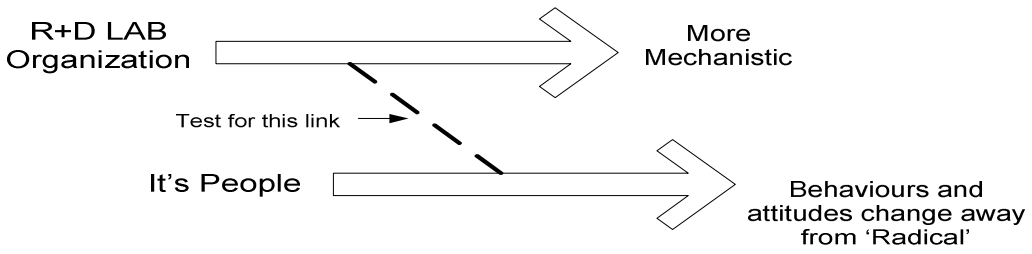

Diagram 5.1 Questionnaire graphical abstraction

The survey content was developed using comparable academic studies and literature definitions and consists of two sections:

- Section one relates to organizational structural type.
- Section two relates to innovation variables.

Section one explored how the population viewed the current organizational context within ST, the questions focused on areas such as formalization, centralization, individual autonomy. In addition areas such as availability of resources, managerial attitudes, and organizational support for information sharing (including communication) were probed. The objective is to understand where ST is located on the continuum between mechanistic and organic organizational types. Also, has this position changed in relative terms compared to 12-18 months previously?

Section two focused on the individual and how they respond to the changes in the organizational context. The questions examines the individual propensity to be creative, do people perceive the environment to be supportive. In addition, the questions focus on individual motivation, work behaviours and individual attributes such as contribution to knowledge, openness, risk taking and engagement across teams and with customers. The objective is to determine if behaviours and attitudes have been moderated by changes in organizational structure.

5.11 How the Questions were framed.

Likert (1932) scales were used to frame the questions, Fisher (2004,p165) comments that "*these are a form of rating scale that is commonly used to ask people about their opinion and attitudes*"

Also, this method is commonly used within HP for internal surveys so this also assured organizational familiarity with concepts. Pilot feedback also obviated need to develop additional training and explanatory text within questionnaire.

5.12 Questionnaire Section One – Organizational Structure

Question Identifier	Questions	Notes / Theoretical concept
1.1	R+D LAB have written rules and procedures around work practises and procedures and these are strictly enforced	Testing for Formalization
1.2	Looking back 12-18 months, how would you answer question 1.1	Formalization trend.
1.3	Decision making in R+D is shared among many.	Test for centralization
1.4	Looking back 12-18 months, how would you answer question 1.2	Trending question
1.5	There are extra resources either financial or human available for non routine activities. (Example: special technical investigations)	Testing for Slack resources
1.6	Looking back 12-18 months, how would you answer question 1.5	Slack Resources Trend
1.7	There are regular face to face meetings with all your LAB work colleagues	Testing for internal communication.
1.8	There are sufficient face to face meetings with your LAB work colleagues	Baseline
1.9	Looking back 12-18 months ago, How would you answer question 1.8	Baseline trending
1.10	R+D LAB encourages and supports membership of industry professional organizations.	Testing for external communication, is this Reinforced structurally
1.11	Looking back 12-18 months ago, How would you answer question 1.10	Trending
1.12	R+D LAB contains a wide variety of subject matter experts	Test for specialization
1.13	Looking back 12-18 months ago, How would you answer question 1.12	Specialization trend
1.14	It is easy to get things done in R+D LAB	Test for organization bureaucracy
1.15	Looking back 12-18 months ago, How would you answer question 1.14	Trending
1.16	R+D Managers are supportive of new ideas and innovation	Test for managerial attitude
1.17	Looking back 12-18 months ago, How would you answer question 1.14	Trending
1.18	If you would like to include additional information, please quote the question number.	Freeform text for additional comments

5.13 Questionnaire Section Two – Innovation variables

This section contains the questions posed and how they linked to the theoretical review.

Number	Question	Notes / Theoretical concept
2.1	Within R+D LAB there is a higher acceptance of ambiguity as opposed to objectivity	Ambiguity Test
2.2	Looking back 12-18 months, how would you answer question 2.1	Trending test, is creativity being stifled
2.3	The organization does not penalise people for foolish or whacky ideas	Tolerance for the impractical
2.4	Looking back 12-18 months, how would you answer question 2.3	Trending question
2.5	R-D LAB treat mistakes as learning opportunities	Tolerance of Risks
2.6	Looking back 12-18 months, how would you answer question 2.5	Risk tolerance Trend
2.7	I spend time and effort convincing supervisors to change designs and work practises because it is the 'correct' thing to do	Direction of work behaviour
2.8	Looking back 12-18 months, how would you answer question 2.7	Trending work behaviour
2.9	I document and follow up on all relevant work issues with colleagues and supervisors. In essence, I go the 'extra mile'.	Level of effort
2.10	Looking back 12-18 months ago, How would you answer question 2.9	Level of effort trending over time.
2.11	When faced with roadblocks and obstacles, I keep trying to do the 'correct' thing' even though my beliefs may be unpopular with my supervisor and peers.	Level of persistence
2.12	Looking back 12-18 months ago, How would you answer question 2.11	
2.13	I am willing to learn new skills and competences. For example, would you re-train from a Linux developer to a Windows developer	Acceptance of need to develop additional skills
2.14	Looking back 12-18 months ago, How would you answer question 2.13	Trending
2.15	I regularly contribute to special interest groups, blogs and technical discussions.	Information sharing
2.16	Looking back 12-18 months ago, How would you answer question 2.15	
2.17	I regularly work with people from different	Test for skills diversity

	groups with different skills sets and specializations	
2.18	Looking back 12-18 months ago, How would you answer question 2.17	
2.19	I am regularly exposed to new ideas and concepts	Idea Review
2.20	Looking back 12-18 months ago, How would you answer question 2.19	
2.21	There is an active forum where I can contribute ideas and suggestions	Idea Creation
2.20	I am encouraged to take risks	Test for sense of entrepreneurship
2.21	Looking back 12-18 months ago, How would you answer question 2.20	
2.22	I regularly work closely with my customers	External environment sensing
2.23	Looking back 12-18 months ago, How would you answer question 2.22	
2.24	If you would like to include additional information, please quote the question number.	Freeform text for additional comments

5.14 Questionnaire Pilot

A pilot ‘’draft’’ survey was validated with a senior manager within ST and three experienced engineers prior to final completion. The following feedback was obtained and included within the questionnaire:

- The R+D LAB is composed of various engineering groups, the respondents from this groups may be impacted to a higher or lesser degree by wider structural changes, the questionnaire needed to identify from which sub group the engineer or manager is located.

- The question on testing for centralization may yield different responses across the LAB as managers have different styles and approaches, a text box should be added for additional comments here. This recommendation was accepted as additional comments on centralization would be of significant interest.

- It was also suggested to add a comment box for each question, this feedback was rejected on basis it would make survey unwieldy but a comment box was added at bottom of each screen.

5.15 Questionnaire – Final formatted content

The web based survey tool produced the following formatted output.

Innovation Study

1. Introduction

Hi All,

I am conducting some academic research for my masters thesis on how organizations configure for incremental and radical innovation. The dichotomy between radical and incremental innovation is my particular area of interest.

Please can you assist my research efforts by filling in a small survey.

The survey has 40 questions and will take 10 minutes to complete.

All responses are anonymous. The survey is limited to members of the TSS R+D Tools Lab.

The research is focused within the R+D Lab., please respond to questions within this organizational context.

Many thanks in advance

john.b.walsh@hp.com

Phone + 353 87 203 2766

2. Section 1 - Organizational Structure

1. Which group in R+D do you belong to ?

- ◯ Architecture and Integrated Services
- ◯ Enterprise Serviceability Tools
- ◯ Imaging, Printing and Client Services
- ◯ Remote Support and Proactive Services
- ◯ Storage / SAN/ Network services
- ◯ Other

2. Are you a people manager or a project manager ?

- ◯ Yes
- ◯ No

3. R+D LAB have written rules and procedures around work practices and procedures and these are strictly enforced.

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

4. Looking back 12-18 months, how would you answer question 3 ?

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

5. Decision making in R+D is shared among many.

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

6. Question 5 relates to the degree of autonomy that individuals have within TSS R+D, please add any additional comments in relation to this topic here.

7. Looking back 12-18 months, how would you answer question 5 ?

Innovation Study

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

8. There are extra resources either financial or human available for non routine activities. (Example: special technical investigations .

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

9. Looking back 12-18 months, how would you answer question 7

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

10. There are regular face to face meetings with all your LAB work colleagues.

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

11. There are sufficient face to face meetings with your LAB work colleagues

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

12. Looking back 12-18 months ago, How would you answer question 11 ?

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

13. If you would like to include additional information, please quote the question number.

Innovation Study

3. Organizational Structure

1. R+D LAB encourages and supports membership of industry professional organizations.

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

2. Looking back 12-18 months ago, How would you answer question 1 ?

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

3. R+D LAB contains a wide variety of subject matter experts.

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

4. Looking back 12-18 months ago, How would you answer question 3 ?

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

5. It is easy to get things done in the R+D organization.

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

6. Looking back 12-18 months ago, How would you answer question 5 ?

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

7. R+D Managers are supportive of new ideas and innovation.

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

8. Looking back 12-18 months ago, How would you answer question 7 ?

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

9. If you would like to include additional information, please quote the question number.

Innovation Study

4. Innovation Variables

1. Within R+D LAB there is a higher acceptance of ambiguity as opposed to objectivity.

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

2. Looking back 12-18 months, how would you answer question 1 ?

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

3. The organization does not penalise people for foolish or whacky ideas.

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

4. Looking back 12-18 months, how would you answer question 3 ?

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

5. R-D LAB treat mistakes as learning opportunities.

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

6. Looking back 12-18 months, how would you answer question 5 ?

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

7. I spend time and effort convincing supervisors to change designs and work practices because it is the 'correct' thing to do.

◯ Very Often ◯ Often ◯ Neutral ◯ Sometimes ◯ Never

8. Looking back 12-18 months, how would you answer question 7 ?

◯ Very Often ◯ Often ◯ Neutral ◯ Sometimes ◯ Never

9. I document and follow up on all relevant work issues with colleagues and supervisors. In essence, I go the 'extra mile'.

◯ Very Often ◯ Often ◯ Neutral ◯ Sometimes ◯ Never

10. Looking back 12-18 months, how would you answer question 9 ?

◯ Very Often ◯ Often ◯ Neutral ◯ Sometimes ◯ Never

11. When faced with roadblocks and obstacles, I keep trying to do the 'correct' thing' even though my beliefs may be unpopular with my supervisor and peers.

◯ Very Often ◯ Often ◯ Neutral ◯ Sometimes ◯ Never

12. Looking back 12-18 months, how would you answer question 11 ?

◯ Very Often ◯ Often ◯ Neutral ◯ Sometimes ◯ Never

Innovation Study

13. If you would like to include additional information, please quote the question number.

5. Innovation Variables

1. I am willing to learn new skills and competences. For example; re-train from a Linux developer to a Windows developer or visa-versa.

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

2. Looking back 12-18 months, how would you answer question 1 ?

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

3. I contribute to special interest groups, blogs and technical discussions.

○ Very Often ○ Often ○ Neutral ○ Sometimes ○ Never

4. Looking back 12-18 months, how would you answer question 3 ?

○ Very Often ○ Often ○ Neutral ○ Sometimes ○ Never

5. I work with people from different groups with different skills sets and specializations.

○ Very Often ○ Often ○ Neutral ○ Sometimes ○ Never

6. Looking back 12-18 months, how would you answer question 5 ?

○ Very Often ○ Often ○ Neutral ○ Sometimes ○ Never

7. I am exposed to new ideas and concepts.

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

8. Looking back 12-18 months, how would you answer question 7 ?

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

9. There is an active forum where I can contribute ideas and suggestions

○ Strongly agree ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

10. I am encouraged to take risks.

Innovation Study

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

11. Looking back 12-18 months ago, How would you answer question 10 ?

◯ Strongly agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly disagree

12. I work closely with my customers

◯ Very Often ◯ Often ◯ Neutral ◯ Sometimes ◯ Never

13. Looking back 12-18 months ago, How would you answer question 12 ?

◯ Very Often ◯ Often ◯ Neutral ◯ Sometimes ◯ Never

14. If you would like to include additional information, please quote the question number.

15. The survey is completely anonymous, however if you are available for follow up discussions, please enter your email address here.

Thats it, many thanks for your contribution.

John

5.16 Limitations of research approach

Saunders et all (2007) note that the ‘robustness’ of the survey depends on whether or not a repeated survey would produce similar results at different times within different circumstances. They advocate three approaches to assess reliability:

- Test-retest
- Internal consistency
- Alternative form

Test-retest requires sampling the population twice in a short period of time, this approach was not practicable for the R+D LAB population in a diverse geographical environment, also the element of ‘survey’ burnout was considered.

Internal consistency of the survey design was approach by correlating certain questions and responses, for example responses in relation to ‘formalization’ and ‘bureaucracy’ can be logically linked, we would not expect widely diverging answers to these questions.

Alternative form advocates comparing responses to alternative forms of the same question, this usually involves posing the same question twice (check questions). This mechanism was not used within the questionnaire, as a compromise between overall questionnaire length and potential response rate was considered. However in order to address this important test; a sub sample of respondents were interviewed. The purpose of the interview was to determine consistency of the survey for example;

- Did the respondents interpret the questions as the researcher intended?
- Provide additional soft information on subject at hand.

The output from these interviews and general comments are included within the results chapter.

5.17 Temporal perspectives within questionnaire

A key element of the survey was to determine responses over a period of time, this was done by asking the respondents to re-factor their answer by casting their minds back 12-18 months in time. There are a number of problems with this approach, it is obviously very subjective and peoples memory, perspective of the past is often tinged by the 'now'. The 'far away hills are green' and 'sentimentality is not what it used to be' also have some relevance here. Longitudinal studies by nature of their structure address these concerns.

Yet the approach taken does have some merit, it will yield a sense of direction and may be used by respondents to temper, consider more carefully the answer to the prime question. The structure of the questionnaire was kept consistent through out seeking to dampen more extreme effects. Interviewees were also tested and responded positively; to see if they adapted their answers once they 'internalized' the questionnaire structure.

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Chapter 6: Analysis and Discussion of Results

6.0 Chapter Introduction

This chapter contains two sections:

1. Analysis: collates and analyzes the physical survey results.

2. Discussion: Reviews findings in terms of theory and expectations.

6.1 Analysis

Diagram 6.1 demonstrates how the survey trends were developed.

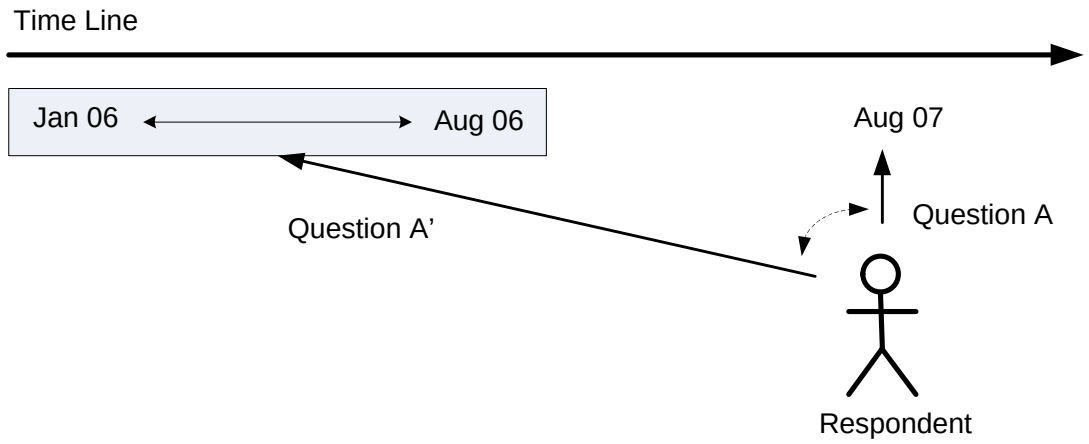


Diagram 6.1 Survey Baselines

Each question in the survey had two parts; Part A tested the response of the individual looking at the issue under scrutiny in August 2007. The second part of the question A' asked the respondent to review how they would answer a similar question 12-18 months in the past. Comparison of the two responses provided evidence of a shift in opinion or attitude. The direction of the trend either positive of negative was based on the expected theoretical outcome as defined in the research methods in chapter 5 and was indicated in terms of a percentage swing to more 'mechanistic' or more 'organic' . For example, if a greater percentage felt that R+D LAB was subjected to higher 'formalization', this was mapped as a swing to more 'mechanistic'.

The survey did not attempt to classify where R+D LAB was located in the continuum between 'Organic' and 'Mechanistic'. This absolute position for the R+D LAB may be entirely different for a similar organization within another company.

The base line for comparison was the perspective in August 07 compared to how people perceived differences in the past. The 12-18 month comparison value was selected as this allowed people to cast view back to when large scale organizational changes and impacts started to be felt as result of organizational re-shuffles.

No doubt some of the responses will have been influenced by more recent individual and organization events, however, it is the relative shift in opinions and behaviours that are of interest for the analysis not the absolute values.

6.2 Survey Feedback and adjustments.

The on-line questionnaire was sent to 220 engineers and managers within the R+D tools group. 65 People responded. 15 Project or People managers from 25 also responded.
In addition 13 people indicted willingness to provide additional comments and feedback, this included 3 managers and 10 individual contributors. Of these; one manager and two individual contributors were selected at random for follow up interviews. The interview purpose was to verify that respondents comprehended questions (alternate form check) and to provide soft data to assist with analysis of results.

6.3 Respondents Feedback

One person indicated that they did not understand the question:

> *Within R+D LAB there is a higher acceptance of ambiguity as opposed to objectivity*.

One person indicates that the question '*Is it easy to get things done*" is too broad.
One respondent indicated whereas he was in the organization less than a year and could not respond to all the questions.

These comments represented a small proportion of overall responses and would not impact validity of the questionnaire results. Responses from these respondents were removed from overall results calculations.

Four questions were included to verify internal consistency of the survey results, notably around ‘formalization’ and ‘bureaucracy’ and ‘’entrepreneurship’ and ‘risk taking’. There was good correlation between the responses. As a result of these adjustments, tests and modifications, the survey output is a fair and representative sample from the R+D LAB.

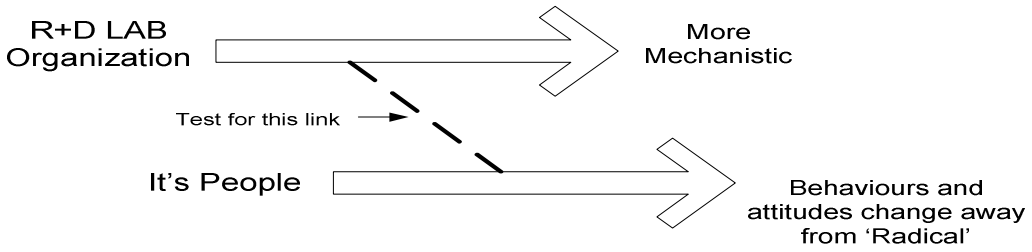


Diagram 6.2 Graphical abstraction of Questionnaire Objective

The above diagram provides the background objective to the questionnaire. The key findings are outlined as below. Individual percentages are rounded up and down. Trend information is the comparison to responses when actors were asked to review answer 12 to 18 months in the past. This is expresses in negative or positive vectors.

Formalization

The survey responses indicated that organization was not highly formalized, however there was a marked shift to more highly formalized (+12%) viewpoint. This corresponded to an equivalent +17% belief that organization was more bureaucratic. Manager responses were probed and these yielded +15% shift in belief that R+D LAB is more formalized than before.

Centralization / Autonomy

Responses indicated no discernable time shift on whether organization control is centralized, 48% believe R+D Lab individual members have wide decision making authority. The additional autonomy question probes this further in terms of individual freedom to make decisions, this yields 82% response as indicating that R+D Lab members have low autonomy. There is a very small shift across all R+D engineering groups to slightly more collaborative decision making. This collaboration seems to be reflected at the individual team or project level, many of the free form comments indicate this but that 'wider decisions' are taken from on high.

Slack Resources

The survey indicated a large negative (81%) response to availability of slack resources, the trend was a shift of 19% . Also there was a similar trend within the neutral responses from 24% to 12%.

Internal and External Communication

Results indicate that 58% disagree and strongly disagree that there are regular face to face meetings with LAB colleagues. This negative trend has increased 11%. Also 48% of replies say that there is insufficient internal communication. Supporting comments indicate that 'travel bans' and 'widely dispersed project' teams contribute to this negative trend. External communication also mimics this trend, 24% respond negatively indicating a negative shift of 10% over time.

Specialization

Replies indicated a high degree of specialization, yet there was a small trend in the negative 3% and associated comments that LAB had lost key people due to redundancies and early retirement programmes.

Bureaucracy

52% of replies believe R+D LAB contains excessive bureaucracy, this is a negative trend of 17%. This negative trend agrees in direction with formalization responses.

Management Support for new Ideas

This has shifted negatively by 11% with additional comments noting that there are no mechanisms to 'handle these' as upper level decisions are negatively preventing an engineer from innovating. Additional comments noted that individual managers may be supportive but higher level dictates and mandates prevented them from supporting new ideas and innovation.

6.4 Summary of responses on organizational variables

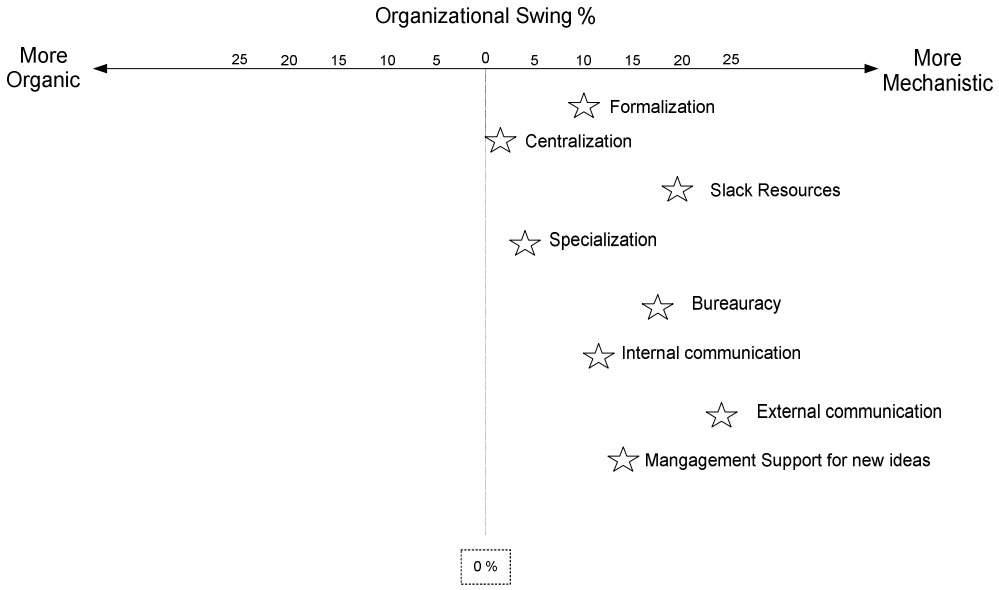


Diagram 6.3 Organizational Swing

The results are mapped in a graph to show direction of user perception when we survey for organizational structural variables. These show that users within R+D LAB believe that R+D is more mechanistic now than in the past.

6.5 Individual innovation survey responses

This deals with the individual user responses and user behaviours. The poles on these scales deal with propensity to radical or incremental innovation.

Ambiguity

33% of responses agreed individuals and organization was more open to ambiguity than objectivity, this was a -9 % trend decrease when compared to the trending value. Also 5% agreed strongly that this was the case 12-18 months ago, this strength of opinion indicator was also negated.

Tolerance of the Impracticable

This question is similar to question on ambiguity and results show similar trend, 17% of responses feel that people are less inclined to offer unusual or 'whacky' ideas for fear of punishment. This is a 10% swing from baseline trend question.

Tolerance of Risk

The trending responses for agreement in this category are similar 1% change, however more significant is the responses in the negative which show that tolerance for risk as decreased by 12% from baseline trend. One comment indicated there is *'no time for mistakes any more''*.

Motivation - Direction of work Behaviour

24% of responses replied in the often and extremely often category compared to a baseline trend figure of 29%, this 5% swing indicates that users are less motivated to contribute at highest levels than as before. This is tempered by swing to increased directional behaviour of ''sometimes'' from 33 to 43%. This question attempts to probe level of discretionary output from individual and it can be deduced that there is a subtle change in user chosen behaviour within R+D LAB over the trending period.

Motivation - Level of Effort

The response for this question was identical for baseline and trend value at 57% in the agree or strongly agree category. This can be interpreted as the level of individual effort in R+D LAB is stable over the time period.

Motivation - Level of Persistence

Individuals within R+D LAB are more motivated to overcome obstacles to perform the chosen behaviours. There is a swing of 4%.

These effects can be aggregated and result in no perceptible change in individual motivation levels.

New Skills Outlook

This elicited a very positive response, 5% swing in positive acceptance of need to develop new skills and also acceptance of need to possibly unlearn existing skills. The Linux versus Windows question was deliberately set to sense if there were 'religious' objections to a particular technology set which may signal deep rooted objections to technology renewal.

Information Sharing

Only 19% of responses indicates that they contributed 'often' to information sharing activities. This was a slight decrease of -2% on trending analysis. Aggregating the often, neutral and sometimes categories there is a positive trend of +2%. However, given the reduction of the top category on this question, it can be interpreted that this value is slightly negative on trend.

Skills Diversity

The key category for analysis is the 'very often', we would expect to see this value increasing within a increasingly radical innovation perspective, individuals would be exposed to wider teams. This value decreased from 28 to 24% over the trending period.

Exposure to new ideas and concepts

There is high agreement 74% of positive exposure but this must be moderated with 7% swing in disagree and strongly disagree responses. This implies that for some population of actors within R+D this has moved negative. This must also be considered in conjunction with ancillary question on idea creation which was tested with a single question. This yielded a positive response of 32% and a negative response of 31%. This would imply only a minority of R+D members feel there is an active forum for idea contribution and recognition.

Entrepreneurship

This measured individual propensity to take risks, this showed a dramatic swing of 15% from more risky past perspective to more risk adverse as measured today. This was also reflected within the comments.

External Environmental Sensing

This showed a mark swing to a more closed perspective, 14% of R+D lab no longer work closely with customers. In the Often and Very Often category, this as moved negatively by 8%

6.6 Summary of Responses of Individual behaviours

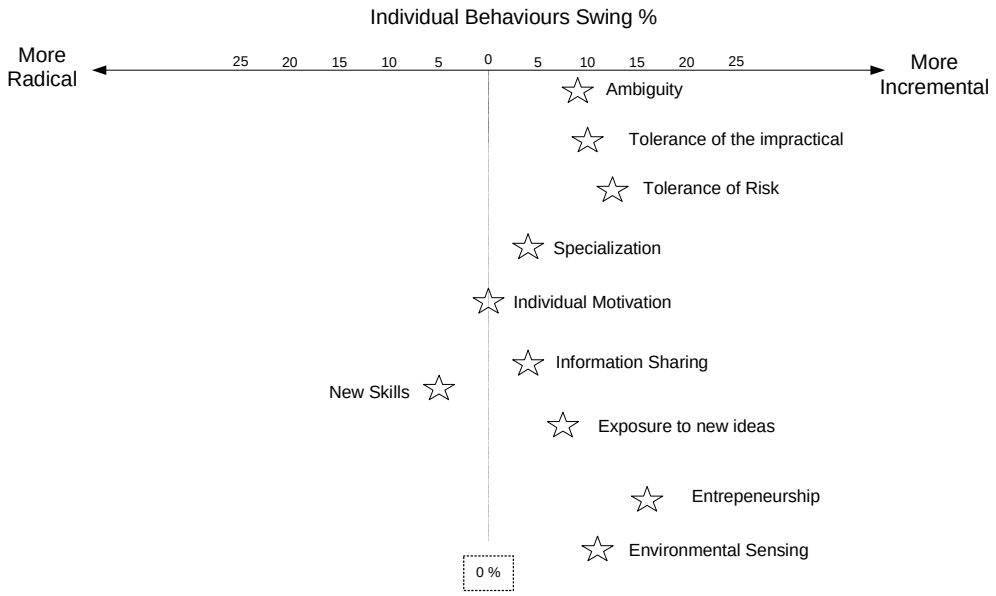


Diagram 6.4 Individual Swing Behaviours

The results are mapped in a graph to shows relative direction of user behaviours based on survey responses

6.7 Analysis Summary

The survey sample size is acceptable and responses have been tested for internal consistency, user understanding and the results adjusted accordingly. The trends have been aggregated enumerated and called out individually based on theoretical headings. The results have been graphed to aid understanding and further discussion.

7.0 Discussion

7.1 Discussion Introduction

The key objective of this section is to ‘make sense’ of the survey results within the context of the research question and literature but also to impart additional insights.

7.2 Background

The academic theory calls out various organizational types or structures and also various flavours of innovation. There is also much discourse on how organizations should approach innovation, there isn’t one magic prescription. A common theme is that organizations are optimized for either radical or incremental innovation. Mechanistic types favour incremental, Organic favour radical innovation as suggested by Burns and Stalker (1961). These tags represent opposite ends of a continuum of organizational types, various authors have called out differing attributes within organic and mechanistic types. Organic is classed as loose and flexible, mechanistic is classed as highly bureaucratic and rigid” Change is a constant in all modern commercial organizations and this research effort focused on a software development engineering group in HP and how it’s members attitudes and behaviours adjusted as they migrated to a more mechanistic environment. The research question posed is:

> ST Managers and Engineers feel that radical innovation is increasingly stifled in a more ‘mechanistic ‘organization

The literature defined the key factors that discerns between mechanistic and organic organizational types and the factors that stimulate innovation in individuals and teams. The research was seeking to examine if there was a noticeable shift in attitudes and behaviours against the backdrop of a changing organizational context. The propensity or openness for individuals and teams to impart radical innovation was the key unit of analysis. It was important to test that the organizational context was in fact shifting in one direction or another, sense making of organizational contexts relies on complex social and individual behaviours as described by (Cummings & Worley 2005; Weick, 2001)

An organizational survey was designed to measure if the organizational context was changing and to detect associated shifts in member attitudes and behaviours. The literature postulated that more organic organizational settings favour a particular set of user behaviours and responses. The survey was undertaken via a web based questionnaire and follow up interviews with selected respondents and results analyzed.
Pierce and Delbec (p36) note that "*organizational structure does not determine innovation, but merely sends signals to organizational actors. The human component of organizations is characterised by members having attitudes and values. These attributes will sometimes dominate and sometimes mediate structural variables*."

Klein and Sorra (1996,p1063) note that '*organizational and group values vary in their intensity and may evolve over time'*. The R+D group is mid transition and behaviours and attitudes are moderating.

The research maps some of these changed attitudes and values and the results have been graphed in the diagrams (6.3 , 6.4) above.

7.3 Questionnaire Key Findings

a) The results show that members perceive that R+D LAB is more 'mechanistic' now than in the past. Free form comments also concur with this.

b) The results also show that on balance radical innovation is more difficult now than in the past, key individual behaviours and attitudes have changed, some more marked than others.

These findings concur with research question and align to expected results from academic theory as postulated by Burns and Stalker (1961) and the '*broad generalization'* of innovation as described by Damanpour and Wischnevsky (2006,p270). It's important to note that there are also dissenting views among academics on best organizational configuration for radical or incremental innovation notably by Cardinal (2001) who discussed incremental innovation in the Pharmaceutical industry

7.4 Discussion R+D Perspective

The shift in organizational context and associated user changes throws up the classic dichotomy. It's clear that the new IT management regime is moderating ST management and member behaviour and driving the more centrally controlled policy driven perspective. This is reflected by large swings in opinion around formalization and bureaucracy. It would also be expected to see associated shift in the measurement around centralization. However, this was not evident from survey. Sub analysis of management responses yielded similar results to wider population. Looking at user comments and follow up interviews indicates that R+D has maintained a strong consensus based approach to decision making. One manager commented that this was a 'blessing and a curse'. Some decisions are foisted from on high such as IT mandates and many of the comments focus on this. Jansen et all (2006) note that centralization negatively affects exploratory innovation. So based on survey, the R+D LAB propensity in this area has not deteriorated. However, it also may be possible that further downstream changes are planned within IT management that will impact this area. One other reason may be the much discussed 'HP culture ' which was traditionally open and consensus based, these core values may be entrenched within R+D LAB,

The IT backdrop of workforce reduction and reducing budgets is also reflected in the responses towards slack resources and communication. There is clearly less room for 'skunk' projects and investment in communication activities. These yielded the largest swings within the survey. These are key structural variables for radical innovation, people must be engaged with external environment and have freedom to experiment according to (Kanter 1998; Amidon 1998,p25) suggests that "*formal business procedures must be balanced with the freedom to create*".

Individual behaviours and attitudes have changed. New ideas, creativity and open communication have been shown to be key attributes of radical innovation. In addition individuals within R+ D feel that the freedom to experiment is markedly reduced, many commentators note the importance of exploration and tolerance of mistakes . (Tushman+ O Reilly 2006; Storey and Salaman 2005).

R+D members are becoming more risk averse. Koberg et all (2003,p28) note that '*individuals operating in open systems, which promote improvisation and experimentation are more likely to discover radical innovations*" .

In terms of motivation, there is no marked difference in people's behaviours or attitudes. Solid measures of individual motivation is notoriously difficult to do. Gunnigle et All (2006,p130) comment "*it is an extremely difficult area in which to apply accurate measurement*". Further probing via additional questions may have yielded additional insights but as was pointed out in Chapter 5, survey depth was balanced with need to obtain sufficient responses.

One interesting result of the questionnaire is the attitude of R+D members to training and new technology. The literature postulates that members focused on solely incremental innovation can get locked into key specializations and are resistant to new technologies. This was not reflected in the survey results, it could be that the inherent attitude to new technologies in R+D is positively entrenched and ' mechanistic 'migration impacts have not had downstream effects yet. However, the trend shifted in opposite direction towards more radical perspective. This could be a natural defensive response of team members seeking job security in the context of IT and R+D downsizings. In short, "*I want to be seen to be open to new technologies*."

Information and knowledge management are the lifeblood of innovation, survey results show that R+D members are less enthusiastic around knowledge transfer and openness. This is contrary to what's needed. Hansen and Birkenshaw (2007) discuss the innovation value chain and call out that concept of idea generation, conversion and diffusion. Cooper (2001) notes that a strong funnels of ideas and concepts; are essential to the innovation process. Cormican and Sullivan (2003,p56) note that "*knowledge sharing and transfer depends on personal networks and the willingness of individuals to share*".

Entrepreneurship , risk taking can be coupled with environmental sensing for the purposes of discussion, Lumpin and Dess (1996) note that studies have shown that firms that successfully develop new products and services must be entrepreneurial in outlook

and were innovative, risk taking and proactive. Managers and employees in R+D lab are now less likely to take risks and are less focused or engaged with customers and external environment.

The literature with few exceptions all postulate that innovative organizations must create a funnel for new ideas and have a clear understanding of the 'voice of the customer' as advised by (Cooper 1995; Alam 2006) . The external environment is a vital engagement point for R+D LAB, it's not clear if the IT 'lens' is masking this engagement but overall trend and absolute scores in this category indicate potential problems for R+D management.

7.5 Discussion IT Perspective

It would be remiss not to review the research question from the wider IT top down organizational perspective to pose the obvious question; "Why is it so?"

From the company and environmental analysis covered in Chapter 4 , it's clear that IT management point of focus is driving cost and operational improvements into the IT organization. IT managements are seeking dramatic cost reductions and scale efficiencies. The scale of the transformation is very large and extent is largely due to scale of integration efforts needed to absorb business elements outlying from recent merger and acquisition activity and increasing external competition. It may be useful to view this activity within IT and R+D against definitions proposed by Damanpour and Wischnevsky (2006, p272) where they distinguish between innovation generating organizations and innovating adopting organizations.

They cite adopting as "*intended to contribute to organizations effectiveness and competitiveness by changing the adopting organization so that it can adapt to new conditions in it's external environment*". This resonates in many respects with IT management objectives. Pierce and Delbeq (1976,p31) note that "*singleness of purpose is generally required for effective adoption and implementation of ideas*". They also note that '*proposals more likely to be adopted and implemented where there are high degrees of formalization*'. This is aligned with IT management perspective.

This also resonates with Jansen et all (1974) as the challenge between initiation and implementation and 'Organic' structures will have momentum to 'initiate' innovation where as 'Mechanistic' structures 'implement' innovation.

On the other hand , Innovation generation organizations create a new product, service or technology that is at least new to an 'organization population' but one major difference is that R+D have really three 'adopting' organizations , the internal IT functions , internal HP service delivery organization and also; most vitally the end customers. Damanpour and Wischnevsky (2006,) conclude that the managerial challenges for each organizational type are different.

7.6 Implications for R+D stakeholders

This research has not focused on measures of innovation output or ability to harness creativity in a structured sense or examined the overall product innovation process as implemented within R+D, as with any system there are areas of improvement or optimization. The survey was not designed to be an 'innovativeness audit' but rather to highlight key trends. These trends have profound implications for R+D members and stakeholders. The current trend indicates that it will be increasingly harder for R+D to sustain and develop radical innovative solutions. Management cannot ensure innovation success but can influence it's odds according to Van den Van et All (1999). It would be overly simplistic to say that singularly refocusing R+D into a more purely organic structure would solve the problems as O'Connor and Martino (2006,p497) comment that major innovation cannot alone be expected in a purely organic organization where flexibility, consensus building and fluidity are the managerial mechanisms. They argue the need for discipline allied to creativity.

R+D management must recognize and internalise the new working environment and the macro effects that they are having. Reviewing these trends should prompt further discussion. There are some key takeaways that R+D can address; outlined below:

The trending direction for information sharing and creativity is negative for radical innovation. This will have a detrimental effect on organizational knowledge. Amidon (1998,p23) notes that "*Creating a culture where knowledge is shared effectively and valued is one of the most difficult challenges faced in practise"*. Once knowledge is lost within an organization it is very difficult to recover, maintaining existing competences must be a key priority for R+D management. For example only a minority of engineers 31% feel that there is an active forum for ideas and discussion. Interestingly many engineers respond that they are exposed to many new ideas and concepts but the sense of community of practise appears lacking. These responses are worth further detailed examination by way of follow up investigations.

Internal and external communication is also trending in the wrong direction, external sensing has been shown to be critical for innovating organizations but in addition a wide body of literature also calls out that internal communication and engagement with multifunctional teams are essential determinants for innovation. Knowledge sharing, competence building are largely driven by social and cognitive interactions and depend on networks and active communities of practise. R+D management should investigate the research scores and also examine the free form textual comments.

Experimentation and risk taking have scored low in this survey, this is a key area that stimulates generation of knowledge both codified and tacit. Ad-hoc problem solving outside of formal constraints is a key contributor to both social and knowledge capital within an organization. R+D Management will need to critically examine investment priorities, there is reducing 'slack' within the organization but some adjustments are urgently needed here if the 'Research' charter is to be maintained.

7.7 Further Research

The results of the research should be broadly applicable within the IT industry, HP's structural problems including macro management issues relating to large scale integration initiatives as described in chapter 4 may be applicable to similar enterprises such as IBM ,Cisco or EMC.

This was not aimed to be an 'innovation' audit, the actual innovation outputs were not examined within the R+D innovation process (systems context). It may be useful to examine rate of innovation output over time.

Also, it may be useful to examine the mix of innovation types both radical and incremental over time, as R+D becomes more mechanistic in outlook, does this translate into increased incremental innovation output.

Obvious research comparisons could be made with other commercial organizations, it maybe be useful to compare similar research organizations in their hosted mechanistic environments. Do the behaviours and attitudes of members of these organizations moderate and modify in similar fashion to HP R+D LAB.

Obviously longitudinal studies would reveal more in depth trending perspectives.

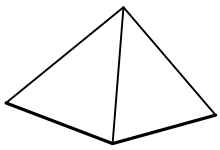
7.8 Conclusion

The ‘great fear’ is according to Ansoff (1998) is that the organizational decision makers who fail to anticipate the trends and discontinuities in the wider environment will be ‘left behind’. The current dichotomy for R+D can be framed against a classic perspective which has been much discussed in literature. Various structural models to square this circle have been postulated; ambidextrous structures, dual core models, separate organic R+D groups, entrepreneurial outsourcing, incubators, corporate venturing organizations, innovation portfolio management (separating short term from long term) and ring fencing among others.

The problem is not one of choice but appropriability for the organization, unfortunately the ‘jury’s out on what to do’ as Downs and Mohr (1976,p713) note that “*there is not a single , unitary theory, but rather different theories to explain different aspects of innovation*” on which to guide R+D management.

Yet, Radical innovation is possible within more mechanistic structures, it’s just more challenging. Recognition of the challenge and associated issues is the first step.

Not everyone gets shot in the cross fire.



Appendices

Appendix A – Raw Questionnaire Results

Q1 - Which group in R+D do you belong to ?		
answer options	Response Percent	Response Count
Architecture and Integrated Services	9.23%	6
Enterprise Serviceability Tools	12.31%	8
Imaging, Printing and Client Services	9.23%	6
Remote Support and Proactive Services	53.85%	35
Storage / SAN/ Network services	10.77%	7
Other	4.62%	3
	answered question	65
	skipped question	0

Q2- Are you a people manager or a project manager ?		
answer options	Response Percent	Response Count
Yes	23.44%	15
No	76.56%	49
	answered question	64
	skipped question	1

Q3- R+D LAB have written rules and procedures around work practices and procedures and these are strictly enforced.		
answer options	Response Percent	Response Count
Strongly agree	1.54%	1
Agree	23.08%	15
Neutral	30.77%	20
Disagree	36.92%	24
Strongly disagree	7.69%	5
	answered question	65
	skipped question	0

Q4- Looking back 12-18 months, how would you answer question 3 ?		
answer options	Response Percent	Response Count
Strongly agree	1.54%	1
Agree	12.31%	8
Neutral	32.31%	21
Disagree	47.69%	31
Strongly disagree	6.15%	4
	answered question	65
	skipped question	0

Q5- Decision making in R+D is shared among many.		
answer options	Response Percent	Response Count
Strongly agree	7.69%	5
Agree	41.54%	27
Neutral	27.69%	18
Disagree	20.00%	13
Strongly disagree	3.08%	2
	answered question	65
	skipped question	0

Q6 - Question 5 relates to the degree of autonomy that individuals have within TSS R+D, please add any additional comments in relation to this topic here.	
answer options	Response Count
	27
answered question	27
skipped question	38

Q7- Looking back 12-18 months, how would you answer question 5 ?		
answer options	Response Percent	Response Count
Strongly agree	4.84%	3
Agree	41.94%	26
Neutral	30.65%	19
Disagree	20.97%	13
Strongly disagree	1.61%	1
answered question		62
skipped question		3

Q8 There are extra resources either financial or human available for non routine activities. (Example: special technical investigations .		
answer options	Response Percent	Response Count
Strongly agree	1.59%	1
Agree	4.76%	3
Neutral	12.70%	8
Disagree	60.32%	38
Strongly disagree	20.63%	13
answered question		63
skipped question		2

Q9 Looking back 12-18 months, how would you answer question 8		
answer options	Response Percent	Response Count
Strongly agree	0.00%	0
Agree	14.29%	9
Neutral	23.81%	15
Disagree	60.32%	38
Strongly disagree	1.59%	1
answered question		63
skipped question		2

Q10 There are regular face to face meetings with all your LAB work colleagues.		
answer options	Response Percent	Response Count
Strongly agree	3.23%	2
Agree	27.42%	17
Neutral	11.29%	7
Disagree	32.26%	20
Strongly disagree	25.81%	16
answered question		62
skipped question		3

Q11- There are sufficient face to face meetings with your LAB work colleagues		
answer options	Response Percent	Response Count
Strongly agree	4.76%	3
Agree	31.75%	20
Neutral	17.46%	11
Disagree	33.33%	21
Strongly disagree	12.70%	8
answered question		63
skipped question		2

Q12- Looking back 12-18 months ago, How would you answer question 10 ?		
answer options	Response Percent	Response Count
Strongly agree	3.23%	2
Agree	40.32%	25
Neutral	19.35%	12
Disagree	29.03%	18
Strongly disagree	8.06%	5
answered question		62
skipped question		3

Q13- If you would like to include additional information, please quote the question number.	
answer options	Response Count
	13
answered question	13
skipped question	52

Q14 - R+D LAB encourages and supports membership of industry professional organizations.		
answer options	Response Percent	Response Count
Strongly agree	3.28%	2
Agree	19.67%	12
Neutral	54.10%	33
Disagree	18.03%	11
Strongly disagree	4.92%	3
answered question		61
skipped question		4

Q15 Looking back 12-18 months ago, How would you answer question 14 ?		
answer options	Response Percent	Response Count
Strongly agree	1.64%	1
Agree	26.23%	16
Neutral	59.02%	36
Disagree	9.84%	6
Strongly disagree	3.28%	2
answered question		61

skipped question	4

Q16- R+D LAB contains a wide variety of subject matter experts.		
answer options	Response Percent	Response Count
Strongly agree	8.33%	5
Agree	68.33%	41
Neutral	20.00%	12
Disagree	3.33%	2
Strongly disagree	0.00%	0
answered question		60
skipped question		5

Q17 Looking back 12-18 months ago, How would you answer question 16 ?		
answer options	Response Percent	Response Count
Strongly agree	10.00%	6
Agree	66.67%	40
Neutral	23.33%	14
Disagree	0.00%	0
Strongly disagree	0.00%	0
answered question		60
skipped question		5

Q18- It is easy to get things done in the R+D organization.		
answer options	Response Percent	Response Count
Strongly agree	3.33%	2
Agree	16.67%	10
Neutral	28.33%	17
Disagree	41.67%	25
Strongly disagree	10.00%	6
answered question		60
skipped question		5

Q19- Looking back 12-18 months ago, How would you answer question 18 ?		
answer options	Response Percent	Response Count
Strongly agree	3.33%	2
Agree	26.67%	16
Neutral	35.00%	21
Disagree	33.33%	20
Strongly disagree	1.67%	1
answered question		60
skipped question		5

Q20- R+D Managers are supportive of new ideas and innovation.		
answer options	Response Percent	Response Count
Strongly agree	5.08%	3
Agree	44.07%	26
Neutral	35.59%	21
Disagree	10.17%	6
Strongly disagree	5.08%	3
answered question		59
skipped question		6

Q21 Looking back 12-18 months ago, How would you answer question 20 ?		
answer options	Response Percent	Response Count
Strongly agree	6.67%	4
Agree	53.33%	32
Neutral	31.67%	19
Disagree	6.67%	4
Strongly disagree	1.67%	1
answered question		60
skipped question		5

Q22 If you would like to include additional information, please quote the question number.	
answer options	Response Count
	12
answered question	12
skipped question	53

Q23 Within R+D LAB there is a higher acceptance of ambiguity as opposed to objectivity.		
answer options	Response Percent	Response Count
Strongly agree	0.00%	0
Agree	38.60%	22
Neutral	40.35%	23
Disagree	21.05%	12
Strongly disagree	0.00%	0
answered question		57
skipped question		8

Q24 Looking back 12-18 months, how would you answer question 23 ?		
answer options	Response Percent	Response Count
Strongly agree	3.45%	2
Agree	31.03%	18
Neutral	50.00%	29
Disagree	15.52%	9
Strongly disagree	0.00%	0
answered question		58
skipped question		7

Q25- The organization does not penalise people for foolish or whacky ideas.		
answer options	Response Percent	Response Count
Strongly agree	1.72%	1
Agree	55.17%	32
Neutral	25.86%	15
Disagree	13.79%	8
Strongly disagree	3.45%	2
answered question		58
skipped question		7

Q26- Looking back 12-18 months, how would you answer question 25 ?		
answer options	Response Percent	Response Count
Strongly agree	5.17%	3
Agree	58.62%	34
Neutral	29.31%	17
Disagree	6.90%	4
Strongly disagree	0.00%	0
answered question		58
skipped question		7

Q26 R-D LAB treat mistakes as learning opportunities.		
answer options	Response Percent	Response Count
Strongly agree	1.69%	1
Agree	40.68%	24
Neutral	38.98%	23
Disagree	11.86%	7
Strongly disagree	6.78%	4
answered question		59
skipped question		6

Q27 Looking back 12-18 months, how would you answer question 26 ?		
answer options	Response Percent	Response Count
Strongly agree	1.67%	1
Agree	40.00%	24
Neutral	50.00%	30
Disagree	5.00%	3
Strongly disagree	3.33%	2
answered question		60
skipped question		5

Q28 I spend time and effort convincing supervisors to change designs and work practices because it is the 'correct' thing to do.		
answer options	Response Percent	Response Count
Very Often	5.26%	3
Often	19.30%	11
Neutral	22.81%	13
Sometimes	43.86%	25
Never	8.77%	5
answered question		57
skipped question		8

Q29 Looking back 12-18 months, how would you answer question 28 ?		
answer options	Response Percent	Response Count
Very Often	3.45%	2
Often	25.86%	15
Neutral	27.59%	16
Sometimes	32.76%	19
Never	10.34%	6
answered question		58
skipped question		7

Q30 I document and follow up on all relevant work issues with colleagues and supervisors. In essence, I go the 'extra mile'.		
answer options	Response Percent	Response Count
Very Often	8.47%	5
Often	49.15%	29
Neutral	13.56%	8
Sometimes	27.12%	16
Never	1.69%	1
answered question		59
skipped question		6

Q31 Looking back 12-18 months, how would you answer question 30?		
answer options	Response Percent	Response Count
Very Often	8.77%	5
Often	49.12%	28
Neutral	17.54%	10
Sometimes	21.05%	12
Never	3.51%	2
answered question		57
skipped question		8

Q32 When faced with roadblocks and obstacles, I keep trying to do the 'correct' thing' even though my beliefs may be unpopular with my supervisor and peers.		
answer options	Response Percent	Response Count
Very Often	1.69%	1
Often	59.32%	35
Neutral	13.56%	8
Sometimes	25.42%	15
Never	0.00%	0
answered question		59
skipped question		6

Q33 Looking back 12-18 months, how would you answer question 32 ?		
answer options	Response Percent	Response Count
Very Often	6.78%	4
Often	49.15%	29
Neutral	23.73%	14
Sometimes	20.34%	12
Never	0.00%	0
answered question		59
skipped question		6

Q34 If you would like to include additional information, please quote the question number.	
answer options	Response Count
	7
answered question	7
skipped question	58

Q35 I am willing to learn new skills and competences. For example; re-train from a Linux developer to a Windows developer or visa-versa.		
answer options	Response Percent	Response Count
Strongly agree	41.38%	24
Agree	53.45%	31
Neutral	3.45%	2
Disagree	1.72%	1
Strongly disagree	0.00%	0
answered question		58
skipped question		7

Q36 Looking back 12-18 months, how would you answer question 35 ?		
answer options	Response Percent	Response Count
Strongly agree	41.38%	24
Agree	48.28%	28
Neutral	8.62%	5
Disagree	1.72%	1
Strongly disagree	0.00%	0
answered question		58
skipped question		7

Q37 I contribute to special interest groups, blogs and technical discussions.		
answer options	Response Percent	Response Count
Very Often	0.00%	0
Often	18.97%	11
Neutral	12.07%	7
Sometimes	41.38%	24
Never	27.59%	16
answered question		58
skipped question		7

Q38 Looking back 12-18 months, how would you answer question 37 ?		
answer options	Response Percent	Response Count
Very Often	0.00%	0
Often	21.05%	12
Neutral	14.04%	8
Sometimes	35.09%	20
Never	29.82%	17
answered question		57
skipped question		8

Q39 I work with people from different groups with different skills sets and specializations.		
answer options	Response Percent	Response Count
Very Often	24.14%	14
Often	53.45%	31
Neutral	1.72%	1
Sometimes	20.69%	12
Never	0.00%	0
answered question		58
skipped question		7

Q40 Looking back 12-18 months, how would you answer question 39 ?		
answer options	Response Percent	Response Count
Very Often	28.07%	16
Often	43.86%	25
Neutral	8.77%	5
Sometimes	19.30%	11
Never	0.00%	0
answered question		57
skipped question		8

Q41 I am exposed to new ideas and concepts.		
answer options	Response Percent	Response Count
Strongly agree	10.34%	6
Agree	63.79%	37
Neutral	18.97%	11
Disagree	5.17%	3
Strongly disagree	1.72%	1
answered question		58
skipped question		7

Q42 Looking back 12-18 months, how would you answer question 41 ?		
answer options	Response Percent	Response Count
Strongly agree	8.62%	5
Agree	67.24%	39
Neutral	24.14%	14
Disagree	0.00%	0
Strongly disagree	0.00%	0
answered question		58
skipped question		7

Q43 There is an active forum where I can contribute ideas and suggestions		
answer options	Response Percent	Response Count
Strongly agree	0.00%	0
Agree	31.58%	18
Neutral	38.60%	22
Disagree	22.81%	13
Strongly disagree	7.02%	4
answered question		57
skipped question		8

Q44 I am encouraged to take risks.		
answer options	Response Percent	Response Count
Strongly agree	0.00%	0
Agree	31.03%	18
Neutral	27.59%	16
Disagree	34.48%	20
Strongly disagree	6.90%	4
answered question		58
skipped question		7

Q45 Looking back 12-18 months ago, How would you answer question 44?		
answer options	Response Percent	Response Count
Strongly agree	0.00%	0
Agree	34.48%	20
Neutral	39.66%	23
Disagree	20.69%	12
Strongly disagree	5.17%	3
answered question		58
skipped question		7

Q46 I work closely with my customers		
answer options	Response Percent	Response Count
Very Often	15.52%	9
Often	25.86%	15
Neutral	10.34%	6
Sometimes	34.48%	20
Never	13.79%	8
answered question		58
skipped question		7

Q47 - Looking back 12-18 months ago, How would you answer question 46?		
answer options	Response Percent	Response Count
Very Often	15.52%	9
Often	32.76%	19
Neutral	15.52%	9
Sometimes	29.31%	17
Never	6.90%	4
answered question		58
skipped question		7

Q48 If you would like to include additional information, please quote the question number.

answer options	Response Count
	5
answered question	5
skipped question	60

Q 49 The survey is completely anonymous, however if you are available for follow up discussions, please enter your email address here.

answer options	Response Count
	14
answered question	14
skipped question	51

Appendix B - Comments from respondents on 'autonomy'

Question 5 relates to the degree of autonomy that individuals have within TSS R+D, please add any additional comments in relation to this topic here.
Collaboration is used to gain best possible solution and ensure all aspects of the issue/solution are understood and accounted for. No single person typically has the whole picture.
Control over what people work on has been tightened over the last 18 months. Managers have less scope for skunk works and ICs have to book their time to officially approved projects. This move to a production environment has been accompanied by a centralisation of decision making - programme and technical.
Decision making is handled by a few managers who decide what direction R&D should be going, what the tools should do, which products should be covered, etc.
Decision making regarding requirements and such are shared among only a few.
Degree of "shared" decision-making is dependent on the nature of the decision. Technical questions often consider the inputs of engineers as well as managers. The higher up in the organization the decision, the fewer decision-makers seem to get involved.
Engineers and lower level managers have a fair degree of autonomy to make certain engineering and design decisions, but others become quickly mired in bureaucracy. Purchasing of software or consulting is particularly problematic.
Here is my view: We have a culture where forgiveness is easier to get than permission. We are also in an environment where many of the practices and procedures are IT-centric and don't work in the R&D environment that has much more innovation and unknowns. In practice many things are informally decided by engineers and later get ratified by management. This has good and bad sides. Abandoning it in favour of tops-down IT structuring would certainly not be an improvement.

	I our organization I strongly agree however across R&D I would not and why I chose the answer to 7 to be the way it is
	I see this as largely reflected by the differences in culture between the teams as well as the differences in the visibility of the particular program/project that is being developed. Some groups are very aggressive in supporting independent decision making while others have evolved to a more committee based approach. In terms of visibility - our critical projects naturally have a high level of scrutiny and ownership across our organizations and business partners making it very difficult to make decisions in isolation.
	I think decision making is limited with whatever information from the engineers often being ignored - at least that is the way it feels
	I think everyone has autonomy to some extent. My concern is that they often do not have the project, product, or program knowledge necessary to tailor their decisions to meet business objectives in all cases, and the autonomy then becomes isolation and is counterproductive for all involved.
	If someone champions an issue, they can usually get agreement as people are not bothered about decisions not in their area
	just POR driven decision, not project or customer oriented R&D
	Management appears to be getting more and more autocratic. I believe this to be from pressure placed on them from above.
	Many decision are directed down from the top. They are mandates and not up for discussion. There is decision making around aspects of implementation but again many of these are constrained by partner group , in particular on the business/operational side.
	Most decisions in R&D seem to be reached in groups as opposed to individually.
	Sometimes there are too many people involved in the decsision making.
	The question may be answered differently depending on what the decision is. For example, day to day work decisions are shared among many, but others, like use of PPM, are decided by a few. I have answered from the perspective of the day to day activities.
	There is much less autonomy now that we are under the IT regime.

	This varies greatly across the teams. Project managers and technical leads can foster this type of environment (or not) by their own actions.
	This very much depends on the project you are working on. Looking back at ISEE v5 architecture planning (specifically the CMS portion), I would even say "Disagree"
	Today the decision making is shared among many (including some outside of R&D such as the PT team). this leads to much discussion and it takes a very long time to get a concensus, an agreement and a decision. for question 7 by "disagree" I mean that we had lead people involved in decision making which resulted in less effort and duration taken to come to a decision i.e more efficient.
	Varies by team and area. Very much depends on the manager's approach as well.
	what kind of decisions are we talking about - program level, project level, component level?
	Within TSS R&D many decisions are taken by management and TSS R&D have to comply with those decisions.
	Within TSS R&D, we can do what we think is right (within limits). Once outside/above, such as when dealing with the IT orgs or the rest of corporate, its all "process, procedure, and handcuffs".

Appendix C - Additional respondents general comments

Distributed teams preclude much "face-to-face".
during new project kickoff, technical training, engineers traveled to Fort Collins. Allowed for face to face meetings.
General comment - our organisation is now focused entirely on IT production - i.e. all 'D' and no 'R' in R+D. Q10, 11 - face to face meetings are good for development, but radical innovation is usually initiated by individuals or very small groups. Q3 - the procedures for development have been improved and tightened over the last 18 months, but there are no procedures for dealing with ideas that fall outside the scope of currently scheduled work, whether they be technical innovation or business opportunities.
Global distribution for every little team but at the same time frequent restrictions on travel
Lack of f2f meetings have had an enormous negative impact in the lab.
No money to travel, travel freezes, etc.
Q10: Regular face to face are difficult because we are a dispersed group but even when we try to arrange face to face we are unable to do so due to travel restrictions/budgets.
We are way too de-centralized and fragmented to hold F2F meetings. This is historical based more than anything.

#7 - New Ideas & Innovation - This is purely a function of the particular manager and not of the group as a whole. I have seen some managers be very effective in supporting new areas, and they do so largely based on this being a personal priority. The organization overall will allow nothing to happen...but it is individuals that make the difference here.
Easy to get things done - No - Bureaucracy has been a growing of getting anything done. R&D managers under increasing pressure to deliver against artificial timelines.
For questions 5 & 6; if we dealt only within our teams (up to and including Paddy's or Ken's level), then it's easy to do our jobs properly. Once we move outside or above, we're held back by bogus irrelevant process and restrictions.
Management are certainly supportive of ideas but at the same time many of the procedures they are made to comply with make them seem unsupportive.
Q7. Project Managers are generally supportive of new ideas, but there are no mechanisms for handling them or allocating time to pursue them if they fall outside the scope of the immediate work schedule. As a result, the PMs hands are tied. This is largely due to the introduction of Calibre and PPM
Re 7 & 8, upper level corporate decisions are having a negative impact on the individual engineer's ability to innovate (i.e. innovation is discouraged).
Regarding #1/#2, I don't think the R&D lab encourages participation, but I do believe they support it if an individual takes the initiative.
Since the mgmt. change and move of TSS R&D into IT, everyone seems to follow the new IT guidelines regardless of the fact, if these are really applicable to a R&D org.
The question 'It is easy to get things done' is fairly broad. There is such an array of 'things' to do, some easy, some difficult, that this question is difficult to answer.
These answers are relative to our tiny, empowered, well-ballanced and go-get-um group. We are efficient and we get things done.
WFRs and EERs have removed several SMEs from the group.

A good example for this is my efforts to make the ISEE v5 CMS architecture somewhat more modular with reagards to integrating mutiple discovery, data collection and event provider sources as opposed to the monolithic design built around HP SIM. I feel all these extra miles and effort were in vain.
For question "The organization does not penalise people for foolish or whacky ideas" I can't really answer because there may be penalizing I am not aware of. For example, if the penalizing was obvious, then I know the penalizing occurs. However, I can not determine an indivual didn't get a raise or a promotion because of their foolish or whacky ideas, as many other possible factors may have been part of the raise or promotion decision (and I am not privy to people's salaries or raises). Given this, I can say I don't see overt, direct penalizing for foolish or wacky ideas.
Q5. There is no time for mistakes any more.
Question 1 and 2: what? Question 3 and 4: how would I know if I've been penalized? Who's gone leak it to me? For example, if I'm paranoid then I think I have been penalized.
Trying to do the right thing, having to represent both R&D and other organizations (at both our and their direction and buy-in) has at times in the past been looked at in the negative in that some of my colegues made comments wondering if I really worked in R&D or not

Acronyms

In order of appearance:

CEO	Chief Executive Officer
HP	Hewlett Packard
R+D	Research and Development
LAB	Laboratory (Hewlett Packard definition for an engineering group)
IBM	International Business Machines
ST	Services Tools (Name of engineering group)
HP-IT	Hewlett Packard Information Technology (Internal group name)
SMB	Small and Medium Business
PC	Personal Computer
IT	Information Technology
ESS	Enterprise Storage and Servers (HP Business group)
HPS	Hewlett Packard Services (HP Business group)
IPG	Image and Printing Group (HP Business group)
HPFS	Hewlett Packard Financial Services (HP Business group)
TSG	Technology Solutions Group (HP Business group)
PSG	Personal Systems Group (HP Business group)
RISC	Reduced Instruction Set Computer
PEST	Political Economical Social Technological
GATT	Global Agreement on Trade and Tariffs
ICT	Information and Communications Technologies
SKU	Stock Keeping Unit
PDA	Personal Digital Assistant (electronic handheld information device
TV	Television
MP3	Moving Picture Experts Group Layer-3 Audio
CIO	Chief Information Officer (Corporate Title)

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