Master Thesis

Role of Project Portfolio Control Techniques in Achieving Efficiency in Project Based Firms

Authors: Pattharawan Karivate, Muhammad Rizwan

Supervised by: Dr. Ralf Müller
DECLARATION OF ORIGINALITY

We, Karivate Pattharawan, Rizwan Muhammad hereby declare that our work entitled “Role of project portfolio control techniques in achieving efficiency in project based firms.” for the degree of “Master of Science in Strategic Project Management (European)”, embodies the results of an original research program and/or consists of an ordered and critical exposition of existing knowledge in a well-defined field.

We have included explicit references to the citation of the work of others or to our own work which is not part of the submission for this degree.

Author’s signature:                      Author’s signature:

............................ ............................
(Karivate Pattharawan) (Rizwan Muhammad)
Date: Date:
ACKNOWLEDGEMENTS

This Master Thesis has been created not just based on the authors’ inputs but also due to commitment and support of several people and organizations. Therefore, we would sincerely like to thank them for their contribution to our research.

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Karivate Pattharawan, Rizwan Muhammad

January, 2010

Umea, Sweden
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<tr>
<td>APM</td>
<td>Association for Project Management</td>
</tr>
<tr>
<td>BCG</td>
<td>Boston Consulting Group</td>
</tr>
<tr>
<td>CAPM</td>
<td>Capital Asset Pricing Model</td>
</tr>
<tr>
<td>CRB</td>
<td>Committee Review Board</td>
</tr>
<tr>
<td>DSS</td>
<td>Decision Support System</td>
</tr>
<tr>
<td>ECV</td>
<td>Expected Commercial Value</td>
</tr>
<tr>
<td>KPIs</td>
<td>Key Performance Indicators</td>
</tr>
<tr>
<td>MORR</td>
<td>Monthly Operational Review Reports</td>
</tr>
<tr>
<td>MS 4</td>
<td>Milestone 4</td>
</tr>
<tr>
<td>MS4C</td>
<td>Milestone 4 Committee</td>
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<tr>
<td>NPV</td>
<td>Net Present Value</td>
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<tr>
<td>PBF</td>
<td>Project Based Firm</td>
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<tr>
<td>PBM</td>
<td>Payback Method</td>
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<td>PBO</td>
<td>Project Based Organization</td>
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<td>PI</td>
<td>Productivity Index</td>
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<td>PMI</td>
<td>Project Management Institute</td>
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<td>PMG</td>
<td>Portfolio Management Group</td>
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<td>POC</td>
<td>Project Oriented Company</td>
</tr>
<tr>
<td>POO</td>
<td>Project Oriented Organization</td>
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<td>PPR</td>
<td>Project Portfolio Reports</td>
</tr>
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<td>PPRS</td>
<td>Project Portfolio Reporting System</td>
</tr>
<tr>
<td>PRB</td>
<td>Project Review Board</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>RCS</td>
<td>Rail Control Solutions</td>
</tr>
<tr>
<td>ROI</td>
<td>Return On Investment</td>
</tr>
<tr>
<td>SBU</td>
<td>Strategic Business Unit</td>
</tr>
<tr>
<td>SET</td>
<td>Senior Executive Teams</td>
</tr>
<tr>
<td>SMART</td>
<td>Specific, Measurable, Achievable, Realistic and Time bound</td>
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<td>TG 2.5</td>
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EXECUTIVE SUMMARY

“While project management and program management have traditionally focused on ‘doing work right’, portfolio management is concerned with ‘doing the right work’” (PMI, 2006)

Nowadays organizations are facing problems with too many projects and having limited resources to execute these projects. Therefore the role of portfolio control is gaining more importance to yield the right balance, mix and number of projects, and also to deal with the challenge of maximizing the value of the portfolio. Therefore the organizations rely on effective portfolio management and are developing new methods to deal with these challenges. Hence present study involves study of those organizations that rely on portfolio control techniques to effectively manage their portfolio of projects.

The aim of this research is to investigate the role of portfolio control techniques in achieving efficiency in project based firms, examine relationship between control techniques and the portfolio efficiency, and to find the role of contextual factors like project and governance type in impacting the portfolio efficiency. Three portfolio control factors: portfolio selection, portfolio reporting, and decision making style were identified and portfolio efficiency was explained by two measures: achievement of portfolio results and achievement of project and program level purpose.

The research was conducted at two multinational organizations, a pharmaceutical company in Europe and engineering and contracting transportation company in Asia. Case study research strategy was used, and data was collected through semi-structured interviews to investigate the impact of using these portfolio control techniques in a project based firms.

The results of the research indicate that these control techniques helps to select and analyse the portfolio from strategic, financial and risk perspective. Furthermore it helps to balance the organizational priorities by taking into consideration project type, market sector, resource constraints and product lines. The portfolio control techniques also involve portfolio reporting which is considered as formal way of communication and information sharing and is believed to be significant project-level factor contributing to portfolio efficiency. Lastly, portfolio decision making helps the organizations in making the right decision in the best interest of the organization. All these control variables were found to have a significant impact on achieving results and achieving project and programme level purpose which in our research are the dimensions of portfolio efficiency.
In our study we also found that there exists a positive relationship between the portfolio control techniques and portfolio efficiency which is affected by the contextual variables such as project type, governance type, organizational complexity, co-localization of team members, communication and clarity of goals and objectives.

**Key words:** project portfolio management, portfolio efficiency, contextual factors, project based firms
CHAPTER 1

INTRODUCTION

In this chapter the introduction of the dissertation and research background is presented. The chapter focuses on some of the key concepts that will be discussed in detail in the rest of this dissertation. Additionally, the objectives of the research are stated briefly in order to provide the concept and structure of the study.

1.0 Research Background

It is commonly stated that portfolio management helps to do the right project whereas project management helps to do the projects right. The question then arises how portfolio management helps to do the right projects? The answer to this question can be provided by the concept of portfolio management process, which defines portfolio management as a dynamic decision making process, whereby a business’s list of active projects is constantly updated and revised. In this process, new projects are evaluated, selected, and prioritized whereas existing projects may be accelerated, killed, or de-prioritized; and resources are allocated and reallocated to the active projects (Cooper et al., 1999). The cyclic scanning of the existing and new project portfolios helps to select few right projects that meet the needs of the organization which are in line with organization strategy. Most of the studies conducted on portfolio management can broadly be categorized into portfolio management of R&D projects (Hall and Nauda, 1990; Henriksen, 1999; Mikkola, 2001) and portfolio management of new product development (Cooper et al., 1997, 1999, 2002).

Some researchers argued that portfolio management is about making strategic choices, resource allocation, resources and capabilities, project selection and balancing among number of projects,. Dye and Pennypacker (1999) defined portfolio management as an art and science of applying a set of knowledge, skills, tools and techniques to a collection of projects and program to meet or exceed the need of an organization s’ investment strategy. A lot of research has been conducted on ways of optimizing portfolio of projects, portfolios performance and best practices in portfolio management (Cooper et al., 1997, 1999, 2000, 2004a, 2004b, 2004c) which involves creating a portfolio of the highest value, making a balance of portfolio by combining projects of long term, short-term, high value and low-risk projects and undertake projects that meet the strategic objectives of the organizations.

An investigation conducted by Müller et al. (2008), to determine the relationship between the project portfolio control techniques and portfolio management performance in different contexts using a quantitative technique and found that strategy aligned portfolio selection was in a positive correlation with achieving results, portfolio reporting was
positively correlated with achieving purpose and also portfolio selection was in a positive correlation with achieving results in some specific contexts. Kendall and Rollins (2003) suggested that one of the problems with portfolio management is too many active projects as compared to its resources which are the result of ineffective implementation of the portfolio control techniques. Ineffective implementation of these techniques further create problem in achieving results, achieving purpose and balancing priorities. This problem suggests us to understand, what portfolio control techniques are and how they help in achieving portfolio efficiency in project based firm. The project based firms are defined as the firms which use the concept of managing by projects and their management includes mapping stakeholder, managing scope, managing organization and managing risk (Turner, 2008).

1.1 Research Purpose and Research Question

The purpose of this research is to understand the role of project portfolio control techniques, how they help in achieving portfolio efficiency in project based firms and what role is played by the contextual factors, for instance how project type and governance type can impact the relationship between portfolio controls and portfolio efficiency.

In addition, the present study focuses on a case study analysis and collecting qualitative data to answer our research question. The research question is;

“How project portfolio control techniques helps in achieving efficiency in project based firms?”

Portfolio control techniques include portfolio selection, portfolio reporting, and portfolio decision making. Portfolio efficiency includes achieving results and achieving purpose.

1.2 Nature and scope of study

There is a common complaint that pipeline gridlock plagues many business portfolios and that is simply because there are too many projects and not enough resources to do them well (Cooper et al, 2000). The research has been conducted in order to investigate the role of portfolio control techniques on portfolio efficiency in project based firms.

This research mainly deals with portfolio control techniques and its impact on portfolio efficiency. In the current research portfolio of projects is taken as the unit of analysis in our research. However, this area is quite broad therefore research aims at gaining deep understanding of how these portfolio control techniques are applied in reality and how the contextual factors such as project and governance type impacts portfolio efficiency. In order to conduct the research, the databases Ebsco Host, Science Direct, Ingenta Connect, JSTOR, and Google scholar search engine were used to find relevant literature and to incorporate previous studies on the subject area. In order to answer our research
question a qualitative study was conducted, case study was used as a research strategy and data was collected through semi-structured interviews from two companies. One was a large Pharmaceutical Company in Europe and other was an engineering and contracting Transportation Company in Asia. Both organizations are considered as world leader in their respective fields. All the interviews were conducted with the practitioners working at the project or the portfolio level.

1.3 Definition of the terms

**Project:** “a temporary endeavour undertaken to create a unique product, service, or result” (PMI, 2004, p. 5)

**Program:** “a group of related projects managed in a coordinated way to obtain benefits and control not available for managing them individually. Programs may include elements of related work outside the scope of discrete projects in the program” (PMI 2004, p.368).

**Program management:** “a centralized coordinated management of a program to achieve the program strategic objectives and benefits” (PMI 2004, p.368).

**Portfolio:** “a collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives. The projects or programs of the portfolio may not necessarily be independent or directly related” (PMI 2004, p.367).

**Portfolio management:** “The centralized management of one or more portfolios, which include identifying, prioritizing, authorizing, managing and controlling projects, program and other related work to achieve specific strategic business objectives” (PMI 2004, p.367).

**Portfolio efficiency:** defined as the degree to which the portfolio has succeeded in fulfilling its objectives of strategic alignment, balance across projects, and value maximization (Cooper et al, 1999).

1.4 Organization of Dissertation

This dissertation is based on five chapters, and each chapter focuses on different issues to carry out the research aims.

*Chapter 1 (Introduction):* This chapter briefly explains about research background, research purpose and research question, followed by nature and scope of study, definition of terms and finally outline of the dissertation will be presented.
Chapter 2 (Literature Review): This chapter will provide an in depth study of the literature on the portfolio management of projects. In addition, this chapter also focuses on the project portfolio control techniques, portfolio efficiency and contextual factors.

Chapter 3 (Methodology): The chapter explains the research philosophy, research approach and research strategy to collect the data, further it explains the credibility and ethical consideration taken into account while conducting the research.

Chapter 4 (Data Analysis): In this chapter, the method of data analysis is explained and results of the findings are presented and discussed.

Chapter 5 (Conclusion): The conclusion of the research, limitations of the study, managerial implications, theoretical implication and recommendations for future research will be presented in the final chapter.
CHAPTER 2

LITERATURE REVIEW

This chapter will provide an in depth study of the literature on the portfolio management of projects. In addition, the chapter focuses on the project portfolio control techniques, contextual factors which may affect portfolio efficiency. The study of the literature has been divided into four major areas portfolio and program management, portfolio control techniques, portfolio efficiency, and contextual factors.

2.0 Structure of Literature Review

The literature relevant for the study can be categorized as:

- Corporate governance, project oriented and project based organizations.
- Portfolio Management and Program Management
- Portfolio control techniques which includes portfolio selection, portfolio reporting, and portfolio decision making
- Portfolio efficiency and portfolio management practices
- Contextual factors that may have an impact on the relationship between portfolio control and portfolio efficiency.

2.1 Corporate Governance

The concept of corporate governance involves the setting of goals for the organization, providing the means to achieve those goals, and controlling progress. (Stawicki and Müller, 2007) Whereas in PMI (2006), Organizational Governance is defined as “Governance is the act of creating and using a framework to align, organize and execute activities in a collectively coherent and intelligible manner in order to meet goals.”

Governance of project management is a subset of corporate governance and relates to project activities, program and portfolio management in an organization. Governance of project management therefore includes the goals which will be achieved in terms of project management and business results. The effectiveness in governance is only achieved by aligning project portfolios with organizations goals. (Blomquist and Müller, 2006b; Stawicki and Müller, 2007) According to APM (2004), governance of project management consist of four main dimensions which are portfolio direction effectiveness and efficiency, project sponsorship effectiveness and efficiency, project management effectiveness and efficiency, disclosure and reporting.
Program and portfolio management addresses the question of governance from two parallel perspectives. (Blomquist and Müller, 2006b) The first perspective considers interconnectedness of various project objectives; that has led to the development of program which is defined as “a group of related projects, managed in a coordinated way to obtain benefits and control that is not available from managing them individually”. (PMI 2004, p.368) The second perspective takes into consideration interrelationships among management requirements of these projects to achieve overall business results; it has led to the concept of portfolio management which is defined as centralized management of one or more portfolios. It includes identifying, prioritizing, authorizing, managing and controlling projects, program and other related work, to achieve specific strategic business objectives” (PMI 2004, p.367). The link between the Portfolio Management and Corporate Governance as explained by PMI (2006) is shown in Figure 2.1 that explains how vision and mission from Executive management level is communicated to Operational management level.

<table>
<thead>
<tr>
<th>Executive Management</th>
<th>Vision</th>
<th>Mission</th>
<th>Strategic Plan</th>
<th>Strategic Objectives</th>
<th>Governance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Portfolio Management</strong></td>
<td>identification</td>
<td>categorization</td>
<td>evaluation</td>
<td>selection</td>
<td>prioritization</td>
</tr>
<tr>
<td><strong>Project&amp;Program Management</strong></td>
<td>Authorized Component</td>
<td>Program &amp; Project Management</td>
<td>Performance Measurement</td>
<td>Program Project Closeout</td>
<td></td>
</tr>
<tr>
<td><strong>Operations Management</strong></td>
<td></td>
<td></td>
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<td>Operations</td>
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</table>

Figure 2.1: Link between Portfolio Management and Corporate Governance (PMI, 2006)

Four different governance styles has been identified in literature which are multiproject organizations, program driven organizations, portfolio driven organizations and project organizations. Until 1990 all these terms were used interchangeably in the literature (Blomquist and Müller, 2006b). These governance types can be understood on the basis of use of shared/unshared resources, and related/unrelated objectives. These four governance types are shown in the Figure 2.2. Multi-project organizations are the
organizations that run projects in which objectives and resources are unrelated. Portfolio driven organizations focus mainly on constraints arising from resources and their skills or availability while program driven organizations emphasize on the combination of different projects for the achievement of a higher objective. Finally, Project Organizations combine program and portfolio management (shared resources and related objectives) for the attainment of their objectives (Stawicki and Müller, 2007).

![Four types of Governance](image)

**Figure 2.2: Four types of Governance (Blomquist and Müller, 2006b)**

In order to understand the types of governance there is a need to understand the difference between project, program and portfolio. PMI (2006) provides the difference between them as stated in Table 2.1.
Table 2.1 Differences between Portfolio, Program and Project (PMI, 2006)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>PROGRAMS</th>
<th>PORTFOLIOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects have a narrow scope with specific deliverables</td>
<td>Programs have a wide scope that may have to change to meet the benefit expectations of the organization</td>
<td>Portfolios have a business scope that changes with the strategic goals of the organization.</td>
</tr>
<tr>
<td>The project manager tries to keep change to a minimum.</td>
<td>Program managers have to expect change and even embrace it.</td>
<td>Portfolio Managers continually monitor changes in the board environment</td>
</tr>
<tr>
<td>Success is measured by budget, on time, and products delivered to specification</td>
<td>Success is measured in terms of return on investment, new capabilities and benefit delivery.</td>
<td>Success is measured in terms of aggregate performance of portfolio components.</td>
</tr>
<tr>
<td>Leadership style focuses on task delivery and directive in order to meet the success criteria</td>
<td>Leadership style focuses on managing relationship and conflict resolution. Program manager’s need to facilitate and manage the political aspects of the stakeholder management</td>
<td>Leadership Style focuses on adding value to portfolio decision-making.</td>
</tr>
<tr>
<td>Project managers manage technicians, specialists, etc.</td>
<td>Program managers manage project managers.</td>
<td>Portfolio managers may manage or coordinate portfolio management staff</td>
</tr>
<tr>
<td>Project managers are team players who motivate using their knowledge and skills.</td>
<td>Program managers are leaders providing vision and leadership</td>
<td>Portfolio managers are leaders providing insight and synthesis.</td>
</tr>
<tr>
<td>Project managers conduct detailed planning to manage the delivery of products of the project</td>
<td>Program managers create high-level plans providing guidance to projects where detailed plans are created.</td>
<td>Portfolio managers create and maintain necessary process and communication relative to the aggregate portfolio</td>
</tr>
<tr>
<td>Project managers monitor and controls task and the work of producing the project products</td>
<td>Program managers monitors project and ongoing work through governance structures.</td>
<td>Portfolio managers monitors aggregate performance and value indicators.</td>
</tr>
</tbody>
</table>

Project organizations are discussed in the literature from two perspectives project oriented organization (POO) and project based organization (PBO).

2.1.1 Project Oriented Organizations

Nowadays, most of the companies are using the project oriented approach to managing their organization. Companies that apply projects and programs to carry out their business processes can be identified as being project oriented company (POC) or project oriented organization (POO). Project oriented organization (POO) identified by Garies (2000, 2004), are the organizations which defines “Management by Projects” as an organizational strategy, manages a project portfolio of different project types, applies a “New Management Paradigm”, has an explicit project management culture, and perceives itself as being project-oriented. POO consider projects as a strategic option for the organizational design of the company whereas POC apart from using traditional approaches to project management use the concept of new management paradigm which includes empowerment of employees, process-orientation, team working in flat
organizations, continuous organizational change, customer-orientated, and networking with clients and suppliers. In addition, POO is classified in three main types of project management processes; which are project management processes, project product-related processes (e.g. engineering processes and manufacturing processes) and project business management processes (Artto, 2001). The relationship among strategy, structure, and culture of POO are shown in Figure 2.3.

![Diagram](image)

Figure 2.3: Strategy, Structure, and Culture of POO (Garies, 2000)

The POC is characterized by the existence of an explicit project management culture and by specific business processes. Project portfolio management processes in context to POC can be described as the assignment of projects, the project portfolio coordination, and the networking between projects. The project-oriented corporations are not combining all management process in entire projects rather use overall business context that includes managerial processes and organization learning. Likewise, Huemann et al. (2007) mentioned human resource management (HRM) as a core process of POO due to specific characteristics of the project-oriented companies that affects the way the organization acquires and use human resources. In project oriented corporations, the portfolio management content identifies relevance to project objectives, management of knowledge, decision making, risks and opportunities under uncertainty situation which covers both project level and business level.

### 2.1.2 Project Based Organizations

Project-based organization (PBO) is the organization that carries out most of their activities in relatively short term and fluid way, also has a flat and strong project management organizational culture. These organizations are formed to purse a specific project outcome and should posses all resources. Also, they involve project based careers and movement of staff between projects is common. (Defellippi and Arthur, 1998) According to Whitley (2006) the project based firm (PBF) becomes project specific legal and financial entity, and is often dissolved upon successful completion of project goals.
Due to specific characteristics of the project–based organization, it is particularly suitable for those industries or organizations with numerous flexible tasks and those facing a fast changing environment, such as high-technology firms and service providing firms which undertakes knowledge-intensive projects.

Lindkvist (2004) recognized PBO places an emphasis on project base activities of structural characteristics, for example high levels of decentralization, autonomous project teams and their temporal characteristics, dynamics and their inter organizational nature. The characteristics of project-based organization are decentralization, short-term emphasis on project performance and distributed work practices. These features are essentials to organization initiative for interpreting, and modification (Bresnen, 2004). The literature demonstrated project-based organizations create their own action in order to solve particular problems by combining knowledge with management best practices. Hargadon and Sutton (1997) added in their research that key approaches for project-based organizations are related to the areas of project problems, potential solution, project itself, geographical boundary, facilitate reuse of the intellectual capital which has been created for one project and to use them for other projects. However, one of the issues in PBO is knowledge diffusion and innovation due to its specific characteristics.

Furthermore, organizing work by projects provide with the flexibility to respond to changing organizational needs but PBO has significant challenges in achieving economies of scale, coordinating cross-project resources, facilitating organization-wide development and promoting organization-wide learning (Hobday, 2000). Boh (2006) conducted research on PBO through case study analysis, and found that the knowledge, capabilities and resources of the PBF are built up through the execution of major projects. These organizations should examine different ways of organizing their work, deploying their personnel or making use of organizational routines and organizational structure to ensure that systematic knowledge sharing takes place amongst their employees. However, it is necessary to understand how these project organizations implement their corporate goals and objectives through project, program and portfolios.

2.2 Role of program and portfolio in implementing strategy

The objectives of the organization are defined by corporate strategy and the portfolios, programs and projects being selected should be aligned with the corporate strategy in order to achieve organizational objectives. Moreover, good governance requires formal alignment between corporate strategy, business portfolio, program, and project plans and objectives. Literature suggests that project management approach enables organizational strategy to be implemented efficiently and effectively, thus shortening the time from strategy formulation to strategy implementation. Projects and program are an important ways for the strategy to be implemented (Hauc and Kovac, 2000; Cooper et al., 2000). Furthermore, Kendal and Rollins (2003) found the portfolio management ensures the selected projects meet the strategic objectives of the organization. The concept of Artto (2001) referred to the project business management (PMB) that performs an important
role in strategy alignment. PBM includes project portfolio management content which lays emphasis on alignment of projects to business objectives through multi-project environment. PMI (2006) shows the link between organizational strategy and project portfolio planning system, which is depicted in Figure 2.4 and explains that execution of the strategy requires the application of strategic management processes, systems, and tools to develop and define high level operation planning, portfolio planning and their management. Cooper et al. (2004b) recommended that by allocating the buckets of resources across project types, markets, and business area helps to ensure strategic alignment with business goals.

![Organizational Context of Portfolio Management](image)

**Figure 2.4: Organizational Context of Portfolio Management (PMI, 2006)**

Additionally, corporate strategy is a mean of thinking through and articulating how organization s’ corporate goals and objectives will be achieved. Morris and Jamieson (2005) stated that there needs to be a link between corporate strategy, portfolio, program and projects to be under taken. The logical sequence of movement of corporate business strategy from top level to individuals is shown in Figure 2.5. The strategy formed at the corporate level is articulated at the SBU (strategic business unit) level, at SBU level these objectives are transformed to take the form of portfolio and programs. The corporate strategy is articulated through top down approach from corporate level to business level and then finally to operational level.
2.3 Program Management

Program is a temporary organization for the performance of a process of high complexity. Program management is defined as centralized coordinated management of a program to achieve the program strategic objectives and benefits (PMI 2004, p.368). Program management roles focus on identification and fulfillment of business opportunities through projects. The literature on program management can be divided into three categories which are: i) program management as an entity for organization structure, ii) program management processes and life cycle, and iii) competencies for program management (Blomquist and Müller, 2006a).

2.3.1 Program Management as an entity for organizational structure

The projects of a program are closely coupled by common overall objectives, overall strategies and common processes and methods. A program has a time limit and is medium or long term in duration. The program management methods are similar to the project management methods, for instance there is a program work breakdown structure, a program bar chart, and a program environment analysis. The difference then between a project and a program is that the objectives of a program are long term, less specific, and less SMART (specific, measurable, achievable, realistic and time bound) than projects (Garies, 2000; Turner and Müller, 2003). According to APM (2004), the key differences
between project and program management is that program have a different purpose and require different management structure and skills to be successful. The program management provides a layer of management above project management teams focused on defining, integrating, and coordinating the projects in order to deliver and realize strategy. The goals of program management are efficiency and effectiveness goals, and business focus goals (Lycett et al, 2004).

Notwithstanding, program as compared to project portfolio is not an organization whilst it is a temporary organization for the performance of a process of high complexity. Thiry (2004) explained that in a program environment there are multiple stakeholders with differing and often conflicting needs, emergent inputs are always affecting the process, and ambiguity is high. Therefore, projects in a program can be performed sequentially or in parallel. As well, best performing organizations use projects and program to implement corporate strategy and programs bridges the gap between projects and the strategic goals of an organization. Researchers (Pellegrinelli, 2002; Thiry, 2004) have identified two characteristics of program which are cyclic process and interdependability that make program management the most suitable methodology to ensure successful implementation of strategies. Program management goals focus on improving efficiency and effectiveness through better prioritization, planning and coordination of projects.

Moreover, research has shown that it is inappropriate for companies to manage all the projects in a program in a consistent way, and research by Turner and Payne (1999) reported more success in projects in which people modify their procedure according to different type and size of projects. They also suggested of using standard procedure to project planning and control at the integrative and strategic level but modify the procedure at the operational level. Additionally, Lycett et al. (2004) emphasized that a unique perspective and approach is required to address the cultural, political and organizational challenges at the program level. Number of issues in program management that are related to an excessive control focus, the results in hierarchical bureaucracy, insufficient flexibility in the context of evolving business strategy and ineffective cooperation between projects within the program have been identified in literature.

2.3.2 Program Management Processes and Life Cycles

Program management life cycle has been divided into four stages which are identification, definition, execution and closure (Lycett et al., 2004). In contrast, APM (2004) has divided the life cycle into pre-program activities, initiation phase, execution phase, closure phase and post program activities. Pre-program activities include agreement of strategy and programs that needs to be delivered. An initiation phase include planning and establishing routes and processes while execution phase include defining, delegation and monitoring of project, and closure involves review of deliverables and lessons learnt. The program life cycle establishes its relationship with strategy which is formulation; organization; deployment; appraisal and dissolution. The formulation and appraisal phases are close to strategy development concepts whereas the organization and deployment phases focus on a systemic and learning view of
management. Accordingly, all these program life cycle stages reflect a strategic and long-term endeavor. Each stage as described by Thiry (2004, p.252) is as under;

(i) Formulation : sense-making, seeking of alternatives, evaluation of options, and choice
(ii) Organization : strategy planning and selection of actions
(iii) Deployment : execution of actions-projects and support operational activities, and control
(iv) Appraisal : assessment of benefits, review of purpose and capability, and re-pacing, if required
(v) Dissolution : reallocation of people and funds, knowledge management and feedback

PMI (2006) differentiates program life cycle and program processes, and segregates the program life cycle into program governance, program benefits and program stakeholder management. The program processes are initiating, planning, executing, controlling and closing and are shown in Figure 2.6. Program management key supporting activities includes planning and resource management, monitoring and control, configuration management and change control, risk and issue management, benefits management, and stakeholder management (Lycett et al., 2004).

![Program Life Cycle](image)

**Figure 2.6: Program Life Cycle (PMI, 2006)**

### 2.4 Project Portfolio Concept

According to Markowitz (1952), portfolio with maximum expected return is not necessarily the one with minimum variance from their stated objectives. There is a rate at which the companies can gain expected return by taking on variance, or reduce variance by giving up expected return, and diversification cannot eliminate all variance. There is a need to find a portfolio that gives both maximum expected return and minimum variance from their desired objectives. The concept of project portfolio techniques was originally
developed by General Electric/McKinsey and Boston Consulting Group (BCG). In seventies BCG Growth-share Matrix was a popular strategic analytical tool applied by multinational corporations for aiding in assigning priorities, investment, and resource allocation decisions. Common pitfalls use in this model include difficulties in defining the relevant market, wrong assumptions about the validity of the product life cycle, the value of the market share, the effect of market structure, and market stability (Blomquist and Müller, 2006b). The concept of portfolio as explained in PMI (2006) is shown in Figure 2.7 that explains portfolio as collection of projects and/or programs and other work that are grouped together to facilitate the effective management of work and to meet strategic objectives of the business.

![Figure 2.7: Portfolio Concepts (PMI, 2006)](image)

Project Management Institute's (2006) introduced Standards for Portfolio Management that provides guidance to managers and helps them develop professionally with the purpose of describing generally accepted processes associated with portfolio management. These provide guidelines for the process of portfolio management and focuses on the relationship among portfolio, program and project management. Within an organization, a portfolio reflects the priorities, investments and resource allocations. As a process, it enables organizations to identify, categorize, evaluate, select, prioritize, authorize, terminate and review various portfolio components to ensure their alignment with current and future business strategy and goals, which in turn helps organization optimize limited resources.

These standards explain the portfolio management process and emphasizes on process, roles and responsibilities of portfolio stakeholders and their influence on organization. Additionally, these concentrates on aligning, monitoring and control process and lastly it suggests tools and techniques for both project portfolio management and each of the
portfolio management sub-processes. Since portfolio addresses all aspects of an organization, such as finance, marketing, corporate communications and human resources, as well as strategic objectives, portfolio management has become a key method to create and execute effective corporate governance frameworks. The process of alignment, monitoring and control of portfolio is shown in Figure 2.8 which forms the basis for strategic planning.

![Figure 2.8: Portfolio management process (PMI, 2006)](image)

In order to satisfy the needs of the organization, companies select a group of projects through their defined processes to form a project portfolio. The projects within the portfolio should be ranked by five criteria which are; strategic fit, ability to increase revenue, ability to increase market share, degree of product differentiation, and technology advancement (Mikkola, 2001). The question then arises, what is the best way of selecting a portfolio that meet the organizations needs? Thus, the research performed by Archer and Ghasemzadeh (1998, 1999, 2000); Cooper et al. (1999, 2000) provided the framework and decision support system to select an optimized portfolio.

### 2.5 Portfolio optimization Tools

Portfolio decision tools are helpful in selecting the project portfolio. These decision tools can be categorized according to three main goals of portfolio which are: maximizing the value of the portfolio, achieving the right balance and mix of projects, and linking projects with strategy. Companies while selecting project portfolios follow at least one of the three goals, subsequently, these portfolio goals are useful to portfolio optimization (Cooper et al, 1999; Dye and Pennypacker, 1999; Stawicki and Müller, 2007).
2.5.1 Maximizing the value of the portfolio

The aim of this goal is to select a portfolio which maximizes the value in terms of its objectives and mainly focused towards maximizing commercial value of the portfolio. Different firms use different models and frameworks that help them in project selection and decision making. Tools commonly used are expected commercial value (ECV), productivity index (PI), dynamic rank ordered list, net present value (NPV), return on investment (ROI), check list and scoring models. The comparative approaches are used for smaller sets of projects while scoring models are used for larger set of projects (Cooper et al., 1997, 2000; Archer and Ghasemzadeh, 1998). The drawback of focusing only on maximizing the value of the portfolio is that the goal takes into consideration only financial aspects and satisfies only one dimension and fails to take into consideration non financial benefits which are related to portfolio and another pitfall may arise with lack of data integrity.

2.5.2 Achieving the Right balance and mix of projects

Balanced portfolio is defined as an assortment of projects that enables a company to achieve the growth and profit objectives associated with its corporate strategy, without exposing the company to undue risks (Hill and Jones, 1992). This aspect of project portfolio takes into consideration non financial aspects which are related to portfolio selection and decision making and attempts to balance the risk and other issues. The portfolio should be selected taking into consideration projects of different time frame and size. Cooper et al. (2002, 2004) explained high performing portfolios takes into consideration right balance and mix of projects rather than just relying only at value maximization. Various charts, including bubble diagrams and pie charts, can be useful in displaying balance in the portfolio. The most popular bubble diagram is the risk-reward chart, while popular pie charts depict resource splits by project type, market sector and product line or group. Another aspect involves, selecting the right number of projects, the projects which exceeds the resource limit are either killed or put on hold. The end result is a significant reduction in number of projects and hence reduced time to market.

2.5.3 Linking strategy with projects

This aspect of project portfolio takes into consideration the strategic fit and aims at selecting only those projects that are aligned with the corporate strategy. This is also known as strategic bucket approach. Portfolio selection frameworks may include building strategic criteria into the gating or scorecard model, strategy table model, strategic bucket model to allocate resources to different project types, market sectors and product groups and developing product roadmaps. Projects are categorized by bucket (e.g. platform projects, new products and minor projects) and then ranked within a bucket, special care needs to be given that the resource commitment must be aligned with the business’s new product objectives, strategies and processes. Moreover, the process of linking project to strategy is being considered as too time consuming and involve collection and analysis of large amount of data (Cooper et al., 2000, 2002).
2.5.4 Best Practices in Portfolio Management

Best practices in portfolio management identified and suggested by Cooper et al. (2004a, 2004b, 2004c; Müller et al., 2008)

- Select a portfolio which contains high-value projects for the business.
- Select a portfolio which has an excellent balance in terms of long-versus short-term, high-versus low-risk, across markets and technologies.
- Develop a breakdown of spending (resources) in the portfolio that truly reflects the business strategy and strategic buckets is one of the methods to achieve the desired resource split.
- Make good balance between the number of new projects undertaken and resource available.
- Proficient ranking and prioritization of projects within the portfolio.
- Select a portfolio of projects that is aligned with the business’ objectives and strategies.
- Formalize and systematic portfolio management system to select the right projects.

Müller et al. (2008) investigated in 133 organizations and they concluded that successful organizations have a method at organization level of selecting and prioritizing projects to make sure that the chosen projects are in line with strategy. Secondly, successful organizations share reporting system to facilitate information flow from projects to the portfolio level. Thirdly, these organizations share responsibility for making decisions at the portfolio level.

2.5.5 Challenges associated with portfolio selection

One of the main challenges of portfolio techniques is the selection of variables and sound indicators for selecting the projects. The question arises as to how many variables need to be considerate in order to make correct assessment of the projects (Mikkola, 2001). Also, one of the issues with project portfolio as identified by Dye and Pennypacker (1999); is the amount and quality of qualitative and quantitative information that is required to be handled for the decision making, and the need to select portfolio decision criteria depending upon organization strategy. Elonen and Artto (2003) identified problems associated with managing portfolios, no link between strategy and project selection, poor-quality portfolios, reluctance to kill projects, scarce resources, a lack of focus, selecting short-term and easy projects, information overflow, lacking quality of information, and decision making based on power.

2.6 Portfolio Control

Müller et al. (2008) found that none of previous studies covers portfolio control as a factor that influences portfolio management performance but many contains supporting evidence that points toward examining this phenomenon further. From the literature it is
found that there exits a need to understand what are the organization’s practices in executing portfolio-level control and how are they used. The earlier studies in this field can be divided into three categories, portfolio selection, portfolio reporting, and portfolio decision making.

2.6.1 Project Portfolio Selection

Project portfolio selection is a periodic activity which involves selecting a portfolio, from available project proposals to meet the organization's stated objectives without exceeding available resources and the portfolio selection method appears to have significant impact on performance results (Archer and Ghasemzadeh, 1999; Cooper et al., 1999). The selection of project within the portfolio may involve multiple groups from the top management level down to the project management level with different professional background, cultures, and social experience, thus causing the differing preferences (Wang et al., 2009). A variety of tools and techniques for the optimal selection of projects and portfolios exists; these techniques may involve criterion lists, strategy tables, scoring tables, visual graphs, force-field analyses and optimization models. Likewise, literature suggested a contingency view: fitting the portfolio selection approach to the surrounding organization’s characteristics and strategy (Müller et al., 2008; Stawicki & Müller, 2007).

Archer and Ghasemzadeh (1998) suggested criteria which includes organization’s objectives and priorities, financial benefits, intangible benefits, availability of resources, project interdependence, and allowable risk levels must be addressed during the portfolio selection process. Cooper et al. (2002) recommended performing solid up-front homework before coming to the Go/Kill decision meetings can pay off in terms of better project selection. As well, selection and prioritization criteria are subject to regular updates to ensure compliance with the organization’s strategy (Stawicki and Müller, 2007).

In addition, the existing methods of portfolio selection can be summarized and categorized into three main types; selection by mathematical programming, benefit measurement methods, and cognitive emulation models (Hall and Nauda, 1990). The model developed by Hall and Nauda (1990) which takes a strategic viewpoint by considering forecasting and competitor analysis, strategic business unit planning, analysis of customer requirements and trends, to meet budget and human resource constraints. Also, Archer and Ghasemzadeh (1999) developed an integrated framework for project portfolio selection process which is shown in Figure 2.9. The framework can be divided into three stages which are pre-process stage, process stage, and post process stage. Pre-process stage supports the elimination of infeasible projects. Process stage includes pre-screening, individual project analysis, screening and portfolio selection. Post-processing stage includes portfolio adjustment and getting the final portfolio. The portfolio selection and evaluation occurs in three phases which include: strategic considerations, individual project evaluation, and portfolio selection. First phase, strategic consideration phase takes into account budget, strategic direction, and specific initiatives for competitive advantage. Second phase, individual project evaluation phase considers economic returns
(PBP, NPV, ROI, IRR, CAPM, and EV), cost benefit analysis, risk evaluation and market research. Third phase, *portfolio selection phase* involves the simultaneous comparison of a number of projects using various portfolio selection methods such as ad-hoc approaches, comparative approaches, scoring model, portfolio matrices, and optimization models.

![Figure 2.9: Framework for project portfolio selection (Archer and Ghasemzadeh, 1999)](image)

However, the most highly ranked projects are selected for the portfolio, subject to resource availability (Archer and Ghasemzadeh, 1999). NPV is the most commonly used method but does not yield the best results, and scoring model is the next most commonly used method Cooper et al. (1999). The problem with financial models and scoring models: it does not take into account the resource constraints associated with highly ranked projects while bubble diagrams is a popular tool for visualizing portfolio, and have the advantage of looking at all projects together where resource requirements are displayed by the size of the bubbles or shapes. The problem with bubble diagrams; it does not generate a list of prioritized projects. Nonetheless, the problem of too many projects and too few resources can be partly resolved by undertaking a resource capacity analysis (Cooper et al., 2000).

A portfolio model developed by Kendall and Rollins (2003), recommended developing portfolio through three different stages. First stage involves ranking and displaying the projects by their NPV and risk. In second stage rank the projects by contribution to the sum of benefits from all projects and in third stage identify the strategic resources and then use NPV to identify the projects with highest return. The strategic resource as defined by Stawicki and Müller (2007) is a resource more demanded than all others and
which constitutes the bottleneck (or constraint) for maximizing throughput of projects through the portfolio. Another widely used portfolio selection technique is scoring model which was developed by Henriksen and Traynor, (1999); this model is based on the criteria of relevance, risk, reasonableness, and return which calculate a relative measure of project value which takes into account both merit and cost. The advantage of this model; it can be customized according to the needs of the organizations, considers non quantitative criteria and peer review during selection, although it does not require detailed economic data. However, a short coming of this model is that the model is appropriate only when there is a low degree of interdependence between projects.

A few empirical qualitative studies give partial support to the potential linkage between portfolio selection and portfolio management performance. Fricke and Shenhar (2000) identified factors such as clear goals, management support, ownership, assignment of resources, experienced staff, prioritization, customized management and communication in a multiproject environment as important for portfolio success. Emphatically, clear goals, top management support, and ownership were identified as “must have” factors, without them, failure is guaranteed. They also identified how the most important multiple-project success factors differ from factors of success in traditional single-project management. Elonen and Artto (2003) also reported problems with managing multiproject environments that include resource allocation, lack of prioritization and lack of portfolio-level activities.

Müller et al. (2008) highlighted on the need to establish organizational routines in order to ensure project selection based on the organization’s strategy. It is not only on personal preferences of individual managers but also recommended periodical reviewing the selection criteria and evaluating portfolios using comparable metrics. From the review of the literature, we come to the conclusion that no estimation exists about the contribution of project portfolio selection techniques to portfolio efficiency.

### 2.6.2 Project Portfolio Reporting

APM (2004) provides guidelines on governance of project management and states reporting as one of the four dimensions for project governance and so is considered as a mechanism for project and portfolio control. Reporting is considered to be a formal way of communication and many researchers have reported the importance of communication in portfolio, and it is one of the important factors in portfolio success. As well, the communication can take various forms from formal to informal and from bottom up to top down (Fricke and Shenhar, 2000). Six management skills have been found useful in multiproject environment, which are leadership, motivation, planning, decision making, coaching, and communication. From this reason, their existences contributes to achieve success in multiproject environment and among all communication which involves formal means such as reports and documents, and informal means, was found to have the most dominant effect. Face to face meetings is considered to be the best medium for information exchange. Communication medium used by the decision makers has an impact on communication and ultimately impacts the quality of information (Turner &
Müller, 2004). Communication is found out an interactive control in the form of decision-making styles, and has an impact on portfolio results.

Turner and Müller (2004) mentioned communication and collaboration between the client and project manager can reduce conflicts. Also, Johnson et al. (1994) showed formal reports are perceived by clients as the most credible source of information and the contents of these reports should be based on the project plan, measuring progress and forecasting time and cost for completion while Turner (1999) referred that most people perceive formal reports as bureaucratic and prefer to use more interactive media. Furthermore, Turner and Müller (2004) suggested that best results can be obtained by a balance of formal and informal communication and maintaining regular (daily or weekly) face-to-face meetings. In high performing projects the clients develops medium levels of structure and high collaboration with the project manager. Similarity, Blomquist and Müller (2006a) identified portfolio and program reporting to steering groups on similar templates and similar reporting metric as best practices in high complex organizations. Müller et al. (2008) stated that impact of reporting as a control mechanism is universal whereas the impact of portfolio selection appeared to be context specific. They recommended defining and establishing a common communication and reporting platform for all projects in the portfolio. Correspondingly, this research also suggested devising a mechanism to measure and comparing projects along similar metrics. Turner and Payne (1999) stressed on consistent way of reporting as this would provide the common basis for comparison and prioritization while Parkins (1996) also showed the importance of reporting likewise.

Contrary to above, other researchers used fairly different concepts of information or communication and considered reporting and interaction with colleagues as the most important sources of knowledge. Kasvi et al. (2003) considered communication as very important for organizational learning. They categorized knowledge management of a project into four groups of activities which are knowledge creation, knowledge administration, knowledge dissemination, and knowledge utilization. This idea has been further supported by Bresnen et al. (2003) who examined the significance of social factors in enhancing knowledge management capabilities in project based organizations. They reported that learning and transfer in project settings rely very heavily upon social patterns, practices and processes. As well as, they emphasized the value and importance of adopting a community-based approach in managing knowledge processes.

Research conducted by Martinsuo and Lehtonen (2007) examined how single-project management contributes to project portfolio management efficiency and found that availability of information for decision makers (on projects) is the most significant project-level factor contributing to portfolio management efficiency both directly and through project management efficiency. The other important factors being goal setting, availability of information for decision makers, systematic decision making, project goal achievement, and project management efficiency. The research also suggested understanding of portfolio level issues needs to be considered as part of project managers’ capabilities and not only a top management’s concern. From the above
literature we conclude that there exists a strong relationship between portfolio success and portfolio reporting using similar templates and similar metrics; which can also be used as a tool for collecting and disseminating status reports for high-priority projects. This can be deduced that there is a need to verify the relationship between portfolio reporting and portfolio efficiency.

2.6.3 Portfolio Decision Making

Decision making process can be considered as a four stage process which starts from problem definition, thought, judgment, decision and action. In organizations with unclear goals the decision process is almost random. Rational decision making is an outcome which is dependent on organizational procedures, regulations and politics (Parkins, 1996). Kester et al. (2009) identified three organizational styles of decision making regarding portfolio management: formalist-reactive, intuitive, and integrative. The formalist-reactive firms rely on quantitative criteria and primarily use financial methods in their processes of decision making. Intuitive firms rely on qualitative criteria and use managerial experience in decision making whereas integrative firms use a combination of qualitative and quantitative criteria and apply multiple methods in making portfolio decisions. Each genre can be described by a unique set of portfolio management practices. Regarding project based organizational decision making it is suggested that substantial efforts should be made in aligning the interests of project team with the objectives of the project in order to avoid conflicts and to help in the decision making process.

Tyszka (1998) proposed to distinguish three motivational propensities in decision making: the motivation for accuracy, the motivation for minimization of effort, and the motivation for distinctness. Motivation for accuracy concerns about possible regrets when the decision turns out to be wrong while motivation for minimization of effort tends to consider as few features of the choice alternatives as possible and motivation for distinctness concerns about having a good reason for choosing one out of several competing alternatives. According to Svenson (1996), decision making is a kind of conflict resolution process in which contradictory goals have to be negotiated and reconciled, and conflict resolution is highly dependent on problem, context and individual factors. Decision makers take into account, process perspective which considers both pre and post decision processes before making the final decision. Most publications have suggested using stage-gate process to effectively manage the portfolio, and emphasize the need for clear decisions at gates (Archer & Ghasemzadeh, 1999; Cooper, et al., 2002).

Decisions related to portfolio management are often described as choices of Go, Hold, or Cancel of individual projects and by implementing effective gating process during project portfolio selection helps improving decision making (Cooper et al., 2002). Whereas, the research by McNally et al.(2009) reveals that market criteria typically are important in early gates, product criteria are important in middle gates, and financial criteria are important in the later gates, although differences across firms do exists. Additionally,
organizations with a longer term perspective in established markets often use a mix of quantitative and qualitative decision making tools for portfolio optimization (Cooper et al., 2004a). The short coming with quantitative model includes their inability to handle multiple evaluation criteria, interrelationships between projects, diversity among projects and insufficient integration of R&D managers’ knowledge and experience. There is a need to balance the quantitative and qualitative information for portfolio decisions, and also the need to select the portfolio decision criteria based on organization’s type of portfolio and its strategy (Chien, 2002) Dye; Pennypacker, 1999).

Moreover, project portfolio is considered as a tool helping in making decision regarding capital investment allocation, project selection, prioritization, and resource allocation (Mikkola, 2001). Decision making in project portfolio includes selecting of tools while pursuing portfolio goals which are value maximization, balancing portfolio, and link projects to strategy. Stawicki & Müller (2007) suggested using portfolio optimization tools to achieve a balanced approach to decision making. Martinsuo and Lehtonen (2007) showed the systematic decision making about single projects is in complex relationship with portfolio management efficiency. The relationship appears to be mediated by project management efficiency, and systematic decision making did not explain project management efficiency, neither directly nor indirectly through reaching of project goals. Turner and Müller (2003) suggested that the portfolio decisions must be balanced against organizational performance measures or pressures. Portfolio decisions must be taken in teams after evaluation of the pros and cons of different mixes of priorities and go/no-go decisions, at the organizational and the portfolio level.

Decisions can be made in face-to-face settings or as joint management decisions and should be made in the best interest of the organization, and one way of achieving this objective is through joint management decisions (Müller et al., 2008). A structured, formalized decision process helps decision makers to avoid pressure from interest groups, justify their decision and communicate the decisions to others.

From the review of the above literature we hypothesize that there exists a relationship between portfolio decision making and portfolio efficiency. Hence, it is important to understand and validate qualitatively the relationship between the decision making and portfolio efficiency.

2.7 Project Portfolio Efficiency

For successful product innovation, effective portfolio management is essential in organizations and studies have shown that companies rely on effective portfolio management, and believe this to be important for the success of their business. This has been found to be an “elusive goal, and management rate the effectiveness of their project selection, portfolio management methods, and the results as provocative”. Cooper et al. (1999) developed a conceptual framework to measure the portfolio performance and classified these business into clusters as ‘benchmarks’, ‘cowboys’, ‘cross road
businesses’ and ‘dudes’ on the basis of portfolio performance and management fit. McNally et al. (2009) emphasized that by selecting and prioritizing the projects in portfolio in relation to probability of success and selecting the projects with the highest likelihood of success can significantly improve portfolio performance. In order to improve efficiency of the portfolios effective portfolio management methods should be consistently applied across all appropriate projects. Furthermore, multiple portfolio methods or hybrid approaches such as combination of financial approach; strategic and scoring models contributes significantly in selecting high performance portfolios.

For decades the portfolio performance was evaluated using performance measures combining information on both return and risk (Briec, and Kerstens, 2009). Besides, the efficiency of project portfolio can also be determined by estimating the degree to which the portfolio fulfills its objectives: strategic alignment, balance across projects, and value maximization (Martinsuo and Lehtonen, 2007; Cooper et al., 2000, 2004a, 2004b). The efficiency of the portfolio is also measured by the extent to which it succeeds in achieving results and achieving project and program level purpose. The portfolio performance in engineering and contracting firms depends on a careful elimination of the least attractive bid possibilities, and to concentrate efforts on those projects that provide minimum risk and maximum return. These companies’ uses the concept of Value at Risk to support bid no bid decision-making processes in order to obtain a better balancing of the overall portfolio of projects (Caron et al, 2007). Whereas, Turner (2007) defined the dimensions of project success as meeting user requirements, meeting project purpose, reoccurring business, customer satisfaction, end user satisfaction, team satisfaction, supplier satisfaction, and meeting self defined criteria. Further, Shenhar et al. (1997) identified four dimensions of project success which are project efficiency, impact on customer, business success, and preparing for the future.

Projects within the strategic business units are competing for resources to develop key technologies and to meet customer requirements. The key to success lies in the effectiveness in the use of strategic resources that helps in achieving optimization in portfolio schedule and improves overall portfolio efficiency. Another popular method of achieving project portfolio efficiency is to include an effective gating process into the selection process. The proper implementation of a stage gate process can help to get rid of poor projects at the gates, thereby improving the overall portfolio (Cooper et al., 2002). Research by Cooper et al. (2004b) on high and low performing portfolios found that high performing portfolios include more innovative, riskier and bolder projects which are new to business and new to the world with high values. Companies with high performing portfolios were found to dedicate more resources to sales and marketing and allocate resources based on merit. Additionally, Turner and Müller (2004) also proved that the best levels of project performance are obtained when there is high collaboration between client and project manager, and medium levels of structure.

Martinsuo and Lehtonen (2006) showed an efficiency of project portfolio management is related to of portfolio objectives, strategic alignment, systematic project-related decision making and value maximization. On the other hand, some scholars included the linkage
between single-project level to portfolio level factors will decrease efficiency at multi-project level rather than improving efficiency (Engwall and Jerbrant, 2003; Elonen and Artto, 2003). Multiple-case study research by Fricke and Shenhar (2000) indicated how single-project level success factors may contribute at the portfolio level.

From the review of the related literature we found that certain types of practices are more typical to high-performing firms as compare with low performing firms. However, they do not necessarily explain causality between the practices and portfolio-level performance.

### 2.8 Contextual factors

The associated lack of understanding of the project context prevents the manager from understanding the overall strategic or business objectives of the project, which prevents project managers from full collaboration with the project owner. The differences in knowledge about the project and collaboration are key conditions for high performance in projects. The difference in contextual characteristics, like industry, geography, and market dynamics effects project success (Turner and Müller, 2004). Müller and Turner (2007) developed a model and researched on the importance of success criteria and reported project success by project type, industry and project manager traits. They classified project types in six groups according to i) application area, ii) complexity, iii) project life-cycle stage, iv) importance, v) culture and vi) contract type. They also found the relationship between the importances assigned to success criteria and reported project success against these criteria. The results indicated that the importance assigned to team and end-user satisfaction influences almost all reported success measures. Nationality and perceived complexity were found the strongest impact on the perceptions about the importance of success criteria and success measures.

Besides, the research of Martinsuo and Lehtonen (2007) concluded that single-project management is associated with portfolio management efficiency directly in the form of information availability and project management efficiency whereas indirectly in the form of project types, goal setting and decision making. This literature suggested that the organization management should put emphasis on single-project management capabilities and portfolio management efficiency in practice.

#### 2.8.1 Project Types and Governance

Since the emphasis of our study is on project based organizations (PBO), so it is essential to understand the types of projects the PBO undertakes, and how the PBO manages their processes. Project business management process comprises the management of the whole project company and its projects and it has a leading role in governing project management, engineering, and manufacturing processes (Artto, 2001).
Different project types have different strategic importance and each type requires different management approach. In order to manage them effectively different project types and their characteristics should be identified (Artto and Dietrich, 2007). Artto (2001) explained that a project company uses either internal (investment) or external (delivery) projects for its business purposes. The importance of right set of projects in a portfolio for company’s long term growth was identified by Wheelwright and Clark (1992) and classified the projects by degree of change in the product and degree of change in manufacturing process which helps in portfolio classification. These projects are classified as derivative projects, platform projects, breakthrough projects, and R&D projects. Turner and Cochrane (1993) identified four types of projects depending on the clarity of the goals and methods used as shown in Figure 2.10.

**Type 1**
Projects having well defined goals and also the methods to achieve these goals are well defined. These are often engineering projects where a sequence of activities is well defined.

**Type 2**
Projects having well defined goals but methods to achieve these goals are not well defined. The functionality of the final product is well understood but how to achieve this functionality is not yet known. These projects are usually product development projects.

**Type 3**
Projects in which goals are not clearly well defined but methods to achieve them are well defined. In these projects the specifications are refined through the stages of the project and are usually IT application development projects.

**Type 4**
These are the projects in which neither goals nor methods are well defined. In these projects only the business problem that needs to be solved is known. These are usually organizational change or research projects.
Furthermore, Blomquist and Müller (2006) investigated different roles and responsibilities related to organizations governance structure. Ultimately, Shenhar et al. (1997) found differences in contextual characteristics, like industry, geography, and market dynamics to have a moderating effect on project success, perception of success, or other measures of performance. The research conducted earlier does not explain the impact of project types and governance type on portfolio efficiency.

### 2.8.2 Environmental Complexity

Another important contextual aspect of project portfolio management identified by researchers is environmental complexity. It was found that higher environmental complexity is one of the factors taken into account during decision making. Clear roles help to create and identify business opportunities and business planning. Environment has been classified in literature as simple and complex. Simple environment is the one whose environment is clearly understood, and an effective ways of dealing with it exists. Complex environment is the one whose environment is poorly understood and no effective way of dealing with the environment is known to the organization. The extent of change in the factors representing environment is defined as stability, and stability can range from stable to turbulent.

By the review of the literature on contextual factors that includes governance type, project type and industry has a mediating role that can affect the relationship between project portfolio control techniques and portfolio efficiency. The literature review shows a knowledge gap in portfolio control techniques and how they relate to portfolio management performance in different contexts in project based firms.
2.9 Problems associated with Project Portfolio

Four biggest problems associated with project portfolios were identified by Kendall and Rollins (2003) are;

- Too many active projects as compared to its resources.
- Wrong projects that does not add value to the organization.
- Projects not linked to strategic goals.
- Unbalanced projects.

The results of Cooper et al. (2000) showed that problems associated with ineffective use of portfolio methods results in poor performance, low-impact projects, too many short term and lower-risk projects, pipeline gridlock, right balance and number of projects, higher failure rates and portfolio that do not reflect the strategic priorities of the business. Four areas in portfolio management related to above problems are resource balancing, prioritizing projects against one another, difficulty in making Go/Kill decisions, and too many minor projects in the portfolio.

From the review of the related literature found out that there exists a knowledge gap about how portfolio control techniques impacts portfolio efficiency in project based firms and what roles is played by the contextual factors in affecting the portfolio efficiency. Therefore, in order to answer our research question we developed a proposition that is stated as under

*Proposition:* There exists a positive relationship between portfolio control techniques and portfolio efficiency, which can be proved qualitatively.

After reading and deep understanding of the relevant theoretical and empirical literatures, we will now continue to elaborate and present in the next chapter the research methodology.
CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this chapter is to describe and analyze the methods used to conduct the research and will start with the concept of research philosophy that will be followed by research approach. Later the research strategy used to collect the data will be discussed, which will help us to investigate the role of project portfolio control techniques in achieving portfolio efficiency in project based firms.

3.0 Research Philosophy

Creating and defining a conceptual framework of research helps to simplify research tasks, clarify research topic and research question (Fisher et al., 2007). Easterby-Smith et al. (2001) identified three main reasons to understand research philosophy which are;

- Firstly, it helps the researchers to specify and refine the research methods. This will further help them to clarify the overall research strategy, by which data would be gathered and will help to answer the posed question.
- Secondly, helps researchers to evaluate different methods and methodologies earlier in the research process.
- Thirdly, helps the researcher to be innovative and creative in selection of methods.

Business research is affected by five factors that are epistemology, ontology, practical considerations, theory and values (Bryman and Bell, 2007) which are depicted in the Figure 3.1. The role of these factors and its effects on business research needs to be clarified and understood in order to conduct business research. The concepts of epistemology and ontology will be discussed and explained in detail later in the chapter.
Saunders et al. (2007) states that research philosophy is concerned about the nature of knowledge a researcher develops in a particular field of research and categorises three major ways of thinking about research philosophies that are epistemology, ontology and axiology. An epistemological issue concerns about what is (or should be) regarded as acceptable knowledge in a field of study, within the field of epistemology there exist two basic beliefs or research philosophies which are positivism and interpretivism. The researchers using the positivist approach in their research, collects objective data (quantitative data) which takes the form of statistical result whereas the researchers that takes interpretivist approach collects subjective data (qualitative data) and requires the social scientists to grasp the subjective meaning based on their feelings (Bryman and Bell, 2007). The researcher using positivist approach, use existing theory to develop the hypothesis and will end up with collection of credible quantitative data, the hypothesis will confirmed or refuted based on the result of the analysis of data, the end result of positivist approach will be law like generalization. While, in the interpretivist approach the concept of ‘social actors’ is significant and is considered as highly appropriate method for business research, as business situations is quite complex and unique. The results obtained from interpretivist approach are context specific and are not generalizable (Saunders et al., 2007).

Another research philosophy is ontology which is concerned with the nature of the reality and the ways how the business research will be conducted; in simple words it is concerned with how we view the world (Bryman and Bell, 2007). Within the philosophy of ontology, there exists two aspects objectivism and subjectivism. Objectivists ignores social actors as part of social entities whereas the subjectivists considers them as the cause for every social phenomena and believe that social phenomenon are created from
perceptions and consequent actions of these social actors (Saunders et al., 2007). Also, interpretivism considers the differences among researches due to the human factor and is not meant for generalization. As our research is conducted in the business environment which is constantly changing and involves top management, who are involved in the portfolio selection, reporting and decision making that lies within notion of subjectivism in the ontology. Besides, the research is context specific and is not meant for generalization so the appropriate epistemology would be interpretivism. In conclusion, our research philosophy will be based on notion of interpretivism and subjectivism.

3.1 Research Approach

There are two general approaches to reasoning, which have been identified in literature which may result in the acquisition of new knowledge, namely deductive reasoning and inductive reasoning. Deductive reasoning, which is a theory testing process that starts with an established theory or generalization and tries to examine if the theory applies to specific instances whereas inductive reasoning which is a theory building process that starts with the observations of specific instances and seeks to establish generalisations about the phenomenon under investigation (Hyde, 2000). Deduction approach is generally applied to positivist philosophy while inductive approach is applied to interpretivist philosophy. Deduction is subject to rigorous testing and has the characteristics that results can be generalized, whereas induction process is applied on a small sample and is particularly concerned with context (Saunders et al., 2007). The steps of inductive reasoning are shown in Figure 3.2.

![Figure 3.2: Steps in the Induction Process](image)

It is also generally believed that quantitative enquiry adopts a deductive process, while qualitative enquiry usually adopts an inductive process. From traditional view, quantitative enquiry examines data which are numbers whilst qualitative examines data which are narrative (Easterby-Smith et al., 2002). As well, Bryman and Bell (2007) stated that qualitative data analysis involves a general strategy of analytic induction. In the literature, there also exists a conventional view that quantitative researchers subscribe to a “positivist” paradigm of science whilst qualitative researchers subscribe to a “relativist” paradigm (Hyde, 2000).
The key distinctions between qualitative and quantitative study as identified by Bryman and Bell (2007) are illustrated in table below;

Table 3.1: Key distinction between Qualitative and Quantitative Study

<table>
<thead>
<tr>
<th>Term</th>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of theory in relation to research</td>
<td>Deductive; testing of theory</td>
<td>Inductive; generation of theory</td>
</tr>
<tr>
<td>Epistemological orientation</td>
<td>Positivism</td>
<td>Interpretivism</td>
</tr>
<tr>
<td>Ontological orientation</td>
<td>Objectivism</td>
<td>Constructivism</td>
</tr>
</tbody>
</table>

Moreover, the key distinction between the qualitative and quantitative study as identified by Hyde (2000), a quantitative approach takes a large sample from population of interest and try to measure the behavior and characteristics of that sample under study. Thus, the study tries to construct generalizations regarding the population as a whole, attempts to describe the general and overlook the particular. The qualitative methodologies attempt to explain the particular units under investigation. It also provides relationships and conclusions for the particulars unit of analysis. Therefore, it helps us to understand the issues in depth and produce a large amount of data on a small number of individuals. Furthermore, Saunders et al. (2007) states that quantitative analysis is conducted through the use of diagrams and statistics, whereas qualitative analysis are conducted through the use of conceptualization.

By understanding of the research philosophies and approaches, we come to the conclusion that we will be employing an interpretive research paradigm in our research, and interpretivist philosophy, subjectivist aspect of ontology, and approach of inductive reasoning as we are concerned with only with the context, small sample of subjects and less concerned with the generalization of the results. Case study will be used as research strategy and starts by collecting qualitative data through semi-structured interviews. The use of these research concepts will help us in order to answer our research questions and finally to conclude our research findings.

3.2 Research Strategy

The purpose of the research determines the research strategy. The purpose of the research as classified by Saunders et al. (2007) which are exploratory, descriptive and explanatory. Exploratory study is conducted to find “what is happening; to seek new insights; to ask questions and to assess phenomena in a new light” (Robson, 2002, p. 59). It is particularly useful to clarify the understanding of the problem whereas descriptive studies are usually a “forerunner to a piece of exploratory research” and to portray accurate
profile of an event or situation. The explanatory studies are carried out to establish the causal relationships (Saunders et al., 2007, p. 134). Our research is mainly focused on clarifying our understanding and to seek insight of portfolio controls techniques and how it works in reality. Thus, the research study will be exploratory and descriptive in nature.

Various research strategies have been identified in literature and choice of strategy will depend upon the research question, research objective, the amount of time and existing knowledge. Another important aspect in planning your research is whether to go for cross-sectional study which is snapshot taken at a particular time or to go for a longitudinal study which is representation of events over a given period of time (Saunders et al., 2007). Due to time constraint the research cannot be conducted over a longer period of time so we will perform cross-sectional studies which according to Bryman and Bell (2003) are conducted when researcher is interested in diverse answers. Case study research strategy will be used in which data will be collected over a short period of time.

3.2.1 Case Studies

Robson (2002, p.178) defines case study as “a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence” and is considered as one of the most widely used research methodology (Patton, 1991). The case study strategy is of particular interest if required to gain deep understanding of the context and its processes. It is often used in exploratory research and involves multiple methods of data collection (Saunders et al., 2007). Also, as stated by Feagin et al. (1991) case study is simply an in-depth study of a particular instance or a small number of instances and is preferred under certain circumstances for certain research problems. It is an ideal methodology when a holistic, in-depth investigation is needed. Yin (1994) and Stake (1995) concerted that case study research employs both qualitative and quantitative research and qualitative study seeks to identify the underlying concepts and the relationships among the variables under study. The data for qualitative study might include transcripts of in-depth interviews, observations or documents. The case study is designed to bring out the details from the viewpoint of the participants, evidences and indications are mostly received from fieldwork, reports and observations.

Yin (2003) classified case study strategy as single case and multiple cases. He suggested that single case studies are appropriate if the objective of the research is to explore a previously un-researched subject, whereas multiple-case designs are desirable when the intent of the research is description, theory building, or theory testing. Multiple-case designs helps in cross case analysis, making the results generalizable, and the extension of theory. In general, case study can be positivist or interpretivist however it depends on research approach, data collection and method of analysis used by researcher. Moreover, it is not an appropriate approach when research has many variables to control and involves many numbers of variations. Case study is considered to be the most preferred research approach when needs to answer “how” or “why” questions. Even a single case,
if studied in sufficient depth and with sufficient insight, helps to provide the basis for a theoretical explanation of a general phenomenon (Hyde, 2000).

Besides, researchers argue that the conclusions drawn from case study are specific to the particular organizations and may not be generalizable. Likewise, Lee (1989) has identified four major problems which are associated with case study research - a lack of: controllability, deductibility, repeatability and generalizability. On the other hand, Benbasat et al. (1987) identified three strengths of case study research; i) the researcher can study the unit in a natural setting, and can generate theories from practice; ii) the method allows the researcher to understand the nature and complexity of the process and iii) valuable insights can be gained into new emerging issues in that field.

The current research is being conducted through case study analysis of two organizations where the data would be collected through semi-structured interviewees. These case studies are conducted at:

1. Pharmaceutical Company in Gothenburg, Sweden
2. Transportation Company in Bangkok, Thailand

As our research question requires good understanding of theory and concepts of portfolio management. Therefore, to answer the research question there is a need to understand how the portfolio control techniques are applied in the organization and its relationship with portfolio efficiency within specific context. We also consider explanatory case study an appropriate approach to conduct our research that consists of four stages; i) design case study, ii) conduct case study (with semi-structure interview), iii) analyze evidence and strategy and iv) develop conclusion and implication based on evidence obtained from conducting an investigation and with a support from theory. (Yin, 1994)

3.2.2 Choice of Company

To conduct the case study analysis, the biggest challenge is to select the unit of analysis that can provide the researcher with the relevant and in depth information about the research question. As project portfolio control techniques are not widely used in the small scale organizations, rather mostly used in new product development or R&D organizations so there is a concern to select a large size new product development or R&D organization. Moreover, we also need to take not consideration the fact that many companies do not want to share the information so we should select the company that is willing to share information; we also considered the ease of access to data from the company. Keeping in view all the constraints and factors, and our urge to get a deep understanding of project portfolio control techniques in new product development and R&D organizations, for this reason we selected the pharmaceutical organization in Gothenburg as it involves both R&D and new product development. The second organization was selected to observe the similarities and patterns observed in the first organization.
So, these companies were contacted through e-mail to ask for their willingness to share information. The objectives and goals of the study were explained through phone and email, later on data from the Pharmaceutical Company was collected after spending three days in the organization, and from the Transportation Company through telephonic semi-structured interview.

3.3 Data Collection

3.3.1 Semi-Structured Interview

Collecting data using interviews requires considerable skills (Saunders et al., 2007) and Bryman and Bell (2003) states that interviews in qualitative research are based on the opinion of the participants. The interviews may be categorized as structured, semi-structured and unstructured. The structured interviews are based on predetermined and standardized set of questions and are used in quantitative research interviews, whereas semi-structured interviews are in depth and based on non-standardized set of questions. In semi-structured interview the researchers have a list of theme of questions to be covered and questions may vary from interview to interview and additional questions may need to be asked to explore the research questions (Saunders et al., 2007). In addition, Denscombe (1998) documented that in semi-structured interview “the answers are opened-end and there is more emphasis on the interviewee elaborating points of interest” as well as Gillham (2000) stated that the semi-structured interview is a productive research tool.

As our research aim is to collect as much information as possible from the case study so semi-structured interviews were conducted to collect the information from the organizations and were carried out in a Pharmaceutical company and Transportation Company in Thailand. The interviews were carried out with the project managers and team leaders who are very experienced in executing projects, practical work and solving day to day tasks in the company. They also participated in training programs which are particularly related to project management and portfolio management. The main purpose of semi-structure interview in this research was to explore how project portfolio control techniques helps in achieving efficiency in projects based firms. The results from interviewing was analysed and served as a primary data source as semi-structure interview is a common form and helps to investigate interviewee's opinions and experiences as stated by Punch (1998), semi-structure interview can help to know interviewees' perceptions and will help to construct situation.

Before conducting the interviews the guiding questions were sent to the interviewees (portfolio team members, project managers and team leaders) well in advance to allow them to prepare appropriate answers. The interviews were conducted in two different ways, face to face settings and by telephone. The face-to-face interviews are considered to be one of the oldest forms of data collection and have been considered for superior data collection because of its flexibility and great potential (Rossi et al., 1983).
Additionally, the interviewer can prepare dynamic material, for instance, advertisement with picture and animations, etc while, telephonic interview is less flexible and lacks visual indications (Leeuw de, 1992). Face-to-face interview also allows for longer interviews in spite it might be time consuming as compared to telephone interviews. Due to dramatic technological advancements, rapid and worldwide use of technologies, more and more people prefer to interview using telephone as it saves time and cost. Collin et al. (1998) concluded that the successful telephone interview should be conducted in minimum twenty minutes of time but Fray (1983) reported to fifty minute. The drawbacks of face-to-face interview is that, it is more costly as it incurs transportation and travel costs as well as the limitation of geography makes it difficult to be conducted at any time in a day. There may also exist some ethical problems as different cultures have different ethical, social and religious values.

These semi-structured interview questions were aimed to gain information about the viewpoint of the management about the portfolio control techniques and their impact on portfolio efficiency within their organization. The semi-structured interview provided a narrative of portfolio management processes in the Pharmaceutical Company and Transportation Company in Thailand. The sample of semi-structure interview question is provided in Appendix 1. Furthermore, recording was done for intensive information collection to be used for further analysis.

The questions in a semi-structured interview were based on specific topics that served as a basic interview guideline (Bryman and Bell, 2003) therefore, while preparing the interview questions; attempt was made to prepare questions that are based on different aspects of the research question. Before conducting the interview the questionnaire was discussed with our supervisor and then with one of the member of Portfolio Management Group (PMG) in the pharmaceutical company. Every effort was made that the questions are made as simple as possible that our interviewees could easily understand it, and find it relevant to their working experience.

The interviews in Transportation Company were conducted through telephone, first emails were sent to different people in the organization to ask for their willingness. Thereafter, from the group of people who were willing to be interviewed we selected the appropriate people with the sufficient knowledge and background who can understand the research context and provide us with the relevant information. Later on interview questions along with description of the research was sent to them to get better understanding of the research question. Finally, interviews were conducted by telephone as agreed by respondents.

3.3.2 Sampling

As the concept of our study is to fill the knowledge gaps and to get the deep understanding of the subject so our research involves the concept of theoretical sampling which takes into account sample specific issues and look for precise information and collect data that fills the conceptual gaps and relies on comparative methods. The aim of
this sampling is to refine the ideas and also helps to identify the conceptual boundaries. In
the study we have sampled people, document and events and observed patterns and then
returned to the same settings to gain more information. Theoretical sampling helps to
define categories, identify context in which they are relevant and also help to identify
gaps in the categories (Denzin and Lincoln, 2003).

Therefore, we select seven respondents according to their position in organizations; three
respondents were selected from the pharmaceutical company and five respondents from
Transportation Company. Likewise, we also took into consideration their roles,
responsibilities and experiences in the projects as we believe that project manager and
team leader are professional in project management area so they have the competencies
to understand our research questions and have the capability to answer.

3.3.3 Qualitative Data Analysis

After conducting the case study analysis the concern is how to analyze it that gives you
meaningful understanding of the data. The literature suggests number of inductively
based analytic procedures to analyze the data these include data display and analysis,
template analysis, analytic induction, grounded theory, discourse analysis and narrative
analysis (Saunders et al, 2007). To reach the conclusion, and to get deep understanding,
the method of data display and analysis illustrated by Miles and Huberman (1994) will be
used which is shown in the Figure 3.3 that explain the process as consisting of three
concurrent flow of activities, data reduction, data display, and drawing conclusions. All
three analysis activities along with data collection form the cyclic process.

Figure 3.3: Components of Data Analysis (Miles and Huberman, 1994)

Data reduction refers to the process of selecting, simplifying, abstracting, and
transforming the data that appear in the field notes, and it occurs when summarizing,
coding, teasing out the themes, clustering and making memos. It is a form of analysis that
sharpens, focuses and organizes data in a way that conclusions can be drawn. The second
major step of analysis is data display, in which data is organized and displayed in the form of charts, graphs, and networks which helps to draw conclusion. These displays help to organize the data into compact form and ease the analysis process. The form of data display is dependent upon the type of data and choice of researcher. Final step of analysis activity is drawing conclusions and verification, look for patterns, causal relationships, and propositions, once the conclusions are made these needs to be verified by replicating the findings in another settings and that provides validity to the results (Mils and Huberman, 1994).

3.4 Credibility Criteria

There exists a need that the results obtained from analysis of the data should be valid, replicable and reliable. The reliability and validity are more concerned with quantitative research, while in qualitative paradigms the terms Credibility, Neutrality or Confirmability is used (Golafshani, 2003). The validity and reliability is an issue for researcher in qualitative research while designing a study, analyzing results and judging the quality of the study (Patton, 2001).

Yin (1985) suggested that the concerns while conducting the case study analysis is to construct validity, internal validity, external validity and reliability, and these issues arise while data collection. The issues related to quality of data with semi-structured interview are reliability, validity, forms of bias, and generalizability (Saunders et al., 2007) and Bryman and Bell (2007) considers ethical issues another measure of credibility.

3.4.1 Construct Validity

Validity is concerned with the integrity of the conclusion that is drawn from the research, in other words it is concerned about the findings that they are really true what it appears. In constructing validity the researchers are encouraged to deduce hypotheses from a theory (Bryman and Bell, 2007). Following measures have been taken to construct validity;

- Multiple sources of information have been used to collect the evidences by interviewing different people in the same department and asking the same set of questions and also by protecting the data from the researcher biases.
- Chain of evidences have been used in the data collection phase by making notes of observations and interviews that allows to cross check of particular sources of information.
- Review of the draft of the case study report by the member of top management in the company during the report-writing phase.
- Review of interview transcripts and part of the analysis was sent back to participants to make the changes about the unclear aspects.
3.4.2 Internal Validity

Internal validity is concerned about the issue of causality, and is concerned with the question, how confident the researchers are about the conclusion drawn for the causal relationship between two or more variables holds or not (Bryman and Bell, 2007). Following measures have been taken to ensure internal validity.

- During the data analysis phase, diagrams, illustrations and displays were used to assist explanation of the phenomena.
- Cross-checking of the results was done that helped to achieve coherence in internal findings.

3.4.3 External Validity

External validity is sometimes also referred to as generalizability, which is one of the biggest concerns in conducting the research that the results of study can be generalized beyond the specific research context or not. The concept of external validity raises the issue of how people or organizations are selected. The external validity of the results could be limited as data from only two companies have been taken into consideration, therefore, the results may not be generalizable outside the research context.

3.4.4 Reliability

Reliability of the results are concerned with the issue of consistency of results, Robson (2002) identified that there are four threats to reliability, which are participant error, participant bias, observer error and observer bias. In order to make the results of our case study reliable, following measures have been considered.

- Data is collected using tape recorder to avoid losing information.
- Semi-structured case study protocol has been used during collecting the information.
- The collected information was stored in an electronic form in order to organize and document the mass amount of information.
- All efforts have been made to record all the observation as concrete as possible.
- Development and refinement of case study protocol by taking the expert opinion from the researchers.

3.4.5 Ethical Issues

According to Bryman and Bell (2007) the Ethical principles in business research has been broken down into four main areas; these are: Harm to participants, lack of informed consent, invasion of privacy and deception. Harm to participant involves physical harm, harm to participant development or self esteem, future career prospects or professional development, whereas lack of informed consent occurs when the information given to the
individual about the research being conducted is not enough that helps them to decide whether they want to participate in the research or not. Invasion of privacy raises the issue of confidentiality and anonymity and deception is involved when researchers represent their research as something else other than what it is.

While conducting our research all these ethical issues have been taken into consideration, the information was sent prior to conducting the research to the participants that helped them to decide for their volunteer participation. All the replies from the respondents were reported anonymous to protect them from being traced, that is to avoid any harm to their career prospects or professional development. To avoid deception the information provided to participants about the research was based on actual grounds and to the best of knowledge of researchers. Also, the interviewees were made to decide on the optional questions if it involves any confidential concern.

The next chapter will explain how the qualitative data was analyzed and explanation of discussion and findings obtained after the analysis of the data.
CHAPTER 4

DATA ANALYSIS AND DISCUSSIONS

This chapter presents the results that are obtained from the analysis of case study and semi-structured interviews. The replies from the respondents helped us to understand the relationship between project portfolio control techniques and portfolio efficiency. Based on the replies from the interviewees, we also tried to understand how these portfolio control techniques are applied in the Pharmaceutical Industry and in the Engineering and Contracting Transportation Company.

The discussion is focused on three main topics which are portfolio control techniques, portfolio efficiency and contextual factors. Finally, the chapter ends with impact of the contextual factors on the relationship between portfolio control techniques and portfolio efficiency indicated by the respondents. A separate conclusion will be made in the next chapter – Chapter 5.

4.0 Findings and Analysis of Interview

In order to analyze the data, the audio recorded interviews were transcribed which was the first step in performing the qualitative data analysis. Special care was taken during transcription process to avoid transcription error and also to avoid losing contextual information. After the transcription process the copy of the transcript were sent back to the interviewee for final checking and ensuring factual accuracy. To analyze the data systematically and rigorously the mass amount of data was categorized in six dimensions which was guided by our research question namely, portfolio selection, portfolio reporting, portfolio decision making, achieving results, achieving purpose and contextual factors.

Categorization of the data helped us in managing and comprehending the data, identifying key themes and patterns, drawing and verifying the conclusions. After the process of categorization, unitizing of the data was done which is the process of attaching relevant bits and chunks belonging to each category (Saunders et al., 2007). After generating the categories and placing the chunks into each category, the next step was to form a matrix by placing the categories in the column and interviewees in the row for the purpose of analysis. (see Appendix 2) The matrix was also helpful in summarizing the data from seven respondents that consists of three respondents from Pharmaceutical Company and four respondents from Transportation Company. After analysis of data, patterns were observed to draw the propositions about the relationship between the portfolio control techniques and portfolio efficiency and that helped us in making valid conclusion about the relationship between them. The information about the interview and the interviewees is placed in Table 4.1 as below.
Table 4.1: Description of interviews

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Organization</th>
<th>Department</th>
<th>Position</th>
<th>Experience</th>
<th>Interview Time</th>
<th>Interview Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Pharmaceutical</td>
<td>Business Development</td>
<td>Business performance director in Global discovery</td>
<td>10 Years</td>
<td>3 Hours</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Pharmaceutical</td>
<td>Business Development</td>
<td>Portfolio Management Group (PMG) global portfolio business partner</td>
<td>6 Years</td>
<td>90 Minutes</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Pharmaceutical</td>
<td>Business Development</td>
<td>Global Project Manager</td>
<td>11 Years</td>
<td>1 Hours</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Transportation</td>
<td>Project Management</td>
<td>Head of Project Management</td>
<td>20 Years</td>
<td>45 Minutes</td>
<td>Telephone Emailing</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Transportation</td>
<td>Project Management</td>
<td>Divisional Portfolio Manager</td>
<td>14 Years</td>
<td>45 Minutes</td>
<td>Telephone Emailing</td>
</tr>
<tr>
<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Transportation</td>
<td>Project Management</td>
<td>Project Manager of Division</td>
<td>10 Years</td>
<td>1 Hours</td>
<td>Telephone Emailing</td>
</tr>
<tr>
<td>7&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Transportation</td>
<td>Automatic Train Control</td>
<td>Team Leader</td>
<td>9 Years</td>
<td>1 Hours</td>
<td>Telephone Emailing</td>
</tr>
</tbody>
</table>
4.1 Pharmaceutical Company

4.1.1 Company Overview

Pharmaceutical Company in Gothenburg is a world leading pharmaceutical company with a world-class biologics capability. The company had discovered new medicines that are designed to improve the health and quality of life of patients around the world. It has 26 manufacturing sites in 18 countries and activities in over 100 countries with a growing presence in important emerging markets including China; corporate office in London, UK; and major R&D sites in Sweden, UK and the US. The company employs over 65,000 people while it has around 12,000 people in R&D organization and 17 principal R&D centers in eight countries. This pharmaceutical company has discovered and developed human antibody therapeutics in inflammatory disorders. Biological therapeutics offers excellent prospects for growth. This will accelerate the delivery of a pipeline of new products from their resources. It has not only strong science skill but also has wide-ranging commercial skills. Alongside to the commitment to competitiveness and performance, it has continued to be led by core values to achieve sustainable success and development of its business and the delivery of a flow of new medicines that make a difference in the lives of patients and create value for their shareholders and society. (Pharmaceutical Company website, 2009)

4.1.2 Concept of Portfolio Management in the Pharmaceutical Company

As drug development involves large amount of investment and takes long time to bring the product to market, so involves large amount of business risk. According to Mohr et al. (2008) the development and launch of new innovative drug takes around 10 to 15 years, and cost estimates vary from around $500 million to more than $2,000 million, depending on the therapy and the developing firm. The companies are interested to select the projects that meet the strategic objectives of the organization and involve minimum level of risk with maximum return. That is why; the concept of portfolio management is widely applied across the pharmaceutical industry to asses risk and commercial value of development projects. In broad, portfolio management is all about maximising the value of portfolios through proper resource allocation and that involves alignment of the portfolio with strategic business objectives that outlines the unmet medical needs and other factors that considers worth pursuing it.

The company defines its therapeutic area of interest in context of formulating the enterprise strategy. Within the therapeutic area number of projects is segregated according to disease area e.g diabetic disease area, oncology disease area, cardiovascular etc. so number of projects within the same disease area form a group of projects. The combination of various projects within the same disease area forms the portfolio of projects. The projects in the portfolio may enter in various stage of the product development, may be very start in the pipeline or during the later stages. For every portfolio of projects, expected return and risk variance is calculated using various financial tools. One of the measure of risk is distribution curve of expected return, greater
the width of the distribution of expected return, higher the risk is. Narrow the width of the distribution, less risky the portfolio is. These portfolios of projects are then plotted against the expected return and risk variance, and that portfolio of projects is selected with minimum variance and maximum expected return. The final goal of the project portfolio control techniques is to select a portfolio of projects that optimally meets the strategic objectives of the organization and that provide the highest overall value of the portfolio. The process of R&D in the pharmaceutical industry can be shown in Figure 4.1 which consists of three stages; Research, Early Development and Late Development.

Figure 4.1: Process of R&D in the pharmaceutical industry (Mohr et al, 2008)

4.1.3 Drug Discovery and Development Process

Drug development is a long process that takes total of around twelve years from research to drug development. The whole process of new drug development can be divided into three phases, research phase, early development phase or drug discovery phase, and late development or drug development phase. Drugs discovery phase takes around four years and drug development phase takes around eight years. In drug discovery phase the new molecules are discovered by synthesis of potentially new medications or chemical modification of existing compounds. During the drug development phase, preclinical testing of the compound discovered in the discovery phase is done, and involves development and analysis of the dosage and clinical studies. The main problem with this long process of new drug development which takes twelve years, a lot of variables may
change for example competition, laws and regulations and market needs. The dynamic nature of markets and the competition makes it difficult to predict the long term market needs and hence difficult to justify the long-term projects.

The process of new drug development can be depicted in the steps as shown in Figure 4.2;

![Figure 4.2: Steps in new drug development process](image)

In Lead generation, ideas are created or generated by doing a market research of prospective consumer interest or inquiry and then encapsulating the inquiry into a business' products or services. In Lead optimization, structure of compound is generated and is aimed at enhancing the most promising compounds to improve effectiveness, increase absorption or to diminish toxicity. During the preclinical testing period, tests are done to test the effects of single and multiple doses of drug on large number of animals. In Phase 1; the effects of the dose on a small number of healthy volunteers that ranges from 25-50 are studied, in order to determine the effect of drug dose on human and to check if humans show same responses to the medication as observed in labs. The study is performed by clinical pharmacologists in research centers. In Phase 2; the medication is tested on a larger population of patients ranging from 50-200, to determine its efficacy. These studies are conducted in special clinical centers. In Phase 3; the effects of the new product are studied on large number of patients to determine the efficacy and safety of the drug and involves millions of dollars. After successful completion of Phase 3, New Drug Application (NDA) for marketing approval needs to be submitted to the Food and Drug Administration (FDA) along with all the reports of the clinical tests. The approval from FDA may take three years before the final product can be brought to market.

Due to long drug development time, the process of portfolio selection and decision of the projects to continue or to abort the project has to pass through the strict gating criteria, which are similar to the concept of gating criteria put forward by Cooper et al., 2002. These gate decisions ensure that the projects selected in the portfolio of projects meet the strategic needs of the organization and maximize the overall commercial value. These stage gate decisions are called Milestone 4 (MS 4), Toll Gate Decision 2.5 (TG 2.5) and Toll Gate Decision 3.0 (TG 3.0). These decisions need to be taken before the drug development enters into new phase. These Gate decisions are taken by the governing bodies and are called MS4 committee (MS4C) and Project Review Body (PRB). These decision points along with governing bodies are shown in Figure 4.3. MS4C is responsible for taking the decision at the MS4 decision point before the start of Phase 1. Project Review Body takes decisions at the TG 2.5 and TG 3.0 before start Phase 2 and
Phase 3, respectively. The portfolio of projects before the MS4 point is called as local portfolio and the portfolio of projects after the MS4 point is called the Global Portfolio in the company. Despite of all the technological advancements, the pharmaceutical industry faces a high degree of project termination during the rigorous testing and selection process that protects the company from further loss.

![Diagram showing decision points and governing bodies]

Figure 4.3: Decisions points along with the corresponding governing bodies

### 4.2 Project Portfolio Control in Pharmaceutical Company

During the interviews it was found that the concept of portfolio control techniques was quite similar to what has been discussed in the literature of Müller and Blomquist (2008). The concept of portfolio control techniques involved portfolio selection, portfolio reporting and portfolio decision making. Questions were asked from the respondents about the portfolio control techniques. The discussion on these control techniques is based on the answers obtained from the respondents in the Pharmaceutical Company.

#### 4.2.1 Project Portfolio Selection

**4.2.1.1 Selection of the Portfolio based on the organization Strategy**

The company while formulating the company strategy defines its therapeutic areas of interest. The projects in the company are divided according to therapeutic areas. These therapeutic areas according to company Annual Report, 2008 are Cardiovascular, Gastrointestinal, Infection, Neuroscience, Oncology, and Respiratory & Inflammation. Based on the chosen therapeutic area the company defines the disease area and the projects are selected according to disease area strategy. These disease areas are decided according to strategic intent of the organization and projects within these disease areas are selected through the stage gating that ensures the strategic alignment and taking into account high priority disease area. The strategic intent of the organization is decided after deep analysis of the market situation, competitor’s analysis, market trend, unmet medical areas, internal capability analysis and many other factors.

Once the strategic intent is finalized bucket of money is allocated for each disease area. Strategic bucket model was used to allocate the resources, to ensure that the final portfolio of projects reflects the business’s strategy. The concept of strategic bucket was very similar to the Cooper et al. (2000) who stated that firms use strategic buckets
approach to ensure that portfolio spending are made according to strategic priorities. The management pre-allocates funds to various “buckets”: according to project types, markets, technologies, or product lines. In pharmaceutical company the strategic bucket for spending money consists of two major project areas, these are product line extension projects and new drug development projects. Product line extension projects are defined as the projects where the company introduces another product within the same market after its existing product. In other words an existing molecule is used for curing other diseases.

4.2.1.2 Tools and Techniques used to select and optimize portfolio

A variety of portfolio tools, charts and techniques were found to be employed by the Pharmaceutical Company that assist them to review all the projects in the portfolio. These portfolios of projects are reviewed from three different aspects i.e. value maximization, balancing of the portfolio in terms of risk, and linking the portfolio of projects to the strategic intent of the organization which are three major goals in portfolio optimization as stated by Cooper et al. (2002)

The tools used by the company for value maximization of the project portfolio involve financial models such as Net Present Value (NPV), Expected NPV (NPV after risk adjustment), Internal Rate of Return (IRR), Expected Commercial Value (ECV) and Payback Method (PBM). Other variables which are taken into consideration are sales forecast; peak year sales, understanding the value proposition. The concept of value maximization of the portfolio was found to have given the most priority by the company. One main tool of analysis is decision tree analysis, which is an effective tool in R&D decision points. The decision tree analysis takes into account probabilities of uncertain outcomes at each milestone, and potentially resulting decision options. These decision trees also acts as a communication tool for portfolio management, for project management and line functions.

For balancing the portfolio in terms of risk and identifying gaps in the pipeline, company used risk reward matrix, bubble diagram, and scoring models. Visual charts are used to display the probability of success and time-to-market at different development stages. Company does not use very consistent tools and techniques for portfolio selection, rather the tools used are fairly simple and tailor-made according to the need of the organization. The company also uses various characteristic of the portfolio such as risk and value and is displayed through various diagrams and pie charts.

4.2.1.3 Process of Project Prioritization and Communication

Once the portfolio of projects is selected the projects need to be ranked within the portfolio, which is consistent with the concept of project prioritization. Projects are prioritized and are placed in four categories which are high priority category, time to delivery category, not so critical and on-hold category. The projects are then ranked within these categories. The prioritization decisions are made by governance bodies.
which are MS3 committee and PRB. Prioritization is done based on various criteria such as medical need, value proposition, return on investment, risk, strategic need, competitiveness, opportunities to develop quicker, need to cover the gap in the development and various other characteristics. The projects are placed in these categories based on the judgment of the governing bodies after the analysis of the data. Portfolios of projects are reviewed twice a year in portfolio review meetings in order to ensure that the projects within portfolio meet the assumptions and requirements that were made at the start of the projects. The results of the meetings are fed back to the strategy to ensure alignment of projects with the strategy.

Once the projects are prioritized, these priorities need to be communicated to all the people concerned. The company uses the communication matrix, monthly meetings on operations and also priority planning groups. The priorities are communicated during these meetings and later on minutes of meetings are sent to all the concerned people with the relevant details.

### 4.2.1.4 Process of analyzing the portfolio

After selection and prioritization of the portfolio, analysis and review of the portfolio is done twice a year in portfolio review meetings. The process of evaluation takes into consideration both quantitative and qualitative evaluations of individual projects. The quantitative evaluation may include time to launch, probability of launch, and risk-adjusted cost. Further to these evaluations following factors are taken into account.

- Evaluation of the overall pipeline of projects taking into account their distribution across different developmental stages, identification of gaps and the need for in-licensing and out-licensing and frequency of expected future launches. In-licensing is done to fill the gap in the pipeline or for substitution to increase the value of the pipeline, whereas out-licensing is done to share the development risk or when company don’t have the resources to execute the projects.

- Prioritization of projects are done based on pre defined multiple criteria. These projects may be ranked high or low based on these multiple criteria, these criteria may be risk profile, sales volume, value and time to market.

- Identification and review of projects according to firmly assigned resources, review of remaining budget and capacities that are subject to re-allocation.

### 4.2.2 Portfolio Reporting

An effective portfolio management process also needs an effective reporting procedure to take a follow up on actions and decisions taken at the operational level. Reporting of the progress of the projects towards the portfolio is done on monthly basis for research part and for development part reporting is done on quarterly basis by using similar template and few parts of the report may be modify according to need by the top management. These reports are collected from project management system, financial system and
portfolio management system. All these reports are pulled by the Portfolio Management Group (PMG) which combines these reports. This information is then disseminated in portfolio review meetings and pre read meetings, and are then analyzed and review by the board. The company also have a standard template of reporting of key performance indicators (KPIs), there also exists one performance report for the whole organization and that is called R&D performance report, these performance reports includes performance of the whole organization. These reports are then sent to all relevant people, further these project priorities are also sent through emails.

4.2.3 Portfolio Decision Making

The decisions about the portfolio in the pharmaceutical company are made in the face-to-face setting and come out as a joint management decision where group of people from different background like finance, marketing, development, research, statisticians comes up with common decisions. The decisions about the portfolio are made by governing bodies based on analysis of the objective evidences. In order to make sure that the decisions about portfolio are made without individual biases. The decisions are not made by individuals rather are made by the project review board (PRB), committee review board (CRB), and senior executive teams (SET).

At the project level, project review meetings are conducted where every project is represented as individual business case, and is presented to the governance bodies. These project review meetings are carried out every month where these projects have to pass through decisions points. These decision points ensure that only the projects with strong link to strategy are continued and the rest being dropped from the portfolio. We also found that no decision support system (DSS) exists for the decision making, but company employs a framework that outlines the productivity goals and growth. The therapeutic area focus serves as the guideline for portfolio decision making.

4.3. Project Portfolio efficiency in Pharmaceutical Company

When we asked about the impact of using these control techniques on portfolio efficiency we observed that these techniques affect portfolio efficiency both at project and program level. These techniques also affect the value, and help to improve productivity by increasing the value and reducing the cost by effective utilization of resources.

4.3.1 Impact of using portfolio control techniques on achieving results

We tried to measure the impact of using these control techniques on achieving results in terms of customer satisfaction, financial results and combined cost, time and quality. We found that it is difficult to measure the financial impact in pharmaceutical industry in short term as development life cycle is 10 to 15 years rather can be measured only in long term as it has long payback period. The impact of these techniques is measured by observing lead time in each phase, measuring volume and flow of projects at each stage,
measuring rate of projects, and deliverables. Gating process confirms that the product produced meets the customer requirements and will satisfy the customer. Most of the analysis is done before the release of the project. Moreover it was found that these control techniques helps to improve productivity, efficiency, business results, company performance, increase in market size, cost, value and new product launches.

Respondent 1

“In my opinion these portfolio control techniques have impact on overall organization productivity, efficiency, business results, company performance that also includes financial results. We measure the impact of these techniques in terms of productivity of the projects and these techniques also help us to design lean projects and give maximum return”.

“Product development life cycle is 10 to 15 years and it’s a long time to get the money back in terms of financial results. It is not very easy to measure impact of portfolio techniques in short term in terms of the financial results. The Gating process confirms that what we are producing will make our customers happy.”

4.3.2 Impact of using portfolio control techniques on achieving purpose

We also tried to measure the impact of using these control techniques in terms of achieving their purpose set for their projects and program. We found these techniques helps in achieving their results, in achieving project milestones and meeting their budget. Furthermore, it helps to meet the stakeholder expectations in terms of profitability. As project portfolio is all about balancing the priorities of the organizations so some projects and programs needs to be speed up at the expense of the others and others need to put on hold.

Respondent 1

“Yes these techniques help in achievement of project and program level purpose but in terms of timeline I believe that it is a compromise, certain programs are speed up and some programs have to be delayed or put on hold depending on the priority.”

4.4 Contextual Factors effecting Portfolio efficiency in Pharmaceutical Company

The contextual factors like project types, co-localization of team members were found to affect the portfolio efficiency. The pharmaceutical industry is a portfolio driven organization and members of the Portfolio Management Group (PMG) and project teams are located in different parts of the world that hinders the productivity of the employees and have impact on achieving the results and achieving purpose. Furthermore, the communication was found to be the dominant factor in effecting portfolio efficiency.
The organization is involved in internal new product development projects that can be categorized as small molecule type and large molecule type, projects related to in-licensing, out-licensing and product-line extension projects. It was found that the biological projects are more successful than other types of projects. Hence, the project type also plays a role in affecting portfolio efficiency.

Respondent 1

“In my opinion, Global working environment does not work very well. I think the project teams should be localized and also the communication among the multicultural team member plays a significant role in achieving our results. Various project types are more successful than others, for example biological projects are more successful than other types of projects.”

4.5 Transportation Company

4.5.1 Company Overview

Transportation Company is the global leader in the rail equipment manufacturing and servicing industry. They employ 36,000 people and have manufacturing facilities in 24 countries. Transportation Company is a unit of incorporation a Canadian-based diversified manufacturing and Service Company. In addition Transportation Company succeeds through the delivery of projects. It has more than 600 major projects running in parallel at any one time, plus several hundreds of smaller projects. Its wide range of products and services include passenger rail vehicles, total transit systems and a comprehensive portfolio of rail systems including integrated control systems, computer and relay based interlocking, automatic train control systems and wayside equipment. The company delivers a unique product or service to specific, well-known customers. The company also applies specific contracts under specific conditions and work in dedicated teams. Rail Control Solutions (RCS) has a strong skills base of 2,000 employees working in Research and Product Development, Engineering, Safety Assurance, Service and Maintenance, with more than 200 employees based in Bangkok.

Furthermore, over the past decades, its project portfolio has changed both in terms of size and complexities as well as customers’ needs have evolved into ever more challenging requirements leading to more complex projects with full system responsibility, wider scopes, tighter delivery schedules and longer term commitments. The internal environment is challenging with multi-site and multi-divisional projects.

4.5.2 Concept of Project Portfolio in Engineering and Contracting Transportation Company

The problem in engineering and contracting companies is there are too many projects to bid and having insufficient resources to execute the project. Therefore, they want to select and bid for only those projects that give the organization maximum return. For this
reason, the concept of portfolio is gaining more and more importance within the engineering and contracting companies in order to make decisions about which projects be given priority, which projects needs to be removed from the portfolio and which other projects to be added. The ultimate goal using the concept of project portfolio is to select the portfolio of projects that meets the strategic objectives of the organization, provide maximum financial gain with minimum level of risk.

4.6 Project Portfolio Control in Transportation Company

During the interview with the respondents about the portfolio control techniques it was found that the concept of portfolio control is not very much widely used in the organization and has its limited role at the top management level and are applied only at Product Strategy and Sales Phase.

The integrated processes and project life cycle of Transportation Company consists of three phase which are Product Strategy & Sale, Project Initiation & Planning and Project Execution & Control and is shown in Figure 4.4.

![Figure 4.4: Integrated processes and project life cycle](image)

The company uses external delivery projects for its business purposes and wants to bid for only those projects with the maximum return and meets the strategic objectives of the organizations. The company under consideration is a project based organization whose strategy is to maintain multiple relationships with its clients and to create future demand for projects. The discussion of using these control techniques is based on the replies from the respondents.
4.6.1 Portfolio Selection

The selection of project within the portfolio involves people from top management level down to project management level. As portfolio selection is done before the bidding process so the respondents considered process of project selection within the portfolio a very complex decision-making process as it involves comparison of technical and commercial feasibilities. During the selection process they need to consider many critical factors such as probability of technical success, market conditions, government regulations, raw materials availability and various other factors mutually agreed by the top management. Another hurdle identified in project selection was to achieve the consensus among all the members involved in project selection, as it involves multiple groups—from different professional background, social experiences and different cultures therefore having different preferences.

The company considers various aspects before forming the portfolio; these aspects include financial analysis, risk analysis, interdependencies, prioritization, alignment and selection, constraints, impact on organizations and problems within organizations. The company has its own gating model where every project has to pass through certain criteria to enter into the portfolio. In order to ensure alignment of the projects with the strategy the organization uses a document called capture plan. The key aspect of the capture plan involves check list of questions regarding Customer strategy, Pricing strategy, Product strategy and Partner strategy. To yield the right balance of projects and investments various criteria such as project type, market sector and product lines are being considered. Financial criteria were found to be given the highest priority while selecting portfolio.

Once the portfolio is selected then individual projects within the portfolio are prioritized by a scoring model. Weights are assigned to each criteria based on criticality and complexity. In addition, the weighing factor is set at the time of target setting, however may be reviewed and changed at each quarter during the review process. Ranking ordered list of projects is used to display and compare the relative attractiveness of the project. Various characteristics of the projects are used to give the overall score; the projects are placed into four different categories, category A, B, C and D based on the analysis of the qualitative and quantitative data. The projects are then placed according to its score into each of four categories. Risk and financial criteria was found to be most dominant factors to be considered in project ranking. The risk was categorized as political, financial, strategic and customer risk, and the organization uses a checklist having Yes/No questions within each category to rank the projects into high, medium and low category. Company also uses pie charts and bubble diagrams to display the probability of success and commercial attractiveness of projects at different stages of the project life cycle. The review of the portfolio is done on a quarterly basis in which new projects may enter the portfolio others may be put on hold or removed from the portfolio.
4.6.2 Project Portfolio Reporting

The organization generates two kinds of reports which are monthly operational review reports (MORR) and project portfolio reports (PPR). MORR is a standardized, central report that provides an overview of project critical data and also an overview of key performance data and trends across the projects. The key aspects of these reports provides information about project status, financial information, adherence to schedule, projects key performance indicators (KPIs) and trend analysis. Project Portfolio Reporting System (PPRS) provides accurate and reliable information about all projects in one system. Data can be accessed and filtered to generate reports for single projects or selected groups of projects or portfolios across divisions or the company. The PRR provides information about financial, procurement, and risk and opportunities. PRR also helps the organization to make decision about which projects to be added or removed from the portfolio and which projects needs to be given priority.

The MORR are reported by project managers of the division and is supported by the Project Portfolio Reporting System (PPRS). The PPRS is a web-based tool designed to standardize and speed up reporting. These reports are pulled by divisional portfolio managers who analyze and interpret the underlying issues and then reports to divisional Head of Project Management. The reporting of the portfolio is done on a monthly basis and is presented in the meeting to the top management including the president of the division. The minutes of meeting are then sent to all concerned through emails with relevant details.

4.6.3 Project Portfolio Decision Making

Decisions about portfolio are done in face-to-face meeting, are held quarterly and are reported as a joint management decision. These portfolio decisions are about selection, termination, and deletion of projects from the portfolio, requires a long-term vision and involve analysis of large amount of uncertain information. The decision committee consists of people from different educational and professional background and also involves different departments. Joint decision making helps the committee to make the right decision and in the best interest of the organization without individual biases. These portfolio decisions are not only based on individual project characteristics but are viewed from the context of the whole portfolio and achievement of strategic goals. The result of poor portfolio decisions can have extremely negative impacts on portfolio performance, affects long-term growth of the organization and results in loss of long-term competitive position. These face-to-face meetings also allow an easy exchange of knowledge transfer and share of best practices and ideas across the divisions.

4.7 Project Portfolio efficiency in Transportation Company

The company also measures the impact of using these portfolio techniques in terms of portfolio efficiency. The organization measures the portfolio efficiency against the
common predefined standard set of criteria, return on investment, increased value, but our analysis is restricted only on achieving results and achieving project and program level purpose.

4.7.1 Impact of using portfolio control techniques on achieving results

We tried to measure the impact of using these control techniques on achieving results in terms of customer satisfaction, financial results and combined cost, time and quality. We found that the organization is most concerned with financial gains in terms of measuring the impact of portfolio control techniques; however also they do measure customer satisfaction and cost, time, and quality aspects. Yang and Peng (2008) defines the satisfaction as a weighted average of three survey ratings: perceived quality, perceived value, and customer expectations. The respondents replied that they are very much satisfied of using these portfolio control techniques as their net income has increased almost as thrice in 2008 to around US $1 billion as compared to their income in 2007. These control techniques have also helped the company to improve stakeholder satisfaction, as level of stakeholder satisfaction directly impacts the current project and subsequent projects. Specially, the customer satisfaction helps to gain new projects.

Respondent 4

“We have a well defined system of measuring the impact of using the portfolio techniques and we measure them in terms of customer satisfaction and most emphasis is on achieving financial results and these have helped us in achieving the desired results which is evident from our financial results.”

4.7.2 Impact of using portfolio control techniques on achieving purpose

We also tried to measure the impact of using these control techniques in terms of achieving their purpose set for their projects and program. The portfolio techniques help in achieving project and program level purpose. It also provides information about the resource availability from the pool of resources and helps in performing internal capability analysis.

The measurement of these aspects is done by evaluating the performance of the projects and program. The outcome of using these techniques should result in fewer projects related problems, gaining more customers, expansion in new markets, learning and transfer of knowledge from one project to another.

Respondent 4

“Yes, these techniques have helped us in achieving our project and program level purpose and has resulted in fewer project related problems.”
4.8 Contextual Factors effecting efficiency in Transportation Company

The contextual factors such as project type, complexity of the project, organizational structure, multicultural team members, and clarity of project and program goals were found to affect the portfolio efficiency as they affect achieving result both at the project and program level. Communication was found to be the most significant factor affecting portfolio efficiency.

The Transportation Company is a project based organization and is involved in external development projects that can be broadly categorized into two main types which are main line solution projects and mass transit solution projects. The main line solutions involve main railway line projects while mass transit solutions are high capacity light rail/metro system projects. We found Mass transit solution projects are more successful in Europe whereas the main line solution projects are more successful in Asia region. Hence, the project type and governance type also plays a role in affecting portfolio efficiency.

Respondent 4

“In my opinion clarity of project and program goals, organizational structure, multicultural team members, and communication has impact on achieving project and program level purpose.”

4.9 Challenges and advantages associated with Project Portfolio Control Techniques

The respondents were asked to explain the challenges associated with portfolio control techniques in the pharmaceutical industry and engineering and contracting company and how they can be effectively applied in the organizations. We found that these challenges are more extreme in the pharmaceutical industry as it is a very risky business and most of the good opportunities for R&D in the pharmaceutical have already been picked up and new opportunities are hard to find. The reply from these respondents is stated below.

4.9.1 Challenges of Portfolio Control Techniques

The pharmaceutical business is very risky, have long times in drug development, very low success rate of projects, and high attrition rates. We found that these portfolio control techniques have some challenges associated with them. These techniques cannot quantify uncertainty, risk associated and value in the portfolio selection process, as the whole process is based on the sales forecast and predictions. Also, it over emphasizes the financial aspects in business. These techniques over simplify the reality, gives a simplified picture and fails to take many variables into account as characteristics like uncertainty and risk. Over simplification of the reality gives people a false comfort and these techniques should be used as a tool for decision making in order to facilitate the discussion. Hence, the decision makers should not rely solely on these techniques. These
techniques take into account large amount of qualitative and intangible information that needs to be analyzed, consequently increases the complexity. These techniques fail to consider the interdependencies among the projects. Internal stakeholders are not very much satisfied as it centralizes the decision making.

4.9.2 Advantages of Portfolio Control Techniques

The advantages of using these control techniques as identified by interviewees are;

- Maximize the value of portfolios through proper resource allocation, increase productivity in the company by designing lean projects that provide maximum return and reduce the systemic risk.
- Helps in prioritization of the projects and to maintain the business’s competitive position in the global market.
- Provides the link between project selection and business strategy.
- Helps to reduce resource conflicts and supports shared understanding.
- Helps in fast decision making, which is acceptable to majority of the people.
- Identify gaps, analyses risk and provides tracking of project progress.
- Optimization of projects and resources and to identify the outliers in the project portfolio.
- Helps in optimistic planning and provides satisfaction to external stakeholder in terms of increase profitability.

4.10 Key to successful implementation of Control Techniques

Support from top management is the key to effectively apply these techniques. Educating senior managers about these techniques will help them to understand the process and will further help to receive support from them for the effective implementation of these control techniques.

From the analysis of the interviews we found that the impacts of using these control techniques in project based firms is significant and the contextual factors which include project type, communication, organizational complexities play a major role in achieving results at both project and program level. The conclusion of our research will be presented in the next chapter along with theoretical and managerial implications.
CHAPTER 5

CONCLUSION

In this chapter, a summary of the study will be presented. Additionally, this chapter will discuss managerial implications, theoretical implications and limitations of the research. Finally, the recommendations for further research will be suggested.

5.0 Conclusion

We undertook the case study analysis, and semi-structured interviews were conducted to investigate the relationships between portfolio control techniques and portfolio efficiency. The impact of using these techniques on portfolio efficiency was investigated and the role of contextual factors in impacting the relationship between them was explored in successful organizations. The researcher’s conclusions drawn from the collection of data about relationship between portfolio control techniques and portfolio efficiency are presented. Müller et al. (2008) categorized portfolio control techniques in three main areas which are portfolio selection, portfolio reporting and portfolio decision making; the portfolio efficiency was categorized into achieving results and achieving purpose.

The research was conducted at two multinational organizations, a Pharmaceutical Company in Europe and an Engineering and Contracting Transportation Company in Asia. Both are world leading organizations which rely on project portfolio management for an effective management of their projects in order to maintain their competitive positions. According to Lycett et al. (2004) project portfolio management concentrate on entire portfolio of projects with the intention to make decisions about which projects be given priority, which projects be selected or rejected from the portfolio. Therefore, organizations are paying greater attention to project portfolio control techniques in order to meet their strategic objectives and achieving their goals.

The interviews conducted at the Pharmaceutical Company revealed that the concept of portfolio control techniques is well understood, apply simple but tailor-made portfolio management tools, and these tools are applied through the entire drug development process. On the contrary, in the Transportation Company the concepts of portfolio control techniques are not very well understood, not widely applied across the organization rather applied only at product strategy and sales phase by the top management.

According to the aims of the research an extensive amount of literatures was reviewed by researchers to answer the research question, the research focuses on the qualitative study. The research question is stated as;
“How project portfolio control techniques helps in achieving efficiency in project based firms?”

Semi-structured interviews were used to collect data and were analyzed using data display method of analysis to answer the research question. Seven respondents were selected for the interviews that are either involved at portfolio level or project management level. The research question has been answered in two parts; first part is related to how these control techniques helps in achieving efficiency and in the second part, we tried to find the relationship between portfolio control techniques and portfolio efficiency. The portfolio control techniques provide a systematic process for managing project portfolios according to Cooper et al. (2000) stated that “the businesses who implement a systematic process for managing their project portfolios clearly outperform the rest”. These techniques help to select and analyse the portfolio from strategic, financial and risk perspective. Also, it helps to balance the organizational priorities by taking into consideration project type, market sector, resource constraints and product lines.

The portfolio control techniques also involve portfolio reporting which is considered a formal way of communication and information sharing as researched by Fricke & Shenhar (2000); Nobeoka &Cusumano (1997) which showed the link between information sharing and performance in multiproject settings. Lastly, portfolio decision making helps the organizations in making the right decision in the best interest of the organization. During the investigation all these control variables were found to have a significant impact on achieving results and achieving project and programme level purpose, which in our research are the dimensions of portfolio efficiency.

In the second part of the research question we tried to find the relationship between the portfolio control techniques and portfolio efficiency. In our study we found that there are indications for the existence of a positive relationship between the portfolio control techniques and portfolio efficiency which is affected by the contextual variables which are project type, governance type, organizational structure, co-localization of team members, communication and clarity of goals and objectives.

The data analysis and findings also illustrated that in both organizations the portfolio control techniques have a significant impact on portfolio efficiency whereas the contextual factors plays an important role affecting the portfolio efficiency. The impact of improper use of these control techniques can be more severe in portfolio driven organizations as compared to its impact on project driven organizations. We also found the extent of use of these control techniques differentiates successful organizations from less successful organizations depending on their governance structure. Müller et al. (2008) mentioned that successful organizations measure the performance of their portfolio by looking at the extent to which it achieved desired portfolio results, and achieved project and program purpose.
From the holistic point of view, the findings of our research are depicted in Figure 5.1 that explains there exists a positive relation between portfolio control techniques and portfolio efficiency and the relationship is being affected by the contextual factors.

![Diagram of Portfolio Control Techniques and Portfolio Efficiency](image)

**Contextual Factors**

Figure 5.1: Relationship between portfolio control techniques and portfolio efficiency

We found that both companies has project portfolio management system in place that provides the centralized view of all the projects in an organization, enables the top management to perform financial and risk analysis of projects, specify the resource constraints, enable selection and prioritization of projects, and identify the interdependencies among the projects. These portfolio methods ensure accountability, optimization and governance at the portfolio and project level. The analysis of data showed that application of these portfolio control techniques have resulted in the achievement of their results and also the achievement of program and project level purpose. The efficiency of the portfolio is also dependent on the project types, governance, environmental complexity, organizational structure, clarity of project and program goals, and co-localization of team members. The communication plays a significant role impacting portfolio efficiency in multicultural organizations. The proposition that there exists a positive relationship between portfolio control techniques and portfolio efficiency is supported qualitatively by our research. Our result also supports the integrated framework of portfolio management by taking into account the practices of portfolio control and organizational context simultaneously. However, we believe that in Transportation Company, trainings on portfolio control techniques will result in improved efficiency and effectiveness both at the portfolio as well as at the organizational level. In addition, while managing the portfolio at least the governance mechanisms should be taken into consideration apart from other contextual factors. Our results revealed organizations with different governance structure differ in their use of
these control techniques, in portfolio driven organization these techniques are applied through the entire development process whereas in project driven organizations these are applied only at the Product Strategy & Sale phase.

5.1 Theoretical Implication

The research reveals three project portfolio control mechanisms and its relationship to portfolio efficiency. The findings of the empirical research supported and confirmed the proposition about the relationship between portfolio control techniques and portfolio efficiency. The result supports the existing theory and supports the link between portfolio success and organizational strategy. The study also provides a qualitative explanation of the relationship between portfolio control and portfolio efficiency in a project driven and portfolio driven organization which is supporting the work of Müller et al. (2008) who investigated the nature and relationship between portfolio control techniques and project portfolio management performance quantitatively.

The research also provides an in depth knowledge and comparison of two organizations having different governance structure, how they differ in using these control techniques and how they are applied to the internal development and external development projects. This also highlights the importance of communication while working with multicultural teams that has significant impact on portfolio efficiency. The result explains the importance of portfolio selection and gating process in pharmaceutical industry whose future revenue is highly dependent upon the new innovative R&D projects. The results of poor portfolio decisions in pharmaceutical industry can have extremely negative impacts on portfolio performance and can affects long-term growth of the organization. The explanation also supports the importance of gating process and joint management decision in face-to-face settings during project portfolio selection to improve decision making process. In addition, prior research mentioned that single-project management contributes to project portfolio management efficiency and found that availability of information for decision makers on projects is the most significant project-level factor contributing to portfolio management efficiency both directly and through project management efficiency (Martinsuo and Lehtonen, 2007). These Portfolio control techniques also provide a perspective of long-term corporate growth and profitability in portfolio driven organizations, and emphasis its strategic importance while evaluating and selecting the portfolio of projects. The result also showed the challenges and advantages associated with these portfolio control techniques in the pharmaceutical and engineering and contracting transportation company especially linking active projects to strategic goals, adding value to project and balancing portfolio. In short the role of project portfolio is unavoidable in the multi-project organizations.

5.2 Managerial Implication

The results of the study helped the researchers to identify and specify the following recommendations for best practices. The information will be useful for companies’
already using portfolio management system for selection of their projects and organizational planning to improve their portfolio efficiency. The recommendations made are as follow;

- Create common template for reporting and decision making.
- Educate senior managers about these techniques to help them in efficient decision making.
- Portfolio reporting should be done by using similar templates in order to compare results on similar basis.
- Decisions should be made in groups to avoid personal preferences of individual managers and to make the project selection in the best interest of the organization.
- The members who get involve in the decision making process should belong to diverse educational background and experience for improved go/no-go decisions about the projects and also to make a better portfolio review.
- Portfolio decisions should be made after careful analysis of the pros and cons of different mixes of priorities.
- The members who get involve in decision making should be active participants and not only information providers. The levels of flexibility and formality in team discussions must be determined.
- Portfolios reviews should be done periodically.
- For implementation of complex decisions, suggestions from all the members should be taken into consideration to maximize acceptability of decisions.
- There is a need for a centralized system in the organization to provide information on all the projects. This centralized system should be capable of collecting and disseminating information about all the projects and to all concerned people.
- The selection of projects to form a portfolio should ensure that it covers all area of strategy and portfolio is well balanced.

5.3 Strength and Research Limitations

The strength of our research is that the interviews were conducted at Pharmaceutical Company and Transportation Company, having different governance structure (portfolio driven and project driven) and different types of projects (internal and external). Therefore, the research provides an in depth knowledge of different portfolio practices in different types of organizations. The interviews were conducted in Europe and Asia regions so our research demonstrates the impact of geographical location on portfolio efficiency. Moreover, reporting and decision making styles in the two regions are different so it explains about contextual variables and its impact on portfolio efficiency. Both organizations have world class reputation in their respective industries so the study identifies best practices and filtering out the unsuccessful practices.

The weakness in our research is that in both organisations the portfolio management process is not recorded in any official document or handbook. Thus, the results and discussions are based on interviewee’s experiences which are subject to participant bias.
The research is a small-scale investigative research and is aimed at understanding the concept of project portfolio control techniques and its impact on portfolio efficiency therefore various other aspects explaining portfolio efficiency may have been left unexplored. In both the organizations the interviews were conducted only at one department that might have refrained researchers from getting the diversified view of the portfolio management. Moreover, the access to many documents was restricted due to company’s confidentiality, also few questions were not answered by respondents due to nature of sensitivity of the issues. Another weakness in our research, the interviews were conducted at only two organizations so the results of the research are not generalizable but are context specific. Also, according to epistemological considerations the research findings are based on authors’ beliefs and perceptions of reality therefore the conclusions drawn may be flawed by researchers own knowledge of key concepts.

5.4 Suggestion for Further Research

In our research, dimensions of portfolio efficiency were limited only to achieving results and achieving purpose therefore, other dimensions of portfolio efficiency needs to be investigated. In addition, in term of research process, cross-sectional study was conducted and data was collected through semi-structured interviews we suggest further research by collecting both qualitative and quantitative data and longitudinal studies be conducted in order to increase reliability and validity of the results. Furthermore, the investigation should be conducted on a large scale in order to make the results more generalizable for example, involve respondents from different departments, educational and professional background. As different organizations have different processes, strategies and perspectives, comparative analysis of different organizations should also be conducted to get overall picture, to compare different project portfolio control techniques among companies and how they apply portfolio control? Which methods they use?, etc. The results of our research are based on the propositions that stimulate further research. The relationship between portfolio control and portfolio efficiency is affected by the contextual variables. These contextual variables need to be investigated in detail.

In conclusion, the present study has contributed to the knowledge of portfolio management by supporting the existing theory and at the same time expanding the existing knowledge by identifying the ways of achieving portfolio efficiency through portfolio controls. This also helps managers involved in portfolio selection, reporting and decision making and to make them realize the importance of contextual factors that cannot be neglected in order to improve portfolio efficiency in project based firms.
REFERENCES


APPENDICES

Appendix 1: Semi-Structure Interview Question Guide

November 17, 2009

Dear Sirs/Madams,

This research is a part of an MSc Strategic Project Management (European) dissertation of Heriot-Watt University, Edinburgh (United Kingdom), Politecnico di Milano (Italy) and Umea University, Umea (Sweden).

This purpose of this research is found out how project based firms use project portfolio control techniques in achieving efficiency. In our research the unit of analysis will be firms using project control techniques. All data will be used for academic purpose and will be kept confidential.

Thanks for your cooperation.

Respectfully yours,

Karivate, Pattharawan

Rizwan, Muhammad

MSPME Student, 2009
Semi-Structure Interview Questions

Part I: Interviewer background

1. What is your current position in the organization?
2. What are your current roles and responsibilities?
3. How long have you been working with projects?
4. How many projects are conducted from the proposed projects in the departments?
5. How long each projects on average?
6. How many people involved in each project? Who is involved in each project? What are their roles?
7. Can you explain me about how you organize the project and how process work?
8. Can you tell us what kinds of training methods were available before you manage the projects?
9. Have you been facing any problems in the projects? How are these problem resolved?
10. Are there any aspects that needed to improve? Please explain.
11. If we ask you to give a general evaluation how you organized project, what would to say about it?
12. Why do you think these projects are success? Please explain the success criteria?
13. What are the factors that lead to the success of these projects?
14. From how and where you receive your project proposals?
15. What are the minimum criteria for the projects to be considered? e.g financial result
16. What are the type of projects you undertake? and how you categorize them?

Part II: Portfolio control techniques

17. Have you ever heard about portfolio control techniques? If Yes, Please explain
18. How do you know about it?
19. Do you have any idea that what are portfolio control techniques affect to? If Yes, How?
20. Which tools and techniques you use to optimize the portfolio? (Maximizing the value of the portfolio, Achieving the Right balance and mix of projects, Linking strategy with projects)
21. How project are selected based on the organization’s strategy? {portfolio selection}
22. Do you use any framework for portfolio selection?
23. How projects are prioritized? {portfolio selection}
24. How project priorities are communicated? {portfolio selection}
25. How projects are reported toward the portfolio reporting using similar templates and similar metrics? {portfolio reporting}
26. Which tools are used for collecting and disseminating status of all high-priority projects? {portfolio reporting}
27. How decisions are made regarding the portfolio? (face-to-face settings, joint management decisions) and what is the procedure? {portfolio decision making}

28. How you ensure decisions are made in the best interest of the organization without individual biases and use of power?

29. Do you have any decision support system for selecting the portfolio? If yes how does it works?

30. What would you say are there any advantages and drawbacks of portfolio control techniques?

31. Has portfolio management changed your way of managing projects? How? Please give some examples

32. How you measure the impact of using these portfolio control techniques? Please give some examples.

33. Any recommendation about how to effectively apply portfolio control techniques to your projects and ways you consider to improve your system?

34. How often you take review of your selected portfolio?

35. Are you satisfy or dissatisfied with portfolio management? In which process?

36. What others have portfolio control techniques brought to you?

37. What others factors that you think it would be affect to efficiency in your project? (example factors: project types, governance types, geography, organization, etc)

**Part IV: Portfolio Efficiency**

38. Do implementing portfolio techniques help in achieving results? (which includes customer satisfaction; combined time, cost, and quality results; financial results; and user requirements) and how you measure each of these dimensions? Can you provide us some data on these aspects?

39. Do implementing portfolio techniques help in achieving purpose? (deals with achieving both project and program-level purpose) How you establish program purpose and how you measure them?

40. Do implementing portfolio techniques help in balancing priorities? (which includes resource retention timely accomplishments of programs; and stakeholder satisfaction) and how you measure these aspects? Can you provide us some data?

41. Were there any other benefits that you gained from portfolio control techniques?

42. Would you prefer the information from this interview to be disclosed with the name of your Company or anonymously?

43. In case we need further clarification regarding the interview, would it be possible for us to contact you again by email?
APPENDIX 2: The Analysis Matrix

Summary of Project Portfolio Control Techniques apply in Pharmaceutical Company and Transportation Company

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Portfolio Selection</th>
<th>Portfolio Reporting</th>
<th>Portfolio Decision Making</th>
<th>Achieving Results</th>
<th>Achieving Purpose</th>
<th>Contextual Factors</th>
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<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>- Tools: NPV, IRR, ROI - Scoring Model, Bubble Diagram - Gating Model</td>
<td>- Monthly Report, Quarterly Report - Portfolio Review (twice a year) - Similar Template and Metric - Project and Portfolio Reporting System</td>
<td>- Face-to Face meeting - Joint management decision - Decisions based on objective analysis - Decisions are made during project review meeting - No DSS</td>
<td>- Help in achieving customer satisfaction - Combined time, cost and quality results - Financial results cannot be measured in short term - Impact of portfolio control techniques is measured by observing lead time, volume and flow of the project</td>
<td>- Help in achieving project &amp; program level purpose - Help in improvement of productivity and value create</td>
<td>- Project Type - Project Governance - Co-localized of team member - Communication</td>
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<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>- Tools: NPV, Expected NPV, Peak Year Sale - Risk Scoring Model, Bubble Diagram, Decision Tree Analysis - Gating Model</td>
<td>- Monthly Report, Quarterly Report, Pre-read meeting - Portfolio Review (twice a year) - Similar Template and Metric - Project and Portfolio Reporting System</td>
<td>- Face-to Face meeting - Joint management decision - Decisions based on Objective Analysis - Decisions are made during project review meeting, No DSS - Decisions are made by PRB, CRB, SET</td>
<td>- Help in achieving customer satisfaction - Combined time, cost and quality results - Financial results cannot be measured in short term</td>
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<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>- Tools: NPV, Peak Year Sale, PBM, ECV - Risk Log, Bubble Diagram, Decision Tree Analysis - Gating Model</td>
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<td>- Project Type - Project Governance - Co-localized of team member - Communication</td>
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<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>- Tools: NPV, IRR, ROI - Risk Analysis - Interdependencies - Constraints - Impact on organisation - Problems within organisation - Gating Model</td>
<td>- Monthly Operational Review Reports - Quarterly Report - Project Portfolio Reports - Key performance Indicators - Project Portfolio Reporting System</td>
<td>- Face-to Face meeting - Joint management decision - Decisions based on Objective Analysis - Decisions are made based on long term vision - Decision committee involves people from diverse background and different departments - No DSS</td>
<td>- Help in achieving customer satisfaction - Combined time, cost and quality results - Financial result - Stakeholder satisfaction - Impact on current and subsequent projects</td>
<td>- Help in achieving project &amp; program level purpose - Help in performing internal capability analysis - Availability of resources</td>
<td>- Project Type - Project Governance - Environment Complexity</td>
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## Portfolio Control Techniques

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<th>Portfolio Decision Making</th>
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<th>Contextual Factors</th>
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### Contextual Factors
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- Project Governance
- Environment Complexity
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<td>- Face-to Face meeting&lt;br&gt;- Helps knowledge transfer and share of best practices&lt;br&gt;- Joint management decision&lt;br&gt;- No DSS</td>
<td>- Help in achieving customer satisfaction&lt;br&gt;- Combined time, cost and quality results&lt;br&gt;- Financial result</td>
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