OPERATIONAL FLEXIBILITY: A MODEL FOR EFFECTIVE PROJECT MANAGEMENT

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Operational Flexibility: A Model for Effective Project Management

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This is to certify that the thesis entitled "**Operational Flexibility: A Model for Effective Project Management**" is the record of bonafide research work done by Mr. George Joseph under my supervision and guidance at the School of Management Studies, in partial fulfillment of the requirements for the Degree of Doctor of Philosophy under the Faculty of Social Sciences, Cochin University of Science and Technology. It is also certified that all the relevant corrections and modifications suggested by the audience during the pre-synopsis seminar and recommended by the Doctoral Committee of the candidate have been incorporated in the thesis.

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Declaration

I, George Joseph, hereby declare that the thesis titled **"Operational Flexibility: A Model For Effective Project Management",** submitted to Cochin University of Science and Technology under Faculty of Social Sciences is the record of the original research done by me under the supervision and guidance of Dr. Zakkariya K.A., Associate Professor, School of Management Studies, Cochin University of Science and Technology. I also declare that this work has not been submitted elsewhere for the award of any degree, diploma or any other title or recognition.

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List of Abbreviations

AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
CIT	Critical Incident Technique
EFA	Exploratory Factor Analysis
EWS	Economically Weaker Sector
GST	Goods and Service tax
IDFC	Infrastructure development and finance company
IRDA	Insurance Regulatory and Development Authority
IRRs	Internal rates of returns
KMO	Kaiser Meyer Olkin
LARR 2011	Land Acquisition, Rehabilitation & Resettlement Bill 2011
LIG	Lower Income Group
NBFC	Non-bank financial companies
NREGS	National Rural Employment Guarantee Scheme
PE	Private Equity
PLS	Partial Least Square
REIT	Real Estate Investment Trust
REMF	Real estate mutual fund
SD	Stamp duty
SEM	Structural Equation Modeling
ST	Service Tax
UN	United Nations
VAT	Value-Added-Tax
VIF	Variance Inflation Factors

Chapter - 1

INTRODUCTION

1.1 Background

Construction projects all over the world have had often failed to complete on time, budget or in achieving stakeholder objectives, which strengthen the thinking that these projects are complex, uncertain and dynamic instead of long held view as being orderly and predictable.

Complex systems' point of view has been used by several authors to understand project environment. Baccarini (1996) recommends that complexity needs to be defined as 'consisting of many varied interrelated parts'. And he proposes that this explanation can be applied to any project environment pertinent to the project management process, such as organization, technology, environment, information, decision making and systems. Different project stakeholders have diverse interests, which have to be met for effectiveness of projects along with efficiency targets in order to complete the project successfully. When we look into the detail of project process it is found to be highly parallel. Many project activities are independent and may be executed in varied sequence or even simultaneously.

The weather may change the sequence of project planning and unforeseen events from environment (both micro and macro) may enforce further changes in the schedule. Therefore plans and schedules present an idealized linear depiction of what should take place, but not of what actually does take place. Thus, planning does not reflect reality.

Thus, there is an inherent mistake in the well-organized view of the project scenario. All supplies are assumed to be ready as per the project's schedule, which in reality is unreliable and all resources such as machines, materials, labour are supposed to wait or provide just in time with no mercy on supply chain delays.

Most of construction projects are subcontracted to variety of Individual firms with each sharing the same site location, supervision and time asking for a perfect synchronisation of activities. The construction industry is thus highly fragmented and its firms cooperate in ever changing patterns, determined mainly by the lowest bids, idle capacity, availability of manpower, materials, location of projects, etc. They are also interlinked, as every firm at the same time participates, cooperate and compete in more than one project, utilizing the same resources and space.

According to Kreiner (1995) the construction site is a workplace for cooperation and social interaction, in addition, due to the temporary nature, forms a highly transient social system. The workers at the construction project site is not hired by the owners of the project, but by various contractors and subcontractors and thus their commitment is divided between their own firm and the job at hand, often with the owner firm taking the highest priority, which in turn adds on to the complexity in managing projects. So more than complexity, chaos may be the right word to define project environment.

Project managers always confront the conflicting goals of keeping their projects focused and supporting their organisation's necessity to adapt to change and ambiguity in the project-business environment. The focus on stability and efficiency in project management is questioned and disturbed in uncertainty Kreiner (1995), creating "drifting environments". These drifting are a direct consequence of project stakeholders gaining a better

understanding of their own actual needs and improved ability to express the needs. Flexibility is thus often considered as character of projects, in response to environmental uncertainty.

According to Kreiner (1995), even though flexibility is used in projects, it is practiced rarely with preparation. The existing project management knowledge is a practitioner driven theory, focusing on prescribing a methodology to the project manager for achieving efficiency and also recommend to minimize flexibility, once the initial phase is over, underestimating the impact of flexibility in effectiveness of projects, together which only one can measure the success of any project. In reality a project is expected to be flexible even after the initial phase, usually based on the demands of the project owners or users. While current project management theory recommends a stronger emphasis on the planning phase in order to be ready for the projects as early as possible. Thus it says more the preparation, lesser the uncertainty and complexity, putting a tunnel view on project success. The study on project related flexibility will have an impact on the existing project management best practices as mentioned in project management body of knowledge (PMBOK). According to Olsson (2006) it would be unrealistic to strive for eliminating flexibility from projects rather, it needs to be addressed with a priority seriously. The opinion on flexibility held by the different stakeholders seems to be driven by pain and gain of the stakeholders. In short, flexibility has varied demands from the stakeholders who benefit from changes and late locking of projects and hated by those incur a cost to adopt.

1.2 Operational Flexibility

Flexibility is a popular concept that is often used as a worthy attribute of any organization, a process, or a system. However, despite its popularity, flexibility the concept still suffers from overlapping types of

flexibility and has not received the scholarly attention on how to derive each one of them under various organizational settings, industries etc. According to Upton (1995), the concept of flexibility is 'vague and difficult to improve, yet critical to competitiveness'. Flexibility appears to be the next strategic weapon in the battlefield of competition (Parker and Wirth, 1999; Oke, 2005). It is an attribute contributing to firms' ability to survive and prosper in an uncertain and chaotic environment (Dreyer and Gronhaug, 2004).

Flexibility is a multi-disciplinary concept that has different meanings in various domains. According to Sethi and Sethi (1990), there are over 50 definitions of different types of flexibility in manufacturing contexts that are not very precise and still evolving. Intrinsic to the notion of flexibility, is the ability or potential to change and adapt to a range of states (Gupta and Goyal, 1989).

The common platform of agreement is that flexibility is needed in order to cope with uncertainty and change.The project environment is a near perfect example of how much uncertainty an environment can offer. Thus flexibility is one among the answers to cope with project uncertainty and change.

Many studies considered flexibility along three dimensions (Carlsson, 1989; Hayes and Pisano, 1994): (i) operational flexibility; (ii) tactical (or structural) flexibility; and (iii) strategic flexibility. Operational flexibility is often seen as a short-term flexibility potential pertaining to day-to-day operations (Galbraith, 1990; Johnson et al., 2003), or a routine manoeuvring capacity comprising routines that are formulated based upon existing structures and goals of an organization (Volberda,1997). This ability tends to be reactive in nature and enables firms to respond to changes

that they are familiar with in a timely manner. Such changes often lead to temporary, short-term fluctuation in firms' level of project activity (Carlsson, 1989). According to Volberda (1997), though the variety in the environment may be high, the sort of combinations must be realistically predictable so that a firm, on the basis of its experience and extrapolation, is able to develop certain routines to reduce any short-term uncertainty. According to Sethi and Sethi (1990) the firms' operational flexibility is a determinant of speed and cost of response, reinvestment, and degree of interruption in their existing systems and processes. Consistent with these, Johnson et al. (2003) pointed out that a higher level of operational flexibility enables a firm to shorten the time between planning and implementation through quick adjustments, and thus enhances the firm's ability to improvise and respond to short- term fluctuation.

Thus when we look at construction projects on a day to day basis, operational flexibility assumes greater significance on account of its ability to provide quicker adjustments to project environmental uncertainties and changes.

1.3 Knowledge Gap

Review of literature on flexibility reveals two main routes: Empirical and Analytical (Suarez, Cusumano, and Fine, 1991).

1.3.1 Empirical studies

The route that empirical studies take further branches into studies on taxonomies; data based; historical and economic analyses of flexibility.

1.3.1.1 Studies on taxonomies of flexibility

Research on flexibility is extensive and gathered momentum in the 1990s. One of the areas that have received much interest is the classification

of flexibility. Several authors have employed organizational, hierarchy, time based and other objective criteria to develop taxonomies (De Toni and Tonchia, 1998). The most popoular taxonomies use objective criteria is based on production system. These can be classified in two groups. The first group involves taxonomies by authors such as (Browne et al., 1984), (Sethi and Sethi, 1990), and (Gerwin, 1993). This involves criteria like machine, materials, production, volume, routing etc. Each type defined by the ability to carry out changes in other components mentioned above like machine, materials, and production plans with limited cost or time overun. As an example, Gerwin (1993) defined machine flexibility as the types of operations performed by the machine with easy switching.

The second group of taxonomies has used a more aggregated perspective to flexibility. Authors like Slack (1987); Bartezzaghi and Turco, (1989); Suarez et al. (1991), and Chen et al. (1992) have coincided on three major types of flexibility at the system level, namely (i) volume flexibility (the ability to operate economically at different production volumes), (ii) mix flexibility (the ability to change the variety of products in a period), and (iii) product flexibility (the ability to design new or modify existing ones). Additional types in each study included 'delivery flexibility' in Slack, (1987), 'readiness' in Bartezzaghi and Turco (1989), 'delivery-time flexibility' in Suarez et al. (1991), and 'expansion flexibility' in Chen et al. (1992).

The taxonomy of flexibility types as developed by Browne et al. (1984) has formed the foundation of manufacturing flexibility research. In an excellent review, Sethi and Sethi (1990) developed a category of fifty flexibility types. Product flexibility is the ability to switch over to produce new set of products with economy and speed Browne et al.

(1984).Essentially this means the ability to change the mix of products in current production which Carter (1986) refers to as mix- change flexibility.

1.3.1.2 Data based studies on flexibility and performance

This group is led by Suarez, Cusumano, and Fine (1991) and other scholars with backgrounds in economics and operations management. Over the last two decades, several studies have provided evidence for the relationship between flexibility and performance in operations. Authors like Swamidass and Newell (1987) found a significant relationship between manufacturing flexibility and growth in sales and profitability in a sample of 35 companies. Authors like Kekre and Srinivasan (1990) found evidence that product line breadth was linked to performance in market share and return on investment. While, Fiegenbaum and Karnani (1991) suggested that output (volume) flexibility was associated to extra profit in small firms, especially in industries under strong demand fluctuation. Narasimhan and Das (1999) found a significant relationship between modification (product customization) flexibility and manufacturing cost reduction in a sample of 68 companies.

Authors like Jack and Raturi (2002) found evidence to associate volume flexibility, and financial and delivery performance. Finally, Pagell and Krause (2004) replicated earlier studies by Swamidass and Newell (1987) and Pagell and Krause (1999) and found that increased flexibility led to improved performance. The main feature of this group is that authors have analyzed statistical data on flexibility in search of support to hypotheses. Jaikumar (1986) compared flexible manufacturing systems (FMS) in the United States and Japan and Tombak and Meyer (1988) collected a sample of 1445 business units. These are examples of the some studies of similar nature. Flexible manufacturing systems (FMSs) are

technologies combining the benefits of both computers and numerical control machine tools. Jaikumar (1986) finds that unlike Japanese firms, U.S firms generally don't fully use FMS systems. Tombak and Meyer (1988) finds flexibility as a variable positively affecting business unit performance with statistical significance.

Fiegenbaum and Karnani (1991) analyzed 83 industries in order to study the differences in volume flexibility among small and large firms. They conclude that it is small firms who demonstrate more volume flexibility and can trade cost inefficiency with volume flexibility to increase their profits. Their data proves that volume flexibility tends to be important in industries with volatile demand. Nevertheless, shortly after the quick spread in FMS installations, operations managers realized that the simple investment in flexible manufacturing systems would not easily answer the market's demand for still more rapid delivery, product variety, customized product designs, and higher product design turnover as evidenced by reduced product life cycle lengths as there lies more intangible aspects of culture and strategy. The companies have recognized that technical implementation and all other FMS investments must correlate with the corporate and manufacturing strategy that the firm is following.

1.3.1.3 Studies about historical and economic analyses

The third and last group of empirical studies describes the evolution of flexibility in operations with its strategic and economic impacts benefiting the competitiveness of firms, industries or countries. Scholars here come from the social science branches like economics, management, and political science. The common thread is the prominence of the relationships between flexibility and industrial competitiveness.

Two main differences between studies in third and the second group are the following (a) Studies in the third group often have a broader scope than those in the second group and (b) the third group deals with the importance of flexibility and the development of its conceptual frameworks. An important work in this stream is that of Piore and Sabel (1984), who demonstrate flexible specialization as against mass-production; reason out why flexible firms are likely to dominate future markets everywhere. Cusumano (1991) describes the evolution to flexible factories and explains with the case of software production, but also at the same time using a contingency-theory framework reason out that mass-production (i.e. non-flexible production) is still the right choice for commodity-type products that have a stable and simple demand and competition.Piore (1989), draw a spectrum of organizational possibilities, at various levels of flexibilities.

1.3.1.4 Limitations of empirical studies

A glance at the empirical studies reveals a concentration of literature on flexibility groups one and three, while studies with hypotheses and data collection are very limited. This limitation points to practical problems that can be encountered while measuring flexibility. Also there is an absence of integrated studies among the three streams. When we consider the first group, there is no study that has attempted to measure each flexibility type examining propositions with empirical data. Very limited numbers of studies have tried to complement the taxonomy effort with a perspective on firm's strategy, nature of the industry, hierarchy, demand and environmental situations. Data-based studies in the second group on the other hand have viewed flexibility as a uni-dimensional concept, ignoring the first group of studies. According to Jaikumar (1986), flexibility references implicitly mean the ability to produce a wider variety

of parts i.e. mix flexibility, which is just one of the different types of flexibility options in front of firms. Fiegenbaum and Karnani (1991) meant volume flexibility whenever they mentioned about flexibility. Authors like Tombak and Meyer (1988) found that managers are not only concerned with mix flexibility of outputs but variance in inputs in production which Mandelbaum (1978) called as state flexibility and Gerwin (1987), as material flexibility. Another drawback of second group is the fact that they treat flexibility and flexible manufacturing systems as same; infact they are not.

An FMS can be considered as one way to acquire flexibility. Other ways are workers with wide variety of skills, flexible production techniques, and having a network of dependable suppliers. The General Motors Corporation didn't succeed fully in flexible automation in the 1980s, while there were successful "softer" implementations of NUMMI (New United Motor Manufacturing, Inc.) - Toyota joint venture, which shows that there are factors other than investment in FMS that can lead to the flexibility and improve firm's operations.

Also, the second group often fail to establish a link between the levels of flexibility data and features of product strategy, industry life cycle, profits etc. Thus it is difficult to extract conclusions regarding the usefulness of flexibility for a production process. Similarly the third group also possess the above weaknesses. Few studies Cusumano (1991) and Tombak (1988), present data to backup the propositions put forward or pay attention to the different types of flexibility. In almost all these studies the definition of flexibility is vague and most often see flexibility as mix flexibility.

All three groups, with the exceptions of works by Cusumano (1991) and Tombak (1988), assume, implicitly or explicitly that more flexibility is

always better for the organization. This is contrary to literature with quantitative nature where too much flexibility is found to make the firms worser Gaimon (1988) and Fine and Pappu (1988). Therefore research needs to be done in finding out conditions when flexibility types can improve firm's competitive position in search of a optimal combination.

The unit of analysis varies from machine to firm or plant level as we see in first, seond and third groups respectively. Generally cholars have percieved flexibility as an internal attribute of any part of firm Gerwin (1987; Buzacott (1982) or the whole firm of an organization (Hyun and Ahn, 1990). The fact however is that, flexibility can originate externally anywhere from a firm's value chain. Thus suppliers and distributors can become sources of flexibility. Another weakness in empirical studies is their lack of understanding on interrelation among flexibility, efficiency and quality; with exceptions in economics-based papers like that of Stigler (1939), where firms achieve volume flexibility at the cost of efficiency (Fiegenbaum,1991 ;Mills and Schumann,1985). The trade-offs among flexibility, quality, and efficiency are to be evaluated from a feasibility point of view and also in relation to competitiveness.

1.3.2 Analytical model based studies

Fine (1989) classified the streams of work into four groups: (1) Flexibility- life cycle theory; (2) Flexibility - uncertainty; (3) Flexibility-inventory interactions; and (4) Flexibility as a competitive or strategic variable

Many studies have experimented with a common setting of comparing flexible and rigid production technologies. An FMS is more efficient eventhough costlier than a rigid or dedicated standard production line. Hutchinson and Holland (1982) tried to determine situations under

which one is preferable to the other. Thus such studies tried to improve our understanding about the costs and benefits of flexible technology and conditions under which flexible is better, considering the bigger initial investment..

According to Cusumano (1994) the benefits of Flexible Manufacturing Systems vary for each group of studies. For studies belonging to group (1), FMS gives the possibility of exploiting economies of scope. For group (2) it provides ability to cope with uncertainty types. For group (3) it reduces inventory holding costs. Finally for group (4), FMS is a strategic and competitive tool. According to Hutchinson and Holland (1982), the advantage of an FMS increases with the new product introductions and capacity utilization.

This is contrary to common belief that it is always superior to have FMS and automation. In fact, in many of the models it is a disadvantage to have an FMS, like those mentioned in studies of group (4). According to Fine and Pappu (1988) for instance; the FMS player has a chance to be worse off as his threat of entry may not look credible. Thus in short, mathematical models have added insights to the decision involving technology selection.

1.3.2.1 Shortcomings of the Analytical Model based studies

In literature there is no distinction between flexibility and flexible manufacturing systems, and latter is often looked upon as the only way of achieving flexibility. Flexibility is often perceived as a feature that a firm can easily buy fix and use (Hutchinson and Holland, 1982 ; Fine and Li,1988 ; Karmarkar and Kekre 1987).

Existing literature thus ignores the significance of worker training, skills, production-management techniques, role of suppliers and distributors owing to the narrow definition of the concept. Moreover, most papers sees the firm either buying the FMS and becomes flexible fully-1, or stays without flexibility-0 .Very few papers present deeper and richer model like that of (Gupta and Buzacott, 1988). This is a critical weakness because, empirical or historical studies suggest that firms can have much broader range of choice in flexibility levels and types.

Some of the analytical literature on flexibility focus on inventory levels and scheduling and they have neglected strategic and organizational issues (Graves,1988;Porteus,1985;Caulkins and Fine, 1990). Thus, there is still much space for future research addressing the strategic and organizational issues. As pointed out in the studies mentioned before, it is likely that analytical literature can address these issues. Authors of analytical models have to move out of mix flexibility Hutchinson (1986) and Fine and Li (1988) and consider other types of flexibility, which would add new dimensions to the theoretical analysis, like the works of Gaimon (1988), who considers the benefit and liability of volume flexibility. A related point in the fourth group is that many works consider the ability to get in or out of markets as a consequence of flexibility (Fine and Pappu, 1988).

A recent study on flexibility management in construction is by Benson Heng Teck Lim (2010) titled "Organizational flexibility Management in construction" the aim of which was to investigate the organizational flexibility management of construction firms in Singapore. Organizational flexibility was hypothesized as a multi dimensional concept, influenced to varying degrees, by six key determinants: (1) organizational learning culture; (2) organizational structure; (3) employees' skills and

behaviour; (4) technological capabilities; (5) supply chain capabilities; and (6) business strategies. The research method is based on survey. Based on the data collected, two structural equation models were developed to: (i) identify the key dimensions and determinants of organizational flexibility, and (ii) examine the effects of inter-relationships among the determinants on the three dimensions of organizational flexibility.

The results support the view that organizational flexibility is a multi-dimensional concept, comprising: (1) operational flexibility; (2) tactical flexibility; and (3) strategic flexibility, where individual dimensions have their own configuration of determinants. However the study had the following limitations. It didn't measure the influence of each of the determinants on each type of flexibility although he could identify 15 flexibility types, rather it measured three i.e. (operational, tactical and strategic) dimensions of organizational flexibility. His study brought in market and technological conditions as moderators of flexibility. Also the study opens new research areas on any relationship between flexibility potential and project management success or effectiveness. Moreover his study takes construction organization' flexibility in to consideration whereas in reality most of the projects are under separate project management team and construction organization just acts like a corporate office doing more of a inter project coordination and resource allocation. So studying flexibility aspects of project management team can become more focussed study.

From the review of literature on flexibility, it is quit evident that there are several paths of research options by which researchers can improve the way flexibility is addressed theoretically and study flexibility in practice. In particular, any new framework essentially needs to incorporate (1) types of flexibility; (2) the strategic positioning (3) distinctions between flexibility as against flexible automation and other means to achieve

different types of flexibility; and (4) the trade-offs among flexibility, efficiency, and quality.

1.4 Research problem

It appears that little empirical research has been done to examine the collective effect of different organizational attributes on project's operational flexibility. Many construction-related studies specifically examined the influence of individual organizational attributes towards achieving flexibility. The organizational attributes involve: (i) human resource (Lansley et al., 1979; Ofori and Debrah, 1998) (ii) information and process technologies (Betts, 1991; Ekstrom and Bjornsson, 2005; Gil et al., 2005); and (iii) Learning culture (Walker and Loosemore, 2003). These identified organizational attributes are labelled as determinants or predictors and are, to some extent, similar to those identified in manufacturing-related studies where two additional determinants are included: supply chain capability and business strategy.

In view of the above scenario, this study expresses the opinion that it is important to examine the influence of individual predictors and understand the extent to which they influence operational flexibility types, following (Pugh and Hickson, 2007). This is because there appears to be no single explanation of how a project organization gains operational flexibility; what influences the project organization could be due to the individual effect of several possible determinants, each posing certain degrees of influences towards achieving operational flexibility.

In a realistic scenario we can't have as much flexibility as we require as it is this potential that may be moderated by project characteristics or micro and macro environments like market conditions of demand, labour and material availability etc. The purpose of exploiting flexibility is to manage uncertain project environment and ultimately achieving effective project management.

Flexibility in general and operational flexibility in particular is more about a potential to change, and thus, unlike system performance, it is difficult to observe and measure. But how can flexibility obtained? Or what are the determinants of operational flexibility in construction project management and in Indian setting? In what configuration these operational flexibility determinants are demanded by construction project environment for day to day operations? Which all types of operational flexibility are applicable and significant to project environment in India? Does a moderated operational flexibility potential contribute to effective project management?

1.5 Research aims and objectives

The aim of this study is to investigate the role of operational flexibility for effective project management in the construction industry.

The specific objectives are to:

a) Identify the determinants of operational flexibility potential in construction project management
b) Investigate the contribution of each of the determinants to operational flexibility potential in the construction industry
c) Investigate on the moderating factors of operational flexibility potential in a construction project environment
d) Investigate whether moderated operational flexibility potential mediates the path between predictors and effective construction project management
e) Develop and test a conceptual model of achieving operational flexibility for effective project management

1.6 Scope of the research

This research is being done in the Indian construction industry with population comprising builders engaged in construction of multi-storeyed

residences in the state of Kerala. Members of CREDAI -The Confederation of Real Estate Developers' Associations of India (CREDAI), the apex body of organized real estate developers-are considered for sampling. This group conforms to the Code of conduct as laid out by CREDAI and therefore brings in much needed transparency and homogeneity of operations needed for study. Small individual developers who are unorganized were found to be unsuitable for this research as they tend to be very small firms working on small contract award values and these groups may not exhibit the flexibility management on a comprehensive scale and therefore excluded from the scope of this research.

1.7 Research Method

This research used a survey research with data collected using questionnaires through face to face interviews with Senior Project managers/General Manager Projects who have more than 10 years experience in the industry and more than three years of experience in the present company. The data were analyzed using Smart PLS 2.0 M3 statistical software which makes use of Structural equation modelling; Partial Least square Approach.The Research Methodology is explained in detail in chapter 4.

1.8 Research Significance

This appears to be the first empirical research in India which integrated the unique characteristics of the Indian construction industry, ways to achieve operational flexibility and achieve effective project management. This study tries to model effective project management through operational flexibility from its predictors integrating them to a comprehensive model. This study provides a framework on the functioning of operational flexibility, offering guidance to researchers and practitioners for discovering means to gain operational flexibility in construction

projects. This study and its findings provide an empirical understanding on kinds of resources and capabilities a construction firm must accumulate to respond flexibly to the changing project environment, offering practitioners insights into practices that build firms operational flexibility potential. Application of Structural equation in model building and testing the moderating effects by PLS approach is not very common in construction industry, but use of Smart PLS 2.0 M3 for the above proved to be very useful given the exploratory nature of the study and for the model involving nine constructs.

1.9 Structure of the thesis

The thesis consists of eight chapters. The chapters 1 to 3 present the background, environment and theoretical Foundations–Literature Review. The Chapter 4 consists of four parts namely-Research Methodology, Operationalization of constructs, questionnaire development and Methods of Research Analysis. The Chapters 5 to 8 discuss Data Validation, Results, discussion, suggestions and Conclusions.

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Chapter - 2

THE CONSTRUCTION PROJECT ENVIRONMENT

2.1 Introduction

This chapter aims to give an overview of the construction industry in general and Indian construction industry in particular, giving the nature of business and project environment both at a micro and macro level.

2.2 Nature of the construction industry

Construction industry is part and parcel of any development activity and has a great impact on the economy of any country. All infrastructure facilities, socio economic facilities and our own neighbourhood are all outputs of the construction industry. The role of construction industry is quite significant in developing construction with its activity accounting for about 10 % of their GDPs and; more than 50 % of the wealth invested in fixed assets (Jekale, 2004). Despite the contribution, this industry has witnessed for itself insignificant development and efficiency improvements. Therefore project performance and success are not commonplace in the construction industry in developing countries (Long et al., 2004). The poor level of technology utilization and therefore productivity is one of the lowest here with poor management skills. The Construction industry's scope and huge capital investments are in contrast with the project management capabilities, making low profit and inferior management (Guangshe et al., 2008).

According to Jekale (2004), the construction industry in many developing countries is characterized by fragmentation, public sector domination, government interventions, foreign finance and low development and use of indigenous technology. Therefore it still imports construction materials, machinery and manpower in those countries.

2.3 Indian Real Estate Market

The term real estate is defined as land with any building or structure on it. Although, the media use the term real estate for residential living facility, it can be classified based on its use into: residential, commercial and industrial. Examples range from undeveloped land, to houses, condominiums, townhalls, office buildings, retail store buildings and even factories. At present, the real estate and construction sectors are driving India's core infrastructure development. The real estate industry's growth is driven by developments in the retail, hospitality economic services and information technology enabled services. The Indian real estate sector is dominated by regional players with relatively low levels of expertise and resources. This has not benefited from institutional capital and has depended on high net-worth individuals and informal sources of financing, which has led to low levels of transparency. This scenario is changing with the industry embracing consumers' expectations of higher quality and global standards.

2.3.1 Concept of Real Estate Market in India

Indian real estate has seen an unprecedented boom in the last few years. Types of Real Estate Businesses Include:

1. Appraisal – Professional valuation services
2. Brokerage – Assisting buyers and sellers in transactions
3. Development – Improving land for use by adding or replacing buildings
4. Property Management – Managing a property for its owner(s)

5. Real Estate Marketing – Managing the sale side of the property business

2.3.2 Market Scenario

The current contribution of the real estate to India's GDP is about 5% attracts highest FDI and has inflows worth more than 3 billion per year now as on 2014.India leads the pack of top real estate investment markets in Asia for 2012, according to a study by PricewaterhouseCoopers (PwC) and Urban Land Institute, December 2013.

2.3.3 Market Segments

- In recent years the industry has grown into organized form than ever before.
- The sector can be divided into commercial, residential, retail and hospitality.

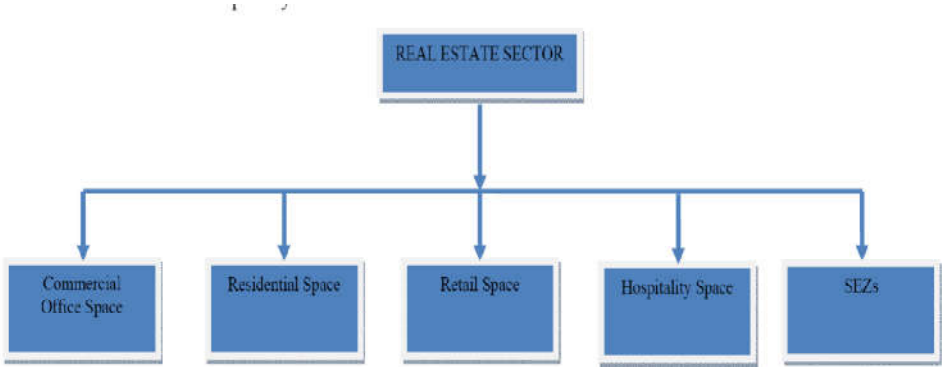

Fig 2.1: Real Estate Sector

2.3.4 Growth Drivers

The robust growth in IT sector with increase in the demand of office space, ever increasing presence of global firms, growth of corporates and increase in middle class consumers is driving the growth. Introduction of REMFs (Real Estate Mutual Funds) and REITs (Real Estate Investment Trusts), global economic recovery and persisting demand supply mismatch can further generate substantial business for Real Estate.

2.3.5 Policy and Regulatory Framework

When we consider the policy and regulatory framework of Indian costruction industry, one must consider the government interventions and policy initiatives from time to time related to FDI, SEZ, Infrastructure and the bills introduced like Land acquisition, Rehabilitation and Resettlement bill,Real Estate Regulation and Development bill 2011 etc.

2.3.5.1 Government Initiatives

The government has introduced measures to unlock the potential of this sector and also to meet the increasing demand levels.

- 100 per cent FDI allowed in townships, housing, infrastructure through the automatic route, subject to guidelines by the Department of Industrial Policy and Promotion (DIPP) and 100 per cent FDI is allowed under the automatic route in the development of Special Economic Zones (SEZ) following provisions of Special Economic Zones Act 2005 and the SEZ Policy of the Department of Commerce.

In recent years the residential real estate segment has witnessed a revival due to improved affordability as several players who have launched budget and value based projects in the affordable housing sub-segment.

Looking at the long-term view on the Indian real estate industry one can find it as positive, with increasing urbanisation, favourable demographics and growth of the services sector, growing income levels, still unmet need in the housing segment, stable economic reforms and large infrastructure investments from the government. New industrial clusters coupled with the improved infrastructure development of land in tier II and tier III cities are also expected to fuel growth in the real estate sector.

Demographic statistics are enough to convince one that India can be the best destination for real estate business in the world. With 1.2 billion population and about 26 million of housing shortage, it's a simple analysis to find the potential of Indian real estate. However, in order to take advantage of these potential needs it must be supported by policies and regulations that can create additional infrastructure without adding pressure on existing cities.

Presently, the real estate sector in India is facing challenges in the form of relatively very high cost of finance, declining demand, rising cost pressures, high property prices and a difficult regulatory framework.

Going back to 2008, when the crisis erupted, this sector had no time to react. Developers who had amassed large tracts of land parcels in expectation of considerable future profits were suddenly left exposed with huge debt. As demand plunged, developers found it extremely difficult to fund their projects with virtually no other source of finance available. With limited FDI, difficult access to funds from domestic banks forced many to borrow funds at unreasonable rates to remain in the business and complete their ongoing projects.

While fund raising challenges remain, the sluggish nature of housing demand further dampens the overall sentiment for the sector. It has been worthwhile to note that despite demand taking a back seat, prices continue to remain high in major Indian cities. In fact the price rises in some cities have surpassed historical highs achieved in 2008. Apart from the sale of non-core assets, developers also resorted to affordable housing, making it possible through a change in specifications. The crisis of 2008 has left enough lessons for everyone to take prudent decisions during challenging situations.

One of the striking differences from the 2008 crisis to present conditions would be a gradual evolution of regulatory response in the form of Land Acquisition, Rehabilitation and Resettlement Bill (LARR) and The Real Estate (Regulation and Development) Bill, 2011. The Indian real estate is presently undergoing multiple headwinds, which has considerably slowed activity in the sector. The rapid rise in property prices, a slew of monetary tightening by the RBI and developers' sticking still to high prices have led to significant slowdown in volumes across markets in the country. Also, the availability of debt has become extremely difficult for the sector, while approval processes have become more stringent. To add to these woes, higher commodity prices and acute labour shortage have dented profitability and led to slower execution.

The impact of actions taken by major real estate stakeholders is leading to lower supply of housing stock at affordable prices, making a contrasting situation where there is abundant demand sitting on sidelines and yet the sector struggles to maintain a sustainable growth. Understanding the demand and supply dynamics affecting the real estate industry will help in analysing the environmental forces.

2.3.6 Environmental factors

The Indian real estate sector can be understood with its peculiar interplay of micro and macro environmental factors as follows.

2.3.6.1 Demand Supply Dynamics

A robust demand exists at the bottom of the pyramid, but the supply is capped by several factors. A robust demand matched by adequate supply is considered to be a positive signal for any economy. The housing shortage in India is enormous. According to a recent KPMG report, India has a housing shortage of about 6 crore units and 99 percent of these homes are

needed by households in the Economically Weaker Sector (EWS) and Lower Income Group (LIG). Rising urbanization, increasing nuclearization and economic growth is expected to further accentuate the housing demand. If at least the current backlog of housing is maintained, a minimum of 30 million homes would be required by 2020. The extent of housing shortfall clearly indicates the extent of opportunity available and can be gainfully monetized under any market conditions. However, there are many supply side factors which restrict achievement of such sustained growth.

2.3.6.2 Availability of adequate land supply

Land is the basic ingredient for any real estate to fructify. Availability of land is becoming more and more difficult, especially in major Indian cities, which is leading to considerable rise in land values and thereby the property prices. A simple math from the 2012 shortage estimate suggests a total area requirement of 189327 – 325031 acres. The land mass required to exhaust this housing shortage would be approximately equivalent to 1.3 to 2.2 times the size of the land mass of Greater Mumbai. Evidently, large tracts of land belonging to Government remain unavailable mainly due to inadequate planning and in some cases such land parcels are encroached.

2.3.6.3 Infrastructure constraints

The urbanization phenomenon has picked up the pace and will see India's urban population to reach a figure close to 600 million by 2031. Such magnitude of urbanization often leads cities to stretch beyond its existing limits, as resources to satisfy demand recedes considerably. Proper infrastructure planning can lead to the smooth transition of demand from the existing city centres. The need of the hour is planned evolution of cities, which can sustain affordability and satisfy every growing housing requirement.

Availability of finances at reasonable rates is one of the biggest concerns for real estate developers. Banks have curtailed its exposure to real estate, citing cautious measures, leaving NBFCs and Private Equity (PE) as the only sources of finance. The PE deals are presently transacted at internal rates of returns (IRRs), or the yield of the investment, of 25 percent to 30 percent. High cost of finance coupled with waning demand has disrupted the cash flow situation of developers. The effect of this situation has created two important scenarios in the marketplace. Firstly, developers are now deferring their project launches, thereby altering the slated supply. Secondly, high cost of finance restrains developers from lowering prices.

2.3.6.4 Input cost inflation

Raw materials, including steel, cement, sand, bricks, etc., which form major construction cost, have seen a significant price escalation (20-50 percent) over the quarters of past five years. The sharp inflation in input costs has severely impacted profitability across projects.

- The price of steel has appreciated by more than 25 percent in the past year, with iron ore prices having risen globally. Cement prices have increased from ~INR 200 / bag to INR 270 - 280/bag (+30-40 percent) in the same period due to declining cement production.
- The price of sand has more than doubled in the last one year owing to supply constraints due to ban on sand mining in several states including Kerala. Labour has become a huge constraint. Rural labourers are increasingly opting for the Mahatma Gandhi National Rural Employment Guarantee (NREGA) scheme, which guarantees 100 days of wage employment a year to a rural household whose adult members volunteer to unskilled manual work.
- While skilled labour is already in short supply, NREGA has led to a shortage of unskilled labour too, causing a sharp rise in labour costs

(up from INR 250/day to INR 325/day for unskilled labour) (Report on Real Estate Sector IDFC, October 2011).

2.3.6.5 Approval delays

Estimates reveal that real estate developers are required to pass through nearly 40 departments of central and state governments and municipal corporations for approvals. Such delays and corruption adds another 25-30 percent of the project cost. The biggest handicap in the approval process is lack of coordination among the multiple authorities. The problems also arise out of overlapping policies and lack of coordination among the departments.

2.3.6.6 Lack of clear taxation regime

The taxability of real estate transactions has also been a subject matter of intense dispute and litigation as the Central Government of India, individual State Governments and local authorities are empowered to impose various indirect taxes. The industry is waiting with a bated breath for these controversies to be resolved as a uniform tax regime or rationalized tax structures will go far in ensuring affordable real estate development. To state a few examples:

- The Central Government proposes to impose Service Tax (ST) on real estate projects here as state governments are imposing Value-Added-Tax (VAT). The government should clearly define 'real estate property' as a product or service and determine tax accordingly, as this creates a double taxation regime and the burden is finally borne by the consumer. This issue merits attention impending the introduction of Goods and Service tax (GST)
- Stamp duty (SD) to be paid at the time of execution of the underlying instrument varies from 5 percent to 15 percent of the

value of property in different states. Respective state governments should expedite their reform and levy a uniform rate across the country.

2.3.6.7 Limited financing avenues

Funding for real estate projects is also one of the major challenges that developers today are grappling with, due to change in or lack of clarity of provisions. Also, REITs and REMFs which could have created excellent funding opportunities for development have failed to gain momentum due to lack of clarity on taxation and additional transaction cost such as stamp duty. The Government could also look at alternate sources for meeting long-term financing needs by granting infrastructure status to the housing sector. Such move would attract funds from insurance companies, which are mandated to invest 15 percent of their funds in social and infrastructure sector (as per IRDA regulations).

2.3.6.8 The Real Estate (Regulation and Development) Bill, 2011

There are initiatives such as the Real Estate (Regulation and Development) Bill, 2011 that have been undertaken by the Government to bring transparency and accountability in real estate sector in India.

The Bill proposes to establish a regulatory authority and appellate tribunals to regulate, control and promote real estate construction as well as attend to buyer grievances and redresses. The Bill would apply to builders, who intend to sell any immovable property developed on land area of 4,000 sq. mt or more.

The Bill makes it mandatory for developers to adhere to the approved plans, specifications, and transparency through better information to the buyers, make necessary payments and other charges as agreed to under the agreement and payment of interest in case of any delay etc.

The Bill is a big step taken by the Government in the direction of recognizing Indian real estate as an industry, which warrants a regulatory agency with transparent rules, regulations, safeguards and redressal systems. The Bill is also expected to lead to a greater flow of FDI into the sector owing to the proposed provisions, which will ultimately benefit developers. However, the Bill fails to address the need for single window for approvals which would enable getting permissions and approvals expeditiously. The other impediment which developers believe is exclusion of small developers due to minimum land area requirements for a particular project.

The Land Acquisition, Rehabilitation and Resettlement Bill (LARR) 2011, was another recent step taken by the Government with a desire to make land acquisition for industrialization and urbanization easier. The bill fails to meet the expectations of real estate developers as it would make land acquisition costly by 60-80 percent due to higher compensation it offers to farmers. The draft bill also states that consent of 80 percent of people is mandatory except where land is acquired for public purpose. Additionally, there are different land acquisition norms in rural and urban areas as well as states are free to have their own land acquisition laws, which makes matters further complex.

Urbanization in India is on a growth trajectory, while the metros are witnessing fast evolving skyline with tall skyscrapers and architecture, the smaller towns are observing transmutation of the surface through expansion of roads and flyovers. According to United Nations (UN), by 2050, India urban population will be more than the combined urban population of major economies such as the US, Germany, Brazil, Russia and Japan. It is estimated about 875 million people will reside in Indian cities in the next four decades. Further, it is estimated that India will have the highest urban population annual growth rate among the BRIC countries and other major

economies of the world, which is likely to remain approximately at two percent for the next four decades. Urban planning has long suggested development of satellite towns around major cities as a solution to decongest them.

2.4 Nature and Characteristics of Construction Projects

According to William (2002), a project has four elements namely: aim, coordinated related tasks and subtasks, specific time span and uniqueness. According to Cleland and Gareis (2006), a project can be defined as a temporary endeavour and a project based firm performs a unique business operation of set scope.

Generally, construction projects have the following nature:

- Capital intensive, complex, requiring significant management skills and technical expertise, commitment and coordination. (Chartered Institute of Building, 2002).
- Vulnerable to dynamic, uncertain external environmental factors like weather and traffic (Gould & Joyce, 2003).
- Must consider and manage the geographical conditions of the site and relation of the project to the micro and macro environmental factors. (Project Management Institute (PMI), 2007).
- Subjected to a variety of laws and regulations ensuring consumer rights, public safety and environmental impacts (Bennett, 2003).
- Labour intensive, heavy use of materials and tools (Jekale, 2004).

2.5 Construction Project Management

2.5.1 Definitions

Summarizing the definitions given by many authors, this research defines a project as a temporary endeavour with a definite time horizon and having various phases like Initiation, Definition, Planning, Execution and

Close; thus build a product or service through coordination of human, material and financial resources (Project Management Institute, 2004; Muriithi & Crawford, 2003; Stanleigh, 2007).

This research defines Project management as the application of management and specifically project management knowledge, skills, tools and techniques to planning, directing, coordinating and controlling of a project from its beginning to end with the objective producing a product and service on time, cost, quality, scope and stakeholder satisfaction. Project management deals with resources, people and change. Managing a project includes: Identifying requirements, setting clear, achievable objectives, balancing the demands of quality, scope, time and cost; while adhering to specifications, plans, concerns and expectations of the various stakeholders. (Project Management Institute (PMI), 2004). Nine core knowledge areas in PMBOK are scope, time, cost, risk, quality, human resources, communications, procurement and integration management. Each consists of processes that must be addressed to achieve respective objectives. For the nine knowledge areas, a total of 44 project management processes is identified in the PMBOK by which management of projects is accomplished. It's the decision and discretion of the project manager and his team to decide which processes to be employed and the degree or rigour of process application. (Project Management Institute (PMI), 2004).

2.5.2 Project Management versus General Management

The fundamental difference between project management and general management is in the nature of work, as the former deals with work of temporary and unique nature, whereas, the latter deals with management of ongoing and repetitive operations. Generally project organization changes as the project progresses and ends as the goal is achieved;

whereas other kinds of organizations has operations that sustain over a period of time.(Project Management Institute (PMI), 2004).

Despite these differences, there are similarities in decision making and implementing philosophies, resource allocation, management interfaces for the organization, leadership and for the people involved. Therefore, in addition to knowledge of project management, successful management of project requires knowledge of theory and practise of general management (Cleland & Ireland, 2002; Project Management Institute (PMI), 2004).

The construction project managements have got many similarities with management of projects in other industries. However, most of the content of PMBOK Guide can be directly applied to construction projects (Project Management Institute (PMI), 2007). According to (Chartered Institute of Building, 2002), the prime work in construction project management is to coordinate professionals in the project team so as to enable them to make their best possible contribution to the project efficiently. In addition to knowledge of project management and general Management, managing construction projects require an understanding of the design and process (Hendrickson, 1989). The ability to communicate in a team environment is also very important for successful management of construction projects (Chen, Partington, & Qiang, 2009).

Hendrickson (1989) has mentioned project management in construction must essentially involve:

1. Specifying scope, budget, schedule, performance requirements, and selecting project stakeholders or participants.
2. Optimum resource utilization according to the schedule
3. Proper coordination and control at several stages of planning, design, estimating, contracting and construction.

4. Development of effective channels of communication and a suitable mechanism for resolving conflicts

2.5.3 Project Management in Developing Countries

Every project is local in its nature of implementation and management, but follows nationally or internationally accepted standards. The project management methodology depends on the nature of the project, location, owner, purpose and objectives. Understanding the context in terms of project management practices of developing countries is necessary to manage projects successfully in those countries. There is a shortage of research works on project management in these countries and many of them are at an infant stage (Jekale, 2004). Many of the available literatures are on development projects of governments and/or donors and not about projects in the private sector.

Project management methods have been extended to solve problems in managing scarce resources and achieving important objectives (Andersen, 2008). As developing countries often suffer from a shortage of resources, the potential benefit of project management is extremely high and critical. It was Voropajev (1998) who pointed out that the PM can gain a lot more importance in developing economies. Development related project failure in developing countries usually has a far reaching consequence beyond financial losses. Similarly, project successes in developing countries can lead to improvement in life of millions.

The projects in developing countries are almost contrastingly different from that of the developed countries where the PM has taken the birth and grown (Cusworth & Franks, 1993; Voropajev, 1998). Projects are complex and dynamic, but in developing countries it is highly uncertain, unstable and constrained by resource shortage. This always challenges a project manager in developing countries than anywhere else.

(Cusworth & Franks, 1993; Jekale, 2004). According to Voropajev (1998) project management processes that are vulnerable to changes like management of risk, procurement, contracts, scope, configuration, communications assumes more importance in developing countries' context. The management of externalities, politics and risk becomes very important in developing countries (Muriithi & Crawford, 2003; Cusworth & Franks, 1993). Table 2.1 presents a summary of the major difference in the nature of the project and the project environment in developing and developed countries.

Table 2.1: Projects and the Project Environment in Developing countries

Developing Countries	Developed countries
Most projects are government owned	Most are private
Infrastructure projects dominate	More or less mix of projects
Highly sensitive to environment	Moderately sensitive to environment
Complex, uncertain environment**	Complex, dynamic, relatively stable environment
Extreme scarcity of resources***	Resource available at cost (constrained)
Underdeveloped private sector*	Developed private sector
Significant involvement of Government	Market economy
(Voropajev, 1998) * (Jekale, 2004) **	(Cusworth &Franks, 1993) ***

2.5.4 Challenges in Developing Countries

Project Management in developing countries is in fact challenging and tough (Jekale, 2004; Abbasi & Al-Mharmah, 2000). Many projects in such countries end up uncompleted, abandoned or unsustainable (Sonuga, Aliboh & Oloke, 2002; Andersen, 2008). Further, the implementation of most projects in those countries is amalgamated with the normal operational undertaking in functional organizations that have low capacity (Jekale, 2004). Further, corruption is complicating project

management in those countries more (Sonuga, Aliboh, & Oloke, 2002;Andersen, 2008). As Jekale (2004) has summarized it-poor infrastructure, low growth level of technology, low ability of implementing institutions, scarcity of resource, unreliable communication, poor documentation, high turnover of key personnels, political instability, low accountability and transparency, and delayed decision-making are typical conditions in developing countries .

Thus a number of factors have been identified for the poor performance of projects in developing countries. Generally, factors such as government policies, insufficient funds, withdrawal of donors, shortage of foreign exchange, inappropriate contract conditions, political priorities, socio-cultural conditions, corruption, low institutional and human capacity, and occurrence of unexpected events such as war, drought are considered to be the major factors behind the poor performance of projects in developing countries (Idoko, 2008;Jekale, 2004; Andersen, 2008).

Projects in developing countries are highly influenced by their external environment (Kuruoglu & E. Ergen, 2000; Jekale, 2004). Moreover, the project environment in many developing countries is unstable and characterized by rapid change of markets, shift of funding sources, frequent change of government policies and the business environment (Kuruoglu & E. Ergen, 2000). Likewise, in India inflation has increased in double digit and cost of construction has almost doubled in the last five years. According to Cusworth & Franks (1993) , "Most of the special problems of project management in developing countries are related to the environment, which can generally be attributed to the turbulence (the tendency of unpredictability) and rapid change in the project environment; and severe scarcity of resources in those countries".

These prevailing external factors are making the planning and general management of the projects extremely challenging for the poorly trained highly constrained project managers in those countries.

Lack of institutional capacity and trained personnel is also another main reason why projects fail in developing countries (Voropajev, 1998). Further, the lack of awareness about the benefit and application of Project Management Knowledge in many developing countries with the presence of only few trained project managers and the wrong perception that these training incurs unnecessary expense; has contributed to the low level of development of project management in those countries (Andersen & Idoko, 2008). According to Nguyen (2007), many of the efforts to transfer Project Management knowledge and technology to the developing countries were not successful mainly due to : lack of support of senior management and a perception that project management methodology is not applicable in developing countries.

In addition to the above, the nature of project management itself is a challenge for many project managers in developing countries. According to Pant, Allinson & Hayes (1996), the principles of PM are contrary to what the managers in developing countries are accustomed to do and trained for. Conventional project structure breeches classical philosophies such as division of labour, organizational, hierarchy and unity of command. It demands certain qualities from its members, including objectivity, flexibility, preparedness to take risks, the ability to make decisions independently, low preference for conformity, low power orientation and low rule orientation which are rare attributes in developing countries (Muriithi & Crawford, 2003). Individuals employed in project organizations are expected to be able to work well in teams, have the ability to lead and maintain close ties with other organizational

members (almost none existent in developing countries). On these evidences, it may be difficult for project managers in developing countries to fulfil requirements of project management (Pant, Allinson, & Hayes, 1996).

2.6 Construction Project Environment

The nature of the relationship between an organization and its environment has always been a hot topic in management research, and the construct of environmental uncertainty has been a focus of most of this inquiry. According to Duncan (1972) the external environment can be defined in terms of its level of uncertainty. He uses two dimensions to assess the level of uncertainty in the external environment in which it operates and competes. One is simple-complex dimension, which is defined as the number of elements that affect the organization's decision making. The other is the static-dynamic dimension, which is described as the degree to which these elements remain the same over time or are in a continual process of change. When there is a low degree of volatility, the organization is in a stable or static environment, where the organizations can operate and function with routines. Instead, if the volatility is high, the organization is in a dynamic environment where the uncertainty is high.

According to Milliken (1987) environmental uncertainty as individual's perceived inability to judge or predict an organization's environment accurately due to lack of information, inability to discriminate what is relevant data and what is not. This definition includes three dimensions: State uncertainty referred to a firm's inability to predict the state of the environment. Effect uncertainty referred to the uncertainty over what the consequences of environmental changes would be on the organization. Finally, response uncertainty related to a firm's options of how to respond to conditions in the external environment.The Project management team needs to continuously scan and process cultural, organizational, social, economic, legal and natural environmental inputs,

identifying stakeholders and their performance expectations. This means working with people is far more challenging in highly technical and complex construction projects. Therefore, it is essential that the project management team sensitize themselves to cultural, organizational and social variables. Identifying conflicts of interest and managing them proactively will help to deal with risks which are otherwise may undermine the success of the project.

2.6.1 Dimensions of the Project Environment

The project environment must be thought of as a flux of project time factors, the internal project culture, corporate culture, and the external environmental factors. Most projects exhibit very unique features as they proceed.

The Project Time Environment – Four Distinct Project Phases

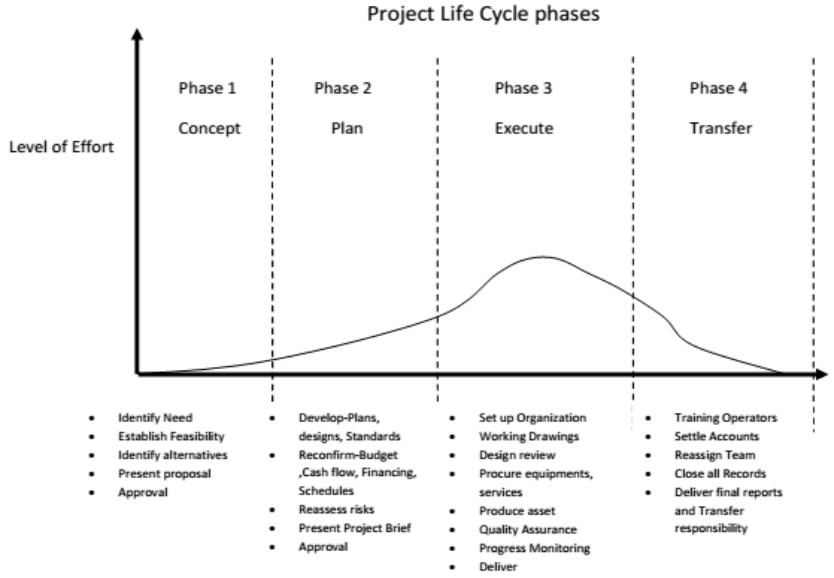

Fig 2.2-Project life cycle phases (Wideman,1990)

From the figure we can see four distinct project periods during the typical life span of a normal project. These phases are

1) Concept
2) Planning
3) Execution, and

4) Transfer

First two phases are also called as the feasibility and engineering phases.It is where the project is built on paper, while in the third and fourth phases, preparation of detailed drawings including specification and physical implementation takeplace. Commissioning and completion approvals are required at the end of the last two phases.

2.6.2 Stakeholder identification

Project managers need to identify and interact with key institutions and individuals, by first organising the process to identify and manage the probable stakeholders in that environment and predict their reaction in project decisions (Cleland, 1999). According to Freeman (1984) stakeholders are a group or individual who can affect, or is affected by the actions or achievements of a firm. The Project Management Institute (PMI) in 2004 has adopted this definition by defining stakeholders as individuals or organisations actively involved in the project or whose interest may be affected before during or after project execution.

There are essentially two categories of stakeholders: internal stakeholders involved in project execution and external stakeholders who are affected by the project (Cleland, 1999).

2.6.3 External versus internal stakeholders

Freeman (1984) presents the stakeholder concept corresponding to different views of the firm. In the production view, where the major concern is input and output, stakeholders considered are the supplier and the customer. In the managerial view, it includes supplier, customer, owners and employees. These four stakeholder groups represent the internal change agents within the firm.

According to Freeman (1984), it is difficult for firms to understand external changes and cope by making internal changes. External changes produce uncertainty affecting comfortable relationship with stakeholders.

External forces affect a project significantly and each phase of project is constrained by time. This is especially true of construction where the project location is specific and external changes shift between phases during project implementation. Project management literature rarely discusses problems of the external environment as mentioned by (Engwall, 1995). But there examples in works like that by (Winch and Bonke, 2002; Newcombe, 2003; Bourne and Walker, 2005).But still emphasis is on internal processes.

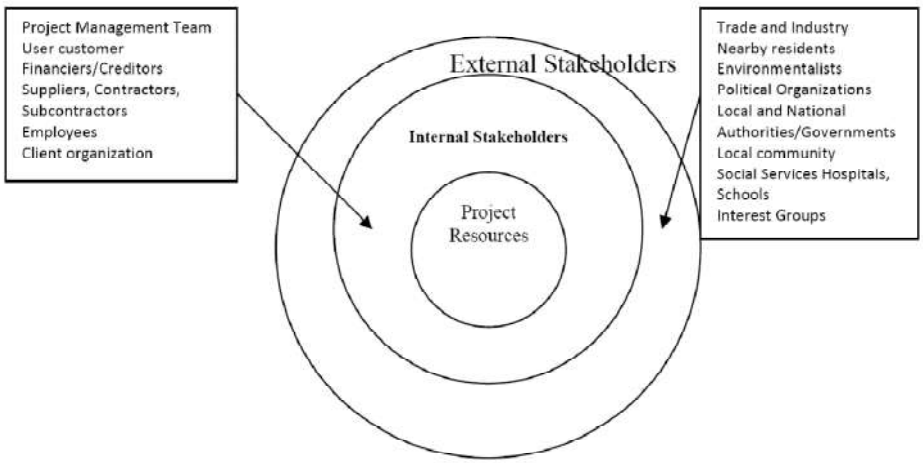

Fig 2.3: Project Stakeholders

Internal stakeholders are formally connected with the project, whereas external stakeholders are those affected by the project in some way (Gibson, 2000). Figure 2.3 is adapted from Cleland (1999) and shows potential stakeholders in classified into internal and external stakeholders. Project External Environment includes project technology on which it's based and enables a complex set of interdependent relationships constantly interacting with the project contributing to uncertainty or risk. Higher the interdependence then higher the uncertainty and greater the challenge for

project management. Thus project environment is unique in the sense it is different for different projects and is determined by factors such as:

a. The product or service envisaged
b. The technology and its application, and
c. Location

2.6.4 The Internal Project Culture

The culture in a project is a reflection of the leadership style and organizational structure in the project and can vary according to the size and nature of the project. A typical project group consists of consultants, contractors and specialists, owner's staff, project control team etc.

Each group or person involved has many allegiances for example project responsibilities to the project manager, and professional responsibilities to home department or firm. This dual reporting form a matrix structure and adds to the complexity of a project. The project manager is under the project mandate and is responsible for the project sponsor on one side and at the same time responsible for personal and professional performance to his own department or company. The project mandate includes directing activities like planning, design, procurement, construction and commissioning and developing various project reports. He must look into financials, law, HR, Infrastructure, Systems, government, and public relations. He must report on a regular basis to the Executive whose interests include expenditure incurred, variations to date, forecast final cost and the scheduled commencement of the facility.

Projects fail due to many internal reasons of technical or managerial nature. Here even technical failures will be ultimately looked upon as management failure of the executive. Projects can look apparently successful, without being in the optimum potential. The Project's Executive

has a vital role to play in achieving project success. The Executive must demonstrate support dynamic sponsorship and control. The project manager must be seen as the authoritative agent in dealing with all parties becoming a single formal contact. The project manager must have the command and authority in organization and site and must be able to control the flow of resources. He is accountable for such decisions. He must be involved in all major decisions related to technical, cost, schedule, or performance and must be competent. He must get commitment, support and the required quality of service through the use of proper information and control systems.

2.6.5 The Project's External Environment

Projects exists due to the stakeholders and external environment, so it is essential for the project management team to be responsive to the potential difficulties to stakeholders by understanding their probability of occurrence and try to face them off in advance by constant interaction with those individuals and institutions. Thus, it is essential to develop a healthy stakeholder environment.

2.7 Developing a Sound Stakeholder Environment

In order to influence the project's cultural environment,it is essential to develop right attitude with the right mindset to an extent of visualizing organization chart with project stakeholders at the top, followed by the project team members and project manager at the bottom. The project team therefore can be visualized as a service organization by identifying the nature of each stakeholder group's interest in the project.In this effort pinpointing the characteristics stakeholders and designing appropriate responses will help to facilitate a good relationship.

2.7.1 Identifying the Project Stakeholders

The project must start with prioritizing the required stakeholder linkages by conducting a stakeholder analysis to identify all the potential stakeholders who might have an impact on the project, and then determine their relative ability to influence it.

2.7.2 Stakeholder Groupings

Different groups can be visualized for stakeholders.One kind of grouping includes suppliers of inputs, consumers of outputs, and managers of the project process. Another gouping includes the persons influencing the physical, infrastructural, technological, commercial/financial/ socioeconomic, or political and legal conditions. Third grouping can be based on various hierarchical infuence in the project such as government authorities at local, regional and national levels and finally there can grouping of groups and associations with some vested interests, unrelated to the project.

2.7.3 Stakeholder Categories

Stakeholders may be categorized according to their relative ability to influence the project as -1. Controllable, 2. Influenceable, 3. By their ability to influence the project. Members of the project team can then prioritize their efforts for linkages with stakeholders and thus give rise to project success.

2.8 Project Public Relations

Traditional management has been recognized as a classic Input-Process-Output a feedback loop. Opening communication channels in both directions are a powerful motivator at the operative level. Quality of information can lead to improvement in performance to a remarkable level, though much less evident on construction projects. A more proactive stance on Public Relations can be seen as one which create a favourable influence

on the environment and can in turn bring surprising effects on the ability of the project team to control the project in terms of cost and time.

2.9 Variation Orders

A critical factor in project environment that cannot be undermined when we consider the environmental forces is the variation order and its continuing influence on projects. Variation order means the alteration, change or modification of design, quality, quantity, work omission, addition or substitution. It also includes the alteration of the type, kind or standard of any of the materials to be used and or the removal from site of any work, materials which are not conforming to the contract.

The need to make changes in a construction project is a reality and affects the cost and time of projects. Even the most thoroughly planned projects may require changes due to various factors. (O'Brien, 1998). Construction contracts usually have a specified time for completion of work, but many construction projects suffer from delays, financial complications, and unsatisfactory outcomes because of the insufficient attention paid for the evaluation of the variation orders. Any addition, deletion or other revision to project goal and scope are considered to be variations, whether they increase or decrease the project cost or schedule. Most commonly, lack of timely and effective communication, lack of integration, uncertainty, changing environment and increasing project complexity are the drivers of project variation. There are provisions on variation orders in a building contract. It will affect cost of the project, extend the completion period and will bring inconveniences to all the parties involved in the construction project.

Learning from variations will help to develop an effective variation management system and selecting the most appropriate controls. The

fundamental idea behind variation management system in a project is to anticipate, recognize, evaluate, resolve, control, document, and learn from past variations so that the project can still be kept viable. Therefore, all parties involved should cooperate to assure that the efficiency of construction and thus minimize the variation orders in the construction industry.

2.9.1 Types of variation

Most often variations come under the category of contractual changes. They are handled and decided upon by the project manager, if within the initial boundaries and mandate given by the client. If the changes are ordered by the client, it will be decided upon by the client. It is however always the project manager, while informing the client, who handles the changes and negotiates with contractors. The majority of contracts today are based on the standardized conditions of contract. The relationships between the client and the contractor in India are regulated by the general conditions of contract.

The types of variation can be classified according to their criteria, which are: The nature of the variation, the identity of the initiator and the effect of the variation (Singh, 2002).

2.9.2 The nature of the variation

The nature of a variation order can be determined by referring to both the reasons for their occurrence and subsequent effects. A beneficial variation order is one issued to improve the quality standard, reduce cost, schedule, or degree of difficulty in a project. It eliminates unnecessary costs of a project and as a result optimizes the client's benefits against the resource input by eliminating unnecessary costs. A detrimental variation order is one that negatively impacts the client's value or project performance (Arain & Phen, 2005).

2.9.3 Identity of the initiator

Classification per identity of the initiator is a change made by any one or more principal parties: consultant, contractor, sub- contractors, suppliers, and also contract administrator.

The variations can happen because of:

- Change in design
- Errors and omissions in design
- Conflicts between contract documents
- Technological change
- Inadequate scope of work for contractor
- Lack of coordination
- Design complexity
- Inadequate working drawing details
- Consultant's lack of judgment and experience
- Lack of consultant's knowledge of available materials and equipment
- Unavailability of equipment.
- Shortage of skilled manpower
- Differing site conditions
- Unfamiliarity with local conditions
- Contractor's lack of judgment and experience

There are other variations such as Safety considerations, new government regulations and other unforeseen problems.

2.9.4 Effect of variation

The most frequent effect of variation orders is the increase in cost. Variation orders may affect the project's total direct and indirect costs. Therefore, any major addition or alteration in the design may eventually increase the project cost. Additional payment for contractor, increase in overhead expenses, rework and demolition were considered as the most frequent effect of variation orders. The management of variation orders of a project is considered successful if the variation orders are resolved in a timely manner to the benefit of all concerned parties (Arain & Phen, 2005).

According to Arain & Pheng (2005) minimizing variation is not easy. But there are strategic actions that can be taken in order to minimize the variation in different stages as: Thorough detailing in the design, Clearer Contract document and adequate time for the Quantity Surveying to prepare the document, Clear and thorough project brief to avoid the unclear scope of work for the contractor and reduce the miscommunications between the parties and finally direct communication and continuous review of the contract documents.

The nature of variation is identified as omission, addition and combination of both. To meet this challenge successfully, project participants can minimize variations with extra care at the design stage and also during the course of construction by having operational flexibility.

2.10 Project Failure and Success

According to Freeman and Beale (1992) the project success is a multi dimensional and context dependent.What success means in the project is very important and must be a result of consensus from a group of people (Jugdev & Moller, 2005).

Fundamentally, project success is seen as achieving deliverables on time, budget and quality Greer (1999), also known as the Iron Triangle (schedule, scope and budget). Thomsett (2002) after analysing 20 failed projects over a period of 18 years expanded the concept of successful project as that which satisfies stakeholders, meets requirements, quality expectations/ requirements, within cost, within deadline, along with professional satisfaction and learning. Lim and Mohamed (1999) put forwarded macro and micro points of view in which micro view is concerned with project completion, while the macro view involves the long range perspective of product use and customer satisfaction. Thus, determining whether or not the project has succeeded must be determined through operational stage, to receiving evaluation of input from the users and stakeholders. Lim and Mohammed's work stressed on setting expectations at the project's onset and alignment between project deliverables and expectations (Jugdev & Moller, 2005).

The project management literature review reveals that, project success is still a topic of debate and discussions are still live on areas of (a) Success criteria and (b) factors contributing project success (Crawford, 2002).

Project Success Factors (PSF) when present, improve the likelihood that projects will be implemented successfully (Kerzner, 1997, 2003; Pinto & Slevin, 1987). According to Kerzner (1987) PSFs are vital elements, required to manage projects with excellence. This demands well defined requirements, management of change with systems to record and assess the effect of the change on the project and a streamlined change approval process (Thomsett, 2002).

According to Butterick (2000) who summarized project success factors across a wide range of industries into lessons learned. One of them is

being able to follow staged approach that minimizes confusion and need for re-learning. This can provide room for planning the next stage. Each stage is separated by a gate for quality control checks; prioritization and to plan forward (Butterick, 2000). Thus, the number one cause of project failure is the lack of adoption of a formal project methodology. Without which a clear methodology for delivery, most project teams start building deliverables without set scope and objectives .This lead to lack of structured processes for undertaking project tasks, and consequent failure to effectively manage time, cost, quality, risks, issues and changes within the project. It is inevitable that such projects suffer from scope creep, milestone delays, poor deliverable quality and a lack of customer satisfaction. So, to avoid project failure: a repeatable project methodology is to be used with structured project processes for initiating, planning, executing and closing projects effectively.

2.10.1 Efficiency and Effectiveness

Efficiency is an internal measure which is linked to the immediate outcome of a project. It is a question of doing things right and producing project outputs in terms of the agreed scope, quality, cost and time. Effectiveness is an external measure which is linked to the longer-term effects of the project, or to do the right things. Eikeland (2001) relates effectiveness to how the results of a project contribute to the value added for owners, users and public at large. According to Samset (2000), effectiveness concerns the extent to which the project's tactical objectives are achieved.

2.11 Need for operational Flexibility

Project management (PM) traditionally focuses on issues of planning, controlling and organising the project (Cleland and Gareis, 2006). According to Cleland and Gareis (2006) contemporary research in project management has moved into concepts such as flat organisational structures, teamwork, organisational networking and their effect on the efficiency, while Taylor (2003) added decision making and leadership. This contemporary approach to project management concentrates on building and managing the dynamics of the project, boundaries and complexity (Cleland and Gareis, 2006).

According to Chin (2003), the traditional project management methods are not applicable any more in the present business and project environments, thus new more adaptable methods should be employed as the traditional approach does not have a high tolerance or flexibility for continuous changes. Agile project management environment focuses on the project execution where the decisions are made during the project development and supported by advanced planning (Chin, 2003).

According to Whitaker (2009) the agile project workflow is continuous with actual development of projects carried out in cycles known as sprints. Here each sprint cycle lasts from 15 to 30 days filled with activities like continuous meetings, development, check-ins, builds and tests supported by planning, operation, updating knowledge about overall project plan, vision of features and required work in the next sprint, thus it involves reevaluation of the practices to make continuous process improvements. An agile project management environment can be defined by the following equation- Agile Project Management Environment = [Uncertainty+ Unique Expertise] x Speed (Chin, 2003).

Thus we can understand agile project environment to be consisting of factors. 1. Internal and external uncertainty. 2. Requires some unique expertises. Both factors are multiplied by. 3. Speed. According to Chin (2003) the internal uncertainties come from technical obstacles, and project plan changes like schedule, scope, resources or decisions in a project. The effects of which diminish with time and experience. While a project manager has no control over external uncertainties coming from customer requirements, competitive moves or business strategy changes. Unique expertise comes from experts that contribute to different project domains. Speed refers to changing schedules or fast-tracking on a project.

According to Chin (2003) uncertainty in a project increases with the pressure of moving faster as decisions are made with less and less information, thus making it important for a project manager to understand the business dynamics, drivers, and project management infrastructure.A literature review by Olsson (2004) found that flexibility is primarily an approach to improve effectiveness of projects rather than efficiency.

Flexibility is considered as a kind of strategy and it means capability of the firm to have multiple responses to the firm's environment. Flexibility thus can be defined as a firm's ability to respond to a variety of demands from its uncertain and dynamic competitive environment (Sanchez, 1995).

A project environment can be considered as a perfect example of uncertain and dynamic environment. Since a project is unique by definition, the only thing certain about projects is that they are uncertain. Even the best laid plans fail due to the presence of variables that force deviation from those plans. Once we accept this reality, the solution, then, is to learn how to manage that uncertainty. Uncertainty can be defined as that information

which is the difference between the sum of information required to perform the task and the sum of information possessed by the organisation (Galbraith, 1977).

Uncertainty needs to be managed to minimize risks and maximize opportunities in projects. Many authors have proposed flexibility for managing uncertainty, such as adopting flexible production methods and broadly-defined work rules. Majority of the programmes embarked on by firms didn't meet with desired results. According to Upton (1995), ignoring the role of people, focusing primarily on technology had been the main reason for such failures. Thus, he concluded that flexibility depended on people than on any other technical factor.

Summary

Quest for flexibility is basically a pursuit for improving effectiveness of projects. Effectiveness and Efficiency are the two dimensions of success that every project manager tries to tackle. The project environment is filled with uncertainty; this is particularly evident in construction projects of developing world. Various forces play in the environment of a project at a macro and micro level. The Project management team needs to be in sync with the cultural, organizational, social, economic, legal, natural and technical environments of the project by identifying the project stakeholders and their ability to affect its successful outcome.

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Chapter - 3

THEORETICAL FOUNDATIONS

3.1 Introduction

This chapter examines the theoretical foundations that form the source for empirical developments in the flexibility literature, enumerating those that are currently in the limelight through research and practice. The researcher begins by examining contingency theories and its various forms of development, followed by organizational learning theory; then looks into the resource based view of firms, complex adaptive system perspective, followed by the Transaction cost theory and finally Organizational Slack theory. This sequence looks into the origin and development of this domain. Each section discusses issues and strengths of the concepts associated and how they are reflected in the concept of flexibility and finally integrate the literature at the end of the chapter.

After costs, quality and time, flexibility came to be looked upon as the fourth important performance indicator in operations. Researchers understood the importance of operational flexibility after 1980s as markets saturated and firms started to compete on product differentiation and above all innovation. As a result, markets witnessed a dramatic increase in product variants and new product introduction. Product innovation and new product of high quality and low cost became hot research fields and concurrent engineering became a new approach to managing the product innovation process (Clark and Wheelwright, 1993). At the beginning of the 1990 time-to-market emerged as a competitive concept indicating awareness of innovation-speed Stalk and Hout (1990). Product diversity and product innovation got challenges from a large increase in demand uncertainty at the product variant level.

During this time, the project management domain has pointed out the importance of managing flexibility in projects. It's natural for project environment to change from planning stage, as owner's desire for changes goes on. This helps happens because as the project progress along the various paths, they gain knowledge about their needs and changes in the project context (Midler, 1995).

According to Kreiner (1995) flexibility is necessary to manage change and uncertainty in the business environment. On the contrary, several studies suggest that flexibility is not desirable, and "a clear project definition" is often found to be a critical success factor for projects, Miller and Lessard (2000). In between the two extremes of rigidity and flexibility, researchers like Olsson (2006) point out that a structured approach is needed to manage flexibility in a project, and flexibility is usually not desired in the late phases of the projects to ensure the efficiency of project execution. However, even though flexibility as a concept has evolved over times, but its theoretical basis has to be unearthed and that will lead to the sound development of the body of knowledge and gather more insights and more value, therefore this chapter tries to unearth those theories found to form the basis for flexibility.

3.2 Theories

The theories that form the basis of flexibility concept are (i) The contingency view of firms (Child, 1972); (ii) The organizational learning theory (Cyert and March, 1963); (iii) The resource-based view of firms (Penrose, 1995); (iv) The complex adaptive system perspective (Prigogine and Stengers, 1984); (v) The Transaction cost theory (Williamson, 1995); (vi) Organizational Slack theory (Bourgeois, 1981);

3.2.1 Contingency Theories

Three popular and related theories under this group are (i) Static Contingency; (ii) Population Ecology; and (iii) Dynamic Contingency.

(i) Static Contingency Theory

This theory was proposed by Burns and Stalker (1961), Woodward, (1965) and Lawrence and Lorsch (1967), who conceptualized the 'goodness of fit' between organizations and contingencies. The contingency theory of organizational structure may also be called as structural contingency theory (Pfeffer, 1982). The fundamental assumption is that the effectiveness of the organization is a function of the congruence between its internal structure and the demands of the environment. There is no one universal effective design which can respond to the contingencies presented by these external conditions. According to Donaldson (1987), the organizations that achieve a fit between strategy and structure can outperform other less fit organizations.

The Higher the level of flexibility, it's easier for organizations to respond to customer needs and overcome unforeseen contingencies (Bowersox et al., 1989). This theory postulates that:

- Organizational feasibility is dependent on a fit between an organization and its context (Pennings,1987), and
- An organization whose structure and purpose suits a particular business condition survives and or flourishes while the rest fails (Miles and Snow, 1978).

(ii) Population Ecology Theory

Organizational theorists who initiated this theory studied the effect of social, economic and political conditions on the relative success and diversity of organizations within a 'population' (Campbell, 1969; Aldrich

and Pfeffer, 1976; Hannan and Freeman, 1977). According to Hannan and Freeman (1977) 'population' can be defined as a group of organizations operating within a similar environment. This theory postulates that, it's the environment that is the sole determinant of organizational survival (Hannan and Freeman, 1989). Organizations that best fit with their environment will be selected and retained to survive, whereas organizations that are misfit will be weeded out by environmental dynamism (Perrow, 1986; Hannan and Freeman, 1989).

(iii) Dynamic contingency theory

More neo-contingency advocates (Donaldson, 2001; Miles and Snow, 1978) asserted that adaptation is a dynamic process that integrates both managerial actions and environmental forces, striving towards an optimal choice for the organization concerned. Thus, this is extremely opposite to the static contingency and population ecology theories, which focused on the concept of 'fits' (which are more a chance and luck rather) than on the process by which they were achieved. Organizational complacency has been suggested as one of the main causes that led to the failure of good companies (Sull, 1999). There will be delayed and ineffective response to dramatic environmental shifts, as organizations tend to persist their established patterns of behaviour and procedures, neglecting the need to identify and analyse opportunities and threats (Sull, 1999; Jayachandran and Varadajan, 2006). According to Sull (1999), this persistence or rigid devotion is termed as active inertia.

Some studies take the view that the main reason why many 'excellent' companies were no longer successful was mainly due to their once successful and still followed 'static' business approaches (Sull, 2005). Companies become successful because they have clear and devoted

commitments, but as time goes by, the very same devoted commitments might harden and constrain companies' ability to adapt and respond when their dynamic and competitive environment shifts (Sull, 1999; 2005; Jayachandran and Varadajan, 2006). In order to avoid active inertia as Sull (2005) points out, decision-makers should regularly review their companies' strategic frame, processes, relationships, routines and values so as to identify hardened commitment and facilitate their adaptation to market changes. He went further to conclude that "success need not breed failure if executives actively manage the organization's various commitments" by a dynamic process of self-assessment and self-organization in order to survive and prosper within a dynamic business environment (Benson Teck Heng Lim, 2010).

3.2.2 Organizational Learning Theory

Skills to learn, unlearn and then relearn on the basis of past behaviour are required for organizations to align themselves with their environments or to reshape environmental influences (Day, 1991; Wang and Li, 2007). This indicates that the process of organizational learning plays a pivotal role in attaining flexibility.

The theory of organizational learning was coined by Cyert and March (1963), and later on by many other organizational analysts who studied learning and its effect on organizational structures and systems (Peters and Waterman, 1982; Kanter, 1989 and Senge, 1990). The concept of learning has been appreciated as a key towards competitiveness (Dodgson, 1993). In a turbulent environment, characterized by rapid technological changes in products and processes, learning faster and responding faster to the rapid changes within the environment is the key to survival (Hannan and Freeman, 1984; Barlow and Jashapara, 1998; Kenny, 2006). As an antecedent of an organization's flexibility, authors have

backed the fundamental role played by the learning (Nemetz and Fry, 1988). In his work Volberda (1997) presents learning as the foundation of flexibility, calling it metaflexibility. The learning system is an antecedent to firm's flexibility potential during environment change. If flexibility represents a capacity to change, metaflexibility is the capacity to be flexible with time (Benson Teck Heng Lim, 2010).

According to Cyert and March (1963), organizational learning is a coolective process through which interaction with the environment and members within organization share information to create its memory in the form of shared beliefs and assumptions that can guide the actions of its members and the organization as a whole (Cyert and March, 1963; Hanvanich et al., 2006). According to Fiol and Lyles (1985) organizational learning can be considered as the development of insights, knowledge and associations from past actions and then utilizing that knowledge for effective future actions.

According to (Hedberg, 1981) the learning process may occur in different, unexpected situations since organizations are engaged in a process of continuous interaction with their environment, and therefore enhance their knowledge of reality by observing the results of their response and planned actions. According to him, learning process is both "adaptive and manipulative in the sense that organizations adjust defensively to reality and use the resulting knowledge offensively to improve the fits between organizations and their environment" (Hedberg, 1981). According to (Levitt and March, 1988) learning can be considered as processes whereby organizations encode inferences from the past into routines that guide behaviour. According to them, "routines" is a multi-dimensional construct comprising organizational rules, procedures, strategies, technologies, cultures, knowledge, etc. These routines are recorded in a collective

memory that is consistent, lasting and subject to continuous improvements due to social influence from other learning organizations (Levitt and March, 1988).

3.2.3 Resource-Based Theories

This theory was developed in the 1950s by Edith Penrose, who originally named it as 'the theory of the growth of the firm' (Penrose, 1959).The resource-based theory of firms (RBT) asserts that the extent to which an organization can learn and adapt depends on its resources and capabilities, explaining how the organization grows and competes in dynamic business environments, through strategy implementation.

According to (Penrose, 1959), a firm is an administrative organization and a pool of productive resources which will remain only if the firm grows continuously. She pointed out that a firm is an entity that has in its custody unique collection of resources and capabilities held together in its administrative structure, and that these resources and capabilities provide the basis for its strategy formulation (Penrose, 1995). In general, this uniquely determines the performance differential between firms (Grant, 1991; Peteraf and Barney, 2003). Competencies, internal strengths, are generated by the alignment and development of resources. These competencies enhance a firm's existing capabilities and create new ones (Day, 1994; Teece et al., 1997).

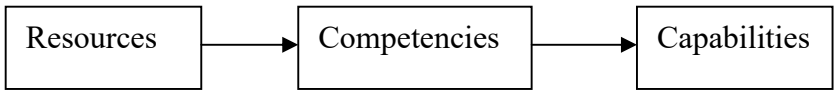

Fig 3.1-Resource –Capability link

RBT assumes that:

- Firms are fundamentally heterogeneous in terms of their unique resources and internal capabilities underlying the production, and

- Resources may not be perfectly mobile across firms, and thus the resources differences persist or sustain over time and may take the form of competitive advantage (Wernerfelt, 1984; Peteraf, 1993).

3.2.3.1 Resources

Organizational resources can be explained as "anything which could be thought of as strengths or weaknesses of a given firm" Wernerfelt (1984), and those assets or inputs to the production process, both tangible and intangible, that the firm owns, controls and has access to on a semi-permanent (i.e., long-term but temporal) basis (Wernerfelt, 1984; Grant, 1991). These may include: (i) brand names; (ii) in-house technological knowledge; (iii) skilled personnel; (iv) machinery; and (v) finance. According to Barney (1991) firms' resources can be summarized into: (i) physical; (ii) human capital and (iii) organizational capital. According to him, physical capital resources refer to a firm's plant and equipment, geographical location, and access to raw materials.

Human capital resources include training, knowledge, experience, judgement, relationship and insight of individual employees within each firm. Organizational capital resources relate to a firm's formal reporting structure, formal and informal- planning, controlling and coordinating systems, and relations among groups within themselves and between them and others within the same sector. According to Grant (1991) the resources in general are not productive, when standalone. Productive activity requires the cooperation and coordination of teams of resources.

3.2.3.2 Capabilities

According to Grant (1991) capabilities can be described as the abilities of an organization resulting from a team of resources working together and involves a complex pattern of coordination and interaction

between people, and between people and other resources. He went on to express that "while resources are the source of a firm's capabilities, which are the main source of firms' competitive advantage". Firm's capabilities have been found to be one key determinant of a firm's success (Teece et al., 1997; Galbreath, 2005; Jayachandran and Varadajan, 2006). Capabilities are groups of skills and knowledge exercised through organizational processes, which enable firms to coordinate activities and make use of their resources (Day, 1994). Capabilities allow an organization to respond and adapt to meet customer demand and provide a competitive advantage (Teece et al., 1997).

3.2.4 Complexity Theory

The complexity theory was developed in the 1960s by Ilya Prigogine, a Russian-born physical chemist, who studied how living organisms or systems are able to survive in highly unstable, or far from equilibrium conditions. In explaining this phenomenon, he developed the theory of 'dissipative structures' that was the first description of what is now being known as 'self-organizing systems' (Prigogine and Stengers, 1984). Subsequently, self-organization and self-organizing systems became the key concepts in the complexity theory.

The complexity theory deals with the study of complex systems that comprise many interactive elements linking in complex ways (Simon, 1996). Frenken (2006) referred to a complex system as a graph represented by nodes (i.e., elements) and edges (i.e., interactions), and the complexities are defined by the number of interactions between elements. It is this structure of interactions between elements within an entire system that is of main interest to researchers who studied complexity theory (Carroll and Burton, 2000; Frenken, 2006). According to Carroll and Burton (2000), a

loss of understanding of the whole system under study will occur if the problem concerned is simply dissected into several smaller parts. Thus a complex system has to be studied by accepting the nature of complexity as it is and not by simplifying and dissecting into parts. Efforts to simplify a complex system or reduce complexity will make the system study more unreal and useless. In organizational science, many studies highlighted that organizations can be seen as a systemized whole comprising many interdependent and coordinating elements, which interact, relate and evolve within their environments (Englehardt and Simmons, 2002 ; Eijnatten and Putnik, 2004). Waldrop (1992) characterized a complex system as the system that (i) comprises a great many independent agents who are interacting with each other; (ii) depends on systemic interactions that lead the system to spontaneous self-organizations; and (iii) learns through feedback. According to Anderson (1999), the element of complexity can be treated as a structural variable that characterizes both organizations and their environments. Daft (1992) operationalized the element of complexity into the number of activities or subsystems within an organization that can be measured along three dimensions. These include: (i) vertical complexity, i.e., the number of levels in an organizational hierarchy; (ii) horizontal complexity, i.e., the number of job titles or department across an organization; and (iii) spatial complexity, i.e., the number of geographical locations. Organizations must match the complexity of their organizational structure against the complexity of their environments and technologies in their attempt to improve firm responsiveness and adaptation (Galbrath, 1973). Two modes of adaptation to complexity were discussed by (Boisot and Child, 1999). First, in a complexity reduction mode, firms seek to understand environmental complexity and deal with them in a timely manner. The other mode is complexity absorption where firms create options and formulates risk-hedging strategies, for example, entering into

partnership relationships and forming alliances, in response to marketplace influences.

3.2.5 Transaction Cost Theory

Transaction cost economics is concerned with the management of contractual relations considering the evaluation of transaction costs in make or buy decisions. Thus the main task of management becomes creation of a system of corporate governance that minimizes production and transaction costs and realizes the objectives of firms. This perspective takes all major factors relevant to organizations into account and looks for minimizing transaction costs. Of the various factors environmental factors consists of uncertainty and complexity and small numbers of exchange (Williamson, 1975). Two typical human factors-Bounded rationality and opportunism influences human transactions. According to Simon (1957) bounded rationality can be defined as a behaviour that is "intendedly rational, but only limitedly so". Opportunism refers to the fact that people tend to act with self interest and guile in pursuing their own goals (Williamson, 1975). These factors add to environmental factors.

The performance of sourcing is measured by standard performance indicators like quality, costs, delivery and flexibility (P. Schoensleben, 2007). Outsourcing provides companies with greater flexibility (Carlson, 1989; Harrison, 1994). A network of suppliers can provide the scale and scope of production capability at lower cost, in response to demand fluctuations at a rapid rate. Thus, flexibility must become part of contractual relationships, but keeping them for a long-term is difficult as technology, competitive and regulatory environment may change wildely and dramatically.

3.2.6 Organizational Slack Theory

Organizational slack is defined as buffer of resources which allow an organization to adapt successfully to internal pressures for adjustment or to external pressures for change in policy, as well as to initiate changes in strategy with respect to the external environment (Bourgeois, 1981). Thus slack can be defined as the pool of resources in an organization that is in surplus of the minimum essential to create a given level of output.

3.2.6.1 Forms of Organisational Slack

Slack resources take the form of surplus rewards to stakeholders, excess dividends, lower prices or excess services to buyers, excess wages and permitted inefficiencies in organisational structure without regard for revenue (Cyert & March, 1963).

3.2.6.2 Financial and Nonfinancial Forms of Slack

The slack has been conceptualized to have both a financial and non-financial form (Daniel et al., 2004; Marino & Lange, 1983). It can be actual or potential (Bourgeois, 1981). Financial forms include cash and other assets while non-financial forms are human resources, social capital, reputation and goodwill (George, 2005).

3.2.6.3 Sources of Organisational Slack

According to Bourgeois (1981) managerial actions and the external environment are the two sources of slack. Managers can create slack by identifying and exploiting positive turns in the external environment (Cyert & March, 1963). Slack may be either deployed, absorbed into as costs, or remain as unabsorbed liquid resources (Singh, 1986).

The ease of slack recovery or the speed of resource recovery for potential redeployment has been discussed by (Bourgeois and Singh, 1983) and they suggested that slack be measured along quickness of recovery. In

their work Nohria and Gulati (1996) focussed on short term slack for resources that can be recovered within a year at the discretion of the manager.It was discussed by Sharfman et al. (1988) as being influenced by the environment, the organization and the values and beliefs of management.

3.2.6.4 Functions of Organisational Slack

According to Bourgeois (1981) the three primary roles of organizational slack are (1) as an internal shock absorber of spare resources against internal stresses, (2) as assisting strategic adjustments to changes in the external environment and (3) as a strategic resource that allows proactive responses to the external environment. He further expanded on his definition of slack to propose four primary functions of organizational slack as: (1) a reason for coalitions, (2) an aid for conflict resolution, (3) a workflow buffer, and (4) a facilitator of the organizational strategic behaviours of flexibility and innovation.

The first three functions of organizational slack help to maintain the internal maintenance of the organization (Bourgeois, 1981). Firstly, slack is viewed as an inducement for members to remain with and contribute to the organization. Relying on Barnard (1938) inducement to contribution ratio, Cyert and March (1963) suggested slack payments are excess payments of inducements greater than that required to maintain the coalition, in essence an inducement to contribution ratio of greater than one. This excess inducement function of slack is seen in the form of high wages and salaries, executive perks and excess dividends. Secondly, slack is a resource for the resolution of conflict between an organization's competing sub-units (Pondy, 1967).

By facilitating decentralized decision making and sequential attention to goals, slack allows options to be dispersed among competing sub-units. Without sufficient slack, sub-units are constrained and forced to compete for resources to achieve their often conflicting operational goals. For example, by allowing a non-standard investment in the production department, their conflict with the sales department may be eased because of the lessening of conflict between production (quality) and sales (volume) goals. Thirdly, slack as a workflow buffer serves the shock absorbing function by buffering deficits in inputs to organisations and variability in organisational systems (Bourgeois, 1981). Whether from a physical technical resource or information processing perspective, slack resources smooths organization workflows. Slack in inventories, for example, buffers discontinuities in external supplies as well as variations in production (Galbraith, 1973; Thompson, 1967). In summary, slack functions within organizational systems to smooth internal processes and insulate it from the effects of environmental shifts. Positioning the theories on the basis of the role they have, giving rise to the concept of flexibility for an organization can be represented by the following diagram.

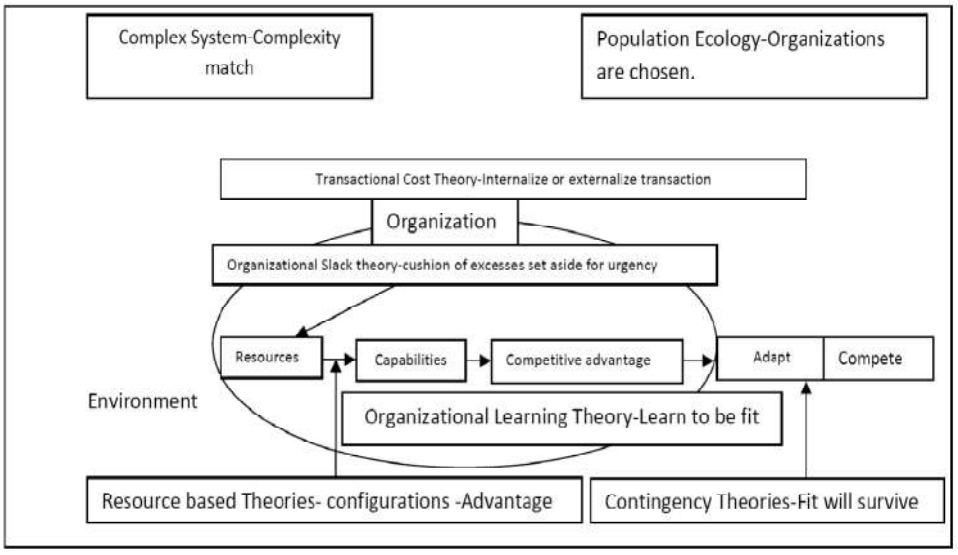

Fig 3.2-Flexibility Theoretical Foundation's summary

Summary

The fundamental assumption is that the effectiveness of the organization is a function of the congruence between its internal structure and the demands of the environment. According to (Donaldson, 1987), the organizations that achieve a fit between strategy and structure can outperform other less fit organizations. A challenge is that, structural contingency theory is static and fails to deal with organizational change and adaptation (Galunic and Eisenhardt, 1994). But, he concludes that the chief axiom is the necessity of attaining and maintaining flexibility. Managers of companies seem to be aware of the benefits of being flexible, but lack the necessary guidance to create this rather ethereal and elusive quality in their organizations. In his work Steers (1975) noted that flexibility has been the evaluation criterion mentioned most often in organizations. Unfortunately, there is relatively little theory on flexibility as well as a lack of theoretical frameworks to guide management in understanding and identifying different types of flexibility and in creating and sustaining flexible organizations (Volberda, 1998).

Eppink (1978) confirms that although flexibility may be regarded as a means of addressing organizational problems, the areas for enhancing flexibility remain largely unexplored. The methods adopted by managers to create flexibility in their organizations, consequently are of an ad hoc nature, rather than forming a comprehensive, systematic and structured approach (Aaker & Mascarenhas, 1984). Thus, there is a need for comprehensive frameworks of the theoretical and practical aspects of flexibility that will help decision makers to assess, create or even destroy flexibility in response to environmental change.

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Chapter- 4

RESEARCH METHODOLOGY

Introduction

This chapter comprises of four parts namely, Part1. Research Design and method of study, Part 2. Operationalization of Constructs, Part 3.Questionnaire Development and Part 4. Methods of Research Analysis. The first part delves deep into the research design used for this study. The phases of research design are explained. Details of sampling, population and data collection are also presented. The second part, contextualize and operationalize the proposed model with already existing scales in similar domains. The third part presents the development of questionnaire with use of multiple Item approach following a semantic differential scale on a Likert design. The fourth part reviews the reasons and relevance of using Structural equation modelling, component based SEM ie. PLS and why SMART PLS software was used for this study. The PLS modelling procedure is explained in detail in the subsequent part.

PART 1-RESEARCH DESIGN AND METHOD OF STUDY

4.1.1 Introduction

This part gives details on the research method used to carry out the present study. This research was conducted in three phases, namely: (i) exploratory phase (ii) questionnaire development phase; and (iii) data collection and analysis phase.

4.1.2 Research Design

A research design is the strategy for getting answers to the questions; distinguished as cross sectional or longitudinal, where cross-sectional design collects data at one point in time and thus limits causal inferences because the study is conducted at one point in time and temporal priority is difficult to establish.This study follows a cross sectional design with survey method as technique of data collection as it is found relevant and sufficient in meeting the research objectives.

4.1.2.1 Justification for adopting survey research method

(i) The Indian construction industry doesn't have sufficient previous literary works on flexibility in general or operational flexibility, in particular, which shrinks the appropriateness of archival or historical research.

(ii) The focus of this research is on the role of operational flexibility in achieving effective project management. An experimental design is thus considered as inappropriate in this research; and

(iii) The research objective required identifying the characteristics of the organizations (87 respondents) that contribute to develop operational flexibility, leading to effectiveness in project management. This has made a case study design unfeasible. It is uneconomical and time-consuming to investigate in detail such a large sample to prepare cases.

Various methods suggested by Churchill (1979) and Dillman (2007) were taken in various phases of this research to compensate for the limitations of survey research. The two major methods adopted here include:

(i) The use of multiple techniques in generating measurement items and

(ii) The use of retrospective reporting and key informant approaches in the data collection process. These two methods sought to improve the reliability and validity of the survey data.

(iii) Multi-item approach and improvised sampling selection process were also adopted.

(iv) A three-phase research process (i.e., exploratory, questionnaire development, and data collection and analysis) were implemented in an attempt to combine both the qualitative and quantitative research approaches. This combination capitalizes on the strengths and complements the weaknesses of each approach, and thus provides a synergistic research design.

4.1.3 Phases of this Research design

This research started with an exploratory phase which involved literature review and semistructured face to face interview. The interview and literature review helped to define the terms for this study. This was followed by development of research hypotheses. A questionnaire survey was used as the data collection method with key informant retrospective reporting. A pilot study was conducted with fifteen respondents, followed by final data collection from seventy two respondents. Thus, a total of eighty seven completed questionnaires were obtained.

4.1.3.1 First Phase-Exploratory Phase

Why, one must study the importance of operational flexibility in the Indian construction industry was the first question that the researcher required to answer, in front of the academia and therefore this phase was utilized to answer the 'why and how' of flexibility and operational flexibility. The objectives of this phase were as follows

1. Identifying the knowledge gap in previous international studies on flexibility and operational flexibility.
2. Look for studies on this concept in Indian project management setting.
3. Find out the predictors / determinants of operational flexibility.
4. Find out the advantages of having the operational flexibility as found in the literature.
5. Understanding and identifying the main characteristics of the Indian construction business environment.
6. Understanding and identifying the various industry specific terms and languages used to define operational flexibility.
7. Understanding and identifying construction industry specific terms and languages related to operational flexibility.
8. Understanding the Indian construction project management practices.
9. Developing operational definitions for operational flexibility, types of flexibility, predictors and for other elements of the model proposed.
10. Go through a cycle of qualitative data analysis by getting what is most suitable from literature review and thereby develop guide questions for semi structured interview and finally use literature review, existing scales and interview findings to build a questionnaire for the final survey.

4.1.3.1.1 Face to face interview during exploratory phase

A semi-structured interview is a qualitative method of research used in the social sciences. Here the researcher combines questions that prompt discussion with the opportunity to explore particular responses, further leading to new ideas. The researcher / interviewer has a framework of themes to be explored.

The interview discussed here could be described along the continuum as 'semi-structured'. Authors like Cohen et al. (2007) draw attention to the variety of interview models discussed in methodology literature. According to Patton (1980), there are four types including the "interview guide approach". This resembles closely the method employed in this phase of research. This ultimately relates to broader questions about qualitative and quantitative methodologies, a point suggested by Cohen et al. (2007). Face-to-face interviewing is appropriate as the depth and meaning of terms are equally important and the research is primarily focused on gaining insights (Gillham, 2000); Ritchie & Lewis, 2003).

4.1.3.1.2 Developing the interview guide questions

List of definitions on the types of flexibility and dimensions of flexibility was presented to the interviewees and were asked to comment on these definitions, which helped in the operationalisation of variables and building definitions that were used in the development of the questionnaire. Review Literature of construction, performance, project management from around the world and on flexibility in manufacturing and construction industry was thoroughly looked into to prepare the guide questions.

A total of five face to face semi structured interviews were conducted with project managers of construction firms. Judgmental and snowball approach was used in selecting the interviewees, as found more practical and suitable in the exploratory phase.

1. Senior most Project managers were identified and straight away this method helped in obtaining quick inputs.
2. The above set was hard to identify but turned out to be more resourceful in contextualizing the questionnaire and therefore even though hard to reach could improve the relevance and meaning of the study.

3. They were also key personnel of the respective firms and had the capacity to, not only answer the questions but also, contribute by feedbacks and insights. This proved to be prerequisite for later industry wide survey.

Criteria kept and met were the following:

1. Interested in research
2. Sufficient and more experience and expertise
3. Willing to share time and experience
4. The numbers of interviewees were decided based on point of of saturation as far as contribution of ideas were concerned.

Interviewees were all senior project managers having more than 15 years of experience, whose views were found noteworthy and reliable. Interviews took about 75 minutes on an average.

4.1.4. Preliminary interview findings

The interviews helped the researcher to understand Indian construction industry at large, and the construction business environment in Kerala, the market forces and the challenges faced by builders from various quarters. The interviewees also shared their perspectives on operational flexibility.

4.1.4.1 Construction industry and its environment in India

Major real estate actors in Indian Real estate markets are Banks, Developers, Buyers and investors and regulators. Banks are trying to reduce exposure to developer community on ground of lack of transparency and appropriate disclosure from developers. This has has led to shortage of fund at reasonable cost. Developers in general, maintain high real estate prices with justification that input costs are rapidly increasing along with high cost of funds.These led to demand shrinkage and interfered with their cash flows,

inturn affecting ongoing and future construction works. Buyers and investors are following a wait and watch approach with a major portion of investors still away. No beneficial actions being taken by regulators, as all of the interviewees expressed concern about the lack of political will, instability and governance issues. Delays in approvals were leading to supply issues. Land is the basic ingredient for any real estate to fructify. Availability of land is becoming more and more difficult especially in Kerala, leading to considerable rise in land values and property prices. This results in developers deferring their project launches, keeping their prices high.

Rising cost of construction materials has also hampered the pace of construction activity in some projects, particularly those under initial stages of implementation. Respondents conveyed that, delay in the ongoing projects is due to the low demand for real estate and lack of suitable technology. Lack of public infrastructure is another problem faced by the developers, especially roads and water. In order to deal with these challenges posed by environment along with interest rate, home loan rate hikes and consequent drops in demand, the interviewee firms adopted practices like:-

1. Increased focus on developing employee skills
2. Better procurement practices
3. Stringent quality and cost control
4. Stricter adherence to project schedules and
5. Balanced portfolio with a mix of flats, villas, rentals, office buildings, lands etc.

4.1.4.2 On Perspectives on flexibility

From their existing knowledge of what flexibility and operational flexibility means and from what the researcher has shared, the definitions of flexibility and operational flexibility emerged were as follows.

1. Respond to changes in internal and external environment rapidly
2. Ability to learn and respond fast
3. Avoid risks and get the best out of opportunities
4. Ability to reallocate resources to better satisfy clients
5. Lead to effectiveness

However, all of them shared the view that in the pursuit of flexibility, the company must not lose its identity, principles and policies and bring anarchy or lack of discipline into the company. When explained about the various dimensions of flexibility, all of them shared the idea that it will be operational flexibility that can bring about effectiveness in projects and needs empowerment of each department and better communication. Three of them shared the view that flexibility must have some boundaries or a space of manoeuvring which is acceptable, with definite goals as it demands extra attention, commitment and hard work from the side of employees.

From what was asked as sources of flexibility, human resource skills, behaviour and practices were pointed out as a prime source from which the concept must start along with, learning practices and knowledge management, supply chain practices particularly the procurement. They also pointed out that technology of the construction process and IT capabilities can enhance operational flexibility potential. They all expressed a concern that the flexibility might hamper their schedules of work, but at the same time can bring smiles on the face of customers.

4.1.5 Definition of terms

Major terms of this study are as defined below:

1. **Construction Firms**

   This study defines construction firms as real estate developers who fulfil the need for infrastructure in the of area housing.

2. **Construction Projects**

   Construction projects are defined for the purpose of this study as the process of adding housing structure to real property.

3. **Project Management Teams**

   A project Management Team essentially has members belonging to different groups and functions assigned to activities for the same project and for a defined period of time.

4. **Flexibility**

   Flexibility is the ability or potential to change and adapt to a range of states in order to cope with demand for change and uncertainty.

5. **Operational flexibility**

   Operational flexibility is defined as a short-term ability pertaining to day-to-day operations. This ability tends to be reactive in nature, but has to be prepared for and enables firms to respond to changes in a systematic and timely manner.

6. **Determinants/Predictors**

   This study defined determinants as the enablers or factors that contribute to attainment of operational flexibility. Determinants or the predictor constructs are group of independent variables comprising: (i) learning culture; (ii) Team members' skills and behaviour; (iii) Technological

capabilities; (iv) Supply chain capabilities; (v) Human resource Management practices.

7. Measurement items

Measurement items are the observed variables or items that are used to assess or measure the value of respective constructs, which could be of single or multi-dimensional nature.

8. Dimensions of flexibility

Flexibility is characterized by three dimensions, namely: (i) operational flexibility; (ii) tactical flexibility; and (iii) strategic flexibility. The dimension that we are concentrating in this research is operational flexibility.

9. Types of operational flexibility

In this study operational flexibility dimension is operationalised into five types- Demand management, new product development, modification, volume and mix flexibility**.**

PART II-OPERATIONALIZATION OF CONSTRUCTS

4.2.1 Introduction

This part of the methodology chapter is devoted for the operationalization of the predictor constructs and the predicted constructs, along with the environmental components which act as moderators. Corresponding sections provide a review of literature on domain and measurement items.

The flexibility is defined as the ability to change or react, without loss of time, cost and performance (Upton, 1994). It can also be defined as "the ability to adapt to both incremental and revolutionary changes in the

business or business process with minimal penalty in current time, effort, cost or performance" (Nelson & Ghods, 1998).

Flexibility cannot be bought; it must be planned, developed from within and managed (Gupta & Goyal, 1989; Gustavsson, 1984). It is possible to conclude that same flexibility can be achieved at an extra cost, but it is more important to know, how flexibility is developed from within at minimal cost and managed.

How much flexibility does construction firm needs? There appears to be a trade off between flexibility and stability. From the managerial standpoint, stability is too valuable to be disregarded and flexibility can be managed while maintaining efficiency.

The construction industry is inherently complex and dynamic in nature with its not so transparent transactions and an exceptionally numerous stakeholder participation like clients, contractors, consultants, stakeholders, shareholders, regulators and others**.**

Dynamism describes "the degree of the market's instability over time and the turbulence caused by interconnectedness between organisations" (Aldrich, 1979; Mintzberg, 1979). In the project situation, this interconnectedness becomes even higher when several projects are being undertaken by the same fimr. According to Keat and Hitt (1988) dynamism of a system is significantly related to performance. Dynamism could be related to the political, natural or social environment. Therefore organisational environmental munificence and dynamism captures the project's external environmental factors. The human and nonhuman factors at play are most often than not, the sources of changes that confront project execution and demand quick strategic response.

The following section presents the literature review and measurement items of identified Predictor variables, Moderators, Operational flexibility and Effective project management.The predictor variables are Project Learning Culture, Supplychain Capabilities, Technological Capabilities, Human Resource Management Practices and Employee Skills and Behaviour.The moderators are namely-Micro Environmental factors and Macro Environmental Factors.

4.2.2 Predictor 1-Project learning Culture

Many studies have indicated the impact of organizational learning culture on firms' financial performances (Skerlavaj et al., 2006; Spicer and Sadler-Smith, 2006; Correa et al., 2007). The cultural orientation towards learning is called learning culture and is the type of culture that a learning organization should have. The central idea underlying this kind of culture is to promote and value individual learning with the objective that, individual learning, through sharing processes, turns into group learning or organizational learning and in doing so can contribute to organizational success. This is a win-win relationship, as when an organization increases its success rate, its employees will benefit too. In fact, facing more and more global, dynamic and uncertain environments, an organizational culture oriented to productive learning will lead to new and useful knowledge which in turn leads to innovative ways to solve problems or optimize processes, increases the probability of success.

Regarding the characteristics that distinguish this kind of culture from other cultures, there are points of convergence among authors (e.g. Marsick and Watkins, 2003; McGill and Slocum, 1993; Simons, 1996). Among them are in learning as a core value, people focus, concern for stakeholders, environment for experimentation, risk taking, a readiness to

admit errors and learn from them, open communication, cooperation, interdependence and sharing of knowledge.

Project organizations, like all other organizations, are facing the challenge of meeting the stakeholder objectives to remain competitive in the environment, which is knowledge based (Toffler, 1990).There is also a need to gain knowledge faster in competition (Stata, 1989). This calls for meeting efficiency, effectiveness criteria in the projects as the customer desires. In order to consistently deliver quality, project managers must develop the ability through experience of handling many projects. Thus professional services entities must develop the ability to learn from experience (Ricks, 1997).

Learning is the process of knowledge creation and improvement by gaining from experience (Bohn, 1994; Fiol and Lyles, 1985). According to Peters and Homer (1996) there is a need for project managers to learn continuously by establishing a set of processes for supporting learning among project team members. According to Garvin (1993) a learning organization is capable of creating, acquiring, transferring knowledge and modifying its behaviour accordingly. The focus here is on improving project quality and performance by building knowledge, as a project organization survives by sake of technical knowledge gained from successes and failures (Kharbanda and Pinto, 1996; Petroski, 1992).

Inorder to learn from project experiences and improve project knowledge and performance; it requires providing a learning framework in a project management environment. Learning-by-doing requires practices to accomplish positive results and avoid negative results (Anzai, 1987). The plan-do-study-act (PDSA) cycle from quality management Juran (1988) is used as a basis for making the scale shown below, to measure learning process in a project environment. In plan step, the project team determines

the nature of the problem and constructs a plan. In the do step, the project team implements the plan. Implementation produces a set of results of expected and unexpected actions. For this study measurement items for project learning culture were taken from the scale of (Kotnour, 2000).

Table-4.1-Measurment items of Project learning culture

Dimensions	Measurement items	Remark
Inter Project learning	During the planning, we review past plans.	@
	During the planning, we review past lessons learned.	@
	During the planning, we involve the people who have completed similar work in the past.	@
	We share what we learn with each other	@
Intra project learning	We produce a detailed project plan discussing cost, schedule, and performance for each project.	@
	When a ``mistake' ' or failure to meet expectations occurs, we admit the mistake.	@
	When a ``mistake' ' or failure to meet expectations occurs, we conceal the mistake or blame someone else.	#
Learning Support	During project execution we collect the data about the actual set of steps used to complete the project.	@
	During project execution we collect the data about the set of problems encountered in completing the project.	@
	We believe as project is an opportunity for learning.	@
	We are willing to share learning about project successes	@
	We are willing to share learning about project failures	@
	When we produce a lesson learned we tell the truth	#

Δ- modified based on the exploratory interview and pilot study findings and tested in subsequent fieldwork
- omitted from subsequent fieldwork based on the preliminary interviews and pilot study findings/ proposed item overlapped with others/ is not applicable to this study.
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4.2.3 Predictor 2- Supply chain capabilities

Supply chain management has a strategic nature of improving the performance of an individual, organization and the entire supply chain participants. SCM must integrate both information and material flows to build sustainable competitive edge. Donlon (1996) describes the latest evolution of SCM practices as supplier partnerships, outsourcing, information technology sharing etc. Tan et al. (1998) identified six aspects of SCM practice as supply chain integration, information sharing, supply chain characteristics, customer service management, geographical proximity and JIT capability. Chen and Paulraj (2004) used supplier base reduction, long-term relationship, communication, cross-functional teams and supplier involvement to measure buyer–supplier relationships. Min and Mentzer (2005) identified the concept SCM as including agreed vision and goals, information sharing, risk and reward sharing, long-term relationship, etc.

The scale used for this study has five dimensions like strategic supplier partnership, customer relationship, the level of information sharing, quality of information sharing and postponement. Table 4.2 lists these constructs along with their definitions and supporting literature. A more detailed discussion of these dimensions is provided below.

The strategic supplier partnership is defined as the long term 'partners like'relationship between the organization and its suppliers that can leverage the strategic and operational capabilities of each other by mutual planning and problem solving, shared responsibility, involvement in early stages of product-design process.

Customer relationship comprises of efforts for managing complaints, building long-term relationships and improving customer satisfaction. Noble and Prather (1996); Tan et al. (1998) consider customer relationship management as an important component of SCM practices. According to Day G. (2000) commitment in relationships brings sustainable advantage because of their inherent protection from competition.

The level of information sharing has two aspects: quantity and quality. Both are independent and important for the practices of SCM (Monczka R. M., 1996). Quantity aspect of information sharing refers to how far the critical and proprietary information is communicated to partners. According to Stein and Sweat (1998), supply chain partners who exchange information regularly can work as a single entity and can understand the needs of the end customer better and respond to market quicker.

Quality of information sharing includes such aspects as the accuracy, timeliness, adequacy, and credibility of information exchanged (Monczka R. M, 1996). While information sharing is important, the significance of its impact on SCM depends on what information is shared, when and how it is shared, and with whom (Chizzo S. A., 1998) & Holmberg S., 2000).

Postponement is defined as the practice of moving forward one or more operations to a much later point in the supply chain. It must consider: (1) How many steps to postpone, and (2) Which steps to postpone (Beamon

B. M., 1998). Keeping materials undifferentiated as close as possible to the output side will reduce costs, increase flexibility in responding to changes in customer demand (Lee H. L, 1995). For this study measurement items of supply chain capabilities were taken from the scale by (Suhong Li et al., 2004).

Table 4.2- Measurement items of supply chain capabilities

Possible Dimensions	Possible Measurement items	Remark
Strategic Supplier Partnership	We consider quality as our number one Criterion in selecting suppliers.	@
	We regularly solve problems jointly with our suppliers.	@
	We have helped our suppliers to improve their product quality.	#
	We have continuous improvement programs that include our key suppliers.	@
	We include our key suppliers in our planning and goal-setting activities.	@
	We actively involve our key suppliers in new product development processes.	@
Customer Relationship	We frequently interact with customers to set reliability, responsiveness, and other standards for us.	@
	We frequently measure and evaluate customer satisfaction.	@
	We frequently determine future customer expectations	@
	We facilitate customers' ability to seek assistance from us.	@
	We periodically evaluate the importance of our relationship with our customers.	#
Level of Information Sharing	We inform suppliers and contractors in advance of changing needs.	@

	Our suppliers and contractors share proprietary information with us	#
	Our suppliers and contractors keep us fully informed about issues that affect our business.	@
	Our trading partners share business knowledge of core business processes with us.	#
	We and our suppliers and contractors exchange information that helps establishment of business planning.	@
	We and our trading partners keep each other informed about events or changes that may affect the other partners.	#
Quality of information Sharing	Information exchange between our trading partners and us is timely.	@
	Information exchange between our trading partners and us is accurate.	#
	Information exchange between our trading partners and us is complete.	#
	Information exchange between our trading partners and us is adequate	@
	Information exchange between our trading partners and us is reliable.	@
Postponement	We try to incorporate a modular concept in our projects	@
	We delay final product assembly activities until customer orders have actually been received.	@
	We delay final product activities until the last possible position (or nearer to customers) in the supply chain.	#

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- omitted from subsequent fieldwork based on the preliminary interviews and the pilot study findings/ proposed item overlapped with others/ is not applicable to this study.

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4.2.4 Predictor 3- Technological capabilities

Residential building construction projects are becoming more technically advanced in terms of the design, nature and internal environment of built facilities (Hassan et al., 1998). Thus, the ability of construction firms to implement advanced and appropriate technologies for better efficiency and productivity of construction activities has become the main source for creating and sustaining firms' competitive advantages (Bennett, 1991; Ho and Liu, 2003).

In construction, technology can be defined in relation to Tatum (1987) and Goulding and Alshawi (2002) process management perspective. According to Tatum (1987) construction technology can be described as the integration of construction practices and resources and work tasks that define the manner of performing a construction operation.

In this study, technology is defined as organizational capabilities or competences, whereby mechanical and intellectual efforts are employed to transform resources into final goods and services. This is consistent with Shirazi et al. (1996) and Scott and Davis (2007), who pointed out that technology includes mechanical and intellectual processes facilitating a firm's input-transform-output process.

4.2.4.1 Dimensions

In this study, technological capability comprises two dimensions: (i) information technology capabilities and (ii) process technology capabilities. Descriptions of these two dimensions are and their respective measurement items are summarized in Table 4.3.

a) Information technology capabilities

A firm's information technological capabilities can be defined as the relative capabilities that facilitate information flow and communication

within the firm and between firms, thereby improving their response capability and competitiveness through better technical and market knowledge (Desarbo et al., 2005). According to Johnson and Clayton (1998), a firm's information technology capabilities could refer to the relative capabilities that help to (i) improve collaboration and effectiveness of individuals in both intra and inter organizational environments, and (ii) create new services and markets by facilitating the acquisition and conversion of information into knowledge that creates distinctive value.

b) Process technology capabilities

Desarbo et al. (2005) defined process technology capabilities as the relative capabilities that help a firm to improve production process efficiency and achieve greater consistency in product delivery, thus leading to improved competitiveness. According to Johnson and Clayton (1998) it is a form of process improvement through the use of information technology. Besides this Tatum (1989) defined process technological capabilities as a firm's ability to achieve process improvement in construction methods, designed to accomplish usual construction operations or to improve the efficiency of a standard operation. For this study measurement items of technological capabilities were taken from the scale by (Benson Teck Heng Lim, 2010).

4.3- Measurement items of Technological Capabilities

Possible Dimensions	Possible Measurement items	Remark
IT capabilities	Our firm has the ability to communicate and share real time information among supply chain parties regardless of geographic dispersion.	@
	Our firm has the ability to communicate and share real time information among all decision makers and employees regardless of geographic dispersion.	@
	Our firm has the ability to retrieve information ie. from existing/past projects, from company database in a timely manner regardless of geographic dispersion.	@
	Our firm has the ability to disseminate information and link similar information providing decision makers with the most up to date and accurate information regarding changing environmental contingencies.	#
Construction Process capabilities	Our firm has the ability to adopt different construction process technologies (eg: Construction materials and methods) to satisfy clients requirements.	#
	Our firm has the ability to apply different process technology software (eg: estimating and purchasing software) to improve firms operational process.	@
	Our firm has the ability to lead in process technology innovation (eg: in house research done in core processes)	@

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@ - incorporated into the questionnaire without modification, based on the preliminary interviews and the pilot study findings, and tested in subsequent fieldwork

4.2.5 Predictor 4- HRM practices

Project-oriented organizations adopt project-based ways of working as a strategic choice Gareis (2005), in response to their customers' demands Turner and Keegan (2001), and so the HRM practices adopted by the organization should support that choice, and the HRM in such organizations are different from main stream HRM due to temporary and dynamic work environment, thus are fine tuned to and support project management practices (Schuler and Jackson, 1996; Flood et al, 1996). Every beginning and end of projects leads to change in the HRM configuration of the organization. Thus traditional models of HRM won't fit in here, (Huemann et al., 2007). In other words project-oriented organizations will require additional and different HRM practices and processes catering to dynamic working environments an inturn must take care of additional stresses on employees.

HRM practices of the company must be attentive to the HR configuration change at the start and finish of projects at its various sites and the temporary organization formed there.Thus there is need for HRM practices pertaining to assigning and dispersing personnel according to project requirements, assessing, developing and rewarding their work on projects and ultimately linking project assignments to careers.

A project oriented company holds a portfolio of different internal and external project types Gareis (2005) and same person may work in dfferent roles in multiple projects leading to role conflict (Rau and Hyland, 2002). The organization needs HRM practices to assign people to meet several roles at the same time.

These organizations possess management culture empowering employees process-orientation and teamwork, organizational change, customer-orientation and networking with clients and suppliers (Gareis, 2005). This demands specific competencies and skills of personnel to work together in projects. This requires HRM practices to build training and development practices that can develop employees specifically to the project environment. For this study measurement items for HRM practices were taken from the scale by (Benson Teck Heng Lim, 2010).

Table 4.4- Measurement items of HRM practices

Dimensions	Measurement items	Remark
Competence development	Organizing training on the latest issues (e.g. A change in regulations and safety requirements) that have direct impact on firms operational processes	@
	Organizing training to upgrade employees' knowledge and skills in using IT equipment and application (e.g. Email)	#
	Organizing training to upgrade employees' knowledge and skills in using IT software (e.g. MS project, AutoCAD and accounting software).	@
	Organizing training to upgrade employees' knowledge and skill on the application of different procurement options (e.g. Design and build).	#
	Organizing training to upgrade employees knowledge and skills on the application of different construction methods and technologies	@
	Offering on the job training.	@

	Offering job rotation programme.	#
	Offering job enrichment programme.	@
	Offering day release schemes to attend part time courses in institutions.	#
	Allowing employees to take a day off for their continual professional development and professional qualification courses.	#
	Implementing the mentoring scheme to support new recruits and recently promoted employees.	#
	Collaborating with management institutes to provide training for employees.	#
	Subsidizing tuition fees of self upgrading courses and seminars attended by employees.	@
Stress Management	Allowing employees to take time off as and when it is necessary	#
	Organizing stress coping and management courses.	@
	Implementing a buddy scheme among employees.	#
	Implementing personal counselling program.	@
Performance management	Organizing informal gatherings to recognize employees' achievements and to foster team building	@
	Providing flexible compensation plans (e.g.: performance bonus)	@
	Organizing company trips to reward employees' contributions to the firm's business performance	#
	Conducting a staff performance appraisal exercise as a formal means of discussing, identifying and recording their training need	@
	Offering career development and promotion opportunities	@
Relationship management	Encouraging regular face to face communication among employees.	@
	Conducting regular meetings among subordinates and superiors	#

	Implementing survey feedback programmes to track the well being of employees	@
	Encouraging regular meetings among employees and parties in the supply chain	#
	Implementing induction programme for all new recruits	#
	Providing subcontractors/suppliers the flexibility to plan their delivery schedule.	@
	Offering incentive scheme to suppliers and subcontractors (e.g.: early payment).	@
	Providing after sales service to clients.	#
	Organizing training for other parties in the supply chain (e.g.: seminar)	#
	Keeping constant contact with clients to keep of their business need	#
	Organizing informal gatherings among other parties in the supply chain	@
Δ- modified based on the exploratory interview and the pilot study findings and tested in subsequent fieldwork # - omitted from subsequent fieldwork based on the preliminary interviews and the pilot study findings/ proposed item overlapped with others/ is not applicable to this study. @ - incorporated into the questionnaire without modification, based on the preliminary interviews and the pilot study findings, and tested in subsequent fieldwork		

4.2.6 Predictor 5-Employee skills and Behaviour

Research on the potential benefit of employee skills and behaviours has taken individual to firm level analysis and outcomes. Scholars have investigated employee adaptability (Lepine, Colquitt, & Erez, 2000; Donovan, & Plamondon, 2000), employee behaviours (Greve, 1998), Human capital dimensions such as education and experience (Hitt, Bierman,

Shimizu, & Kochhar, 2001) and employee resistance (Larsson & Finkelstein, 1999) and firm-level outcomes.

Flexibility of employee skills points to the number of alternative uses or application of employee skills and their rapid redeployment (Wright & Snell, 1998). Employee behaviour flexibility represents a broad range of behavioural scripts that can be adapted to demands of situations. Firms may have employees who possess a set of general and specialist skills. The generalist can generate output streams for existing and alternative requirements. Firms may also employ a wide variety of "specialist" employees who provide flexibility by allowing the firm to reconfigure and improving skill profiles of self and others to meet changing needs (Neuman & Wright, 1999). Broad-based skills are complex and difficult to imitate because these are generated by diverse experiences. At the organizational level, firms develop skill flexibility through processes such as job-rotation, cross-functional teams and project-based work arrangements, all of which generate broad skill configurations specific to the firm that are not easily replicable. This suggests that, higher the level of a firm's skill flexibility, more likely they exhibit higher performance.

There have been numerous situations were, employees may be skilled but lack the behavioural motivation to change or viceversa (MacDuffie, 1995). Behaviour flexibility creates value in two ways. First, adaptable individuals adjust to the complexities and novelties of changed situations (Lepine et al., 2000); therefore losses associated with lack of change or inability to change are minimized. Second, at the organizational level, behaviour flexibility is valuable because it enables the firm to deal with a variety of situations and facilitates change implementation. In their work, Kotter and Heskett (1992) found that organizations having culture that emphasized adaptation to changing environmental forces were more

likely to be high performing. For this study, measurement items of Employee Behaviour and Skills were taken from the scale of (Benson Teck Heng Lim, 2010).

Table 4.5- Measurement items of employee behaviour and skills

Possible Dimensions	Possible Measurement items	Remark
Behaviour	Our employees have the ability to adopt an open mindset to all alternatives	@
	Our employees have the ability to work in a team environment	@
	Our employees have the ability to travel overseas on assignments for an extended period.	#
Skill	Our employees have the ability to learn and adapt to different business conditions.	@
	Our employees have the ability to perform a diverse range of tasks and responsibilities.	@
	Our employees have the ability to gain customer satisfaction.	@
	Our employees have the ability to perform highly sophisticated tasks.	@
	Our employees have the ability to work independently	@
Δ- modified based on the exploratory interview and the pilot study findings and tested in subsequent fieldwork # - omitted from subsequent fieldwork based on the preliminary interviews and the pilot study findings/ proposed item overlapped with others/ is not applicable to this study. @ - incorporated into the questionnaire without modification, based on the preliminary interviews and the pilot study findings, and tested in subsequent fieldwork		

4.2.7 Moderator 1 -Micro Environmental factors

Looking into micro environmental factors that moderates operational flexibility, The measurement items of scale developed by (Pinto, J.K. & Slevin , D.P.,1988), (W.P. Lee et al., 2005) is used in this study.

4.2.7.1 Cash flow

Construction companies often deviate from the fundamentals of cash management resulting in pausing of operations from time to time affecting cost, quality, time and flexibility. It is up to the cash manager to keep a construction company focused on these fundamentals. The construction life cycle during its course has diverse impacts on the cash flow of the project.

a. Pre-Bid and Bid

Decisions made in this phase will impact accounts receivable, work in process, accounts payable and will ultimately determine the project's cash flow and profitability.

b. Contract Award

Once the contract is awarded, the company should perform a more intensive review of the terms of contract and negotiate in areas like timing of payments; method of payments; penalty; reporting and documentation requirements, retention terms etc.

c. Pre-Construction

During the planning, management should consider the work flow by establishing a performance and billing schedule based on values consistent with the company's management and accounting systems.

d. Contract Performance

In this phase all parties work together for Contract performance. Delivering the project in accordance with the plan and following the performance and billing schedules will enhance cash flow.

e. Contract closeout

In the last section of the project life cycle it is most often difficult to collect the final instalments of payment. This can originate due to customer's dissatisfaction with the product. Therefore company tries to satisfy the customer by completing the project as per their taste and preferences.

4.2.7.2 Scope Creep

Scope Creep is the currently a predominant cause of project failure, according to the 2010 Global Survey, Top 10 Obstacles to Project operational performance. Scope Creep in this study is looked upon as a micro environmental factor originating from customers or designers or architects or firm themselves and is generally referred to as the phenomenon where the original project scope to build a product with set features, grows outside the statement of work, without change in due dates or budgets. While some project manager accepts the fact that scope creep is inevitable, they struggle to fight scope creep due to:

1. Ignorance of key stakeholders until the project is underway.
2. The project execution happens years after the completion of study and scope definition.
3. Scope definition done by the wrong people.
4. The scope was defined with insufficient data.
5. Bad change management and absence of scope management and control systems.

6. Managers focus on major scope changes and ignore small changes that could cumulate to bigger scope creep problems.

4.2.7.3 Commitment

Top management commitment to projects has drawn much attention from researchers such as (Ahire et al., 1998; Chin et al., 2003; Low et al., 2004). The work of Rodgers et al. (1993) was about the influence of top management commitment on the success of project management generally. According to him goal setting, feedback, and participation are the roles to be played by the management. Fottler (1977) referred commitment to a project as leadership, participation, resource allocation, monitoring, and recognition over or equal to other projects. According to Feigenbaum (1989) involvement is related to management commitment.

According to Crosby (1996) participation and having the right attitude reflect the commitment of management. On the same matter, Goffin et al. (1996) highlighted the constructs of time and effort spent, clear goals, expertise, and focus on employees, likewise Ahire et al. (1998) highlighted priority, involvement, goals, and resources allocation. According to Howard et al. (1999) having Project specific strategy can be looked upon as the construct for management commitment towards projects. Previous research (e.g. Donald & Canter, 1993; Rodgers et al., 1993) has shown that management commitment is important to project at all stages of its operations.

4.2.7.4 Litigation

Client-related, contract-related, contract relationship related, and external factors have an impact on the disputes that arise during the course of the project. Factors such as delay in the payments for completed work, frequent owner interference, changing requirements, lack of communication between the various parties, problems with neighbours, and unforeseen site

conditions give rise to disputes between the various parties. The disputes, if not resolved amicably, can lead to arbitration or litigation. A competent third-party can settle the disputes amicably without going to the court. Client-related, labour-related, contract-related, contract relationship- related, and external factors escalate disputes to be settled by the litigation process. For this study measurement items of micro environmental factors were taken from the scale of (Pinto, J.K. & Slevin, D.P, 1988) and (W.P. Lee et al., 2005).

Table 4.6- Measurement items of Micro Environmental factors

Possible Dimensions	Possible Measurement items	Remark
Insufficient Cash flow	Failure to meet the delivery date promises leading to customer complaints or dissatisfaction.	@
	Delay in commencement of projects	@
	Lack of adequate cash flow	@
	Projects exceeded budgets	@
Scope creep	Scope or Design changes leading to reworks	@
	Reworks due to poor workmanship	@
Litigation	With customers	@
	With Neighbours	@
	With Govt.	#
Lack of Commitment	Lack of management support	@
	Lack of commitment of project participants	@

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- omitted from subsequent fieldwork based on the preliminary interviews and the pilot study findings/ proposed item overlapped with others/ is not applicable to this study.
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4.2.8 Moderator 2-Macro Environmental Factors

4.2.8.1 Demand

Many studies have examined the theory of housing demand from the perspective of service and investment. Studies by (Henderson and Ioannides, 1987; Berkovec, 1989; Ioannides and Rosenthal, 1994; Rosen, 1996) and Cassidy et al., 2008) suggest that owner-occupied housing has both a consumption role and an investment role. Likewise, Arrondela and Lefebvreb (2001) presented a model suggesting that the difference between the investment demand and the consumption demand for housing. Berkovec (1989) developed an applied general equilibrium model for analyzing the effects of tax policy on housing consumption and investment. Research on the housing market has reported a significant connection with the general performance of the economy and monetary policies (Darrat and Glascock, 1989; Ball, 1994; Maclennan, 1994; Baffoe-Bonnie, 1998; Goodhart and Hofmann, 2008). Also, Darrat and Glascock (1989) found that money supply plays an important role in fluctuations of real estate return. It was (Ball, 1994) who presented a theoretical argument for a relationship between economic growth and urbanization processes, which in turn affect housing prices. More recent studies have discussed how the relationship between money supply and asset investment leads to strong housing price fluctuation. Researchers like Aoki et al. (2004); Iacoviello (2005) and Elbourne (2008) examined the effects of monetary policy shock on housing markets and confirmed that they do influence housing-prices. During this time, Goodhart and Hofmann (2008) assessed the links between money, credit, housing prices and economic activity in 17 industrialized countries over the last three decades. They provided evidence of a significant multidirectional link between housing prices, monetary variables and the macro economy.

4.2.8.2 Availability of raw materials

There are many researches which have been done to identify the material related delaying factors in the construction industry. Delivery of the material is the most critical factor for delay in any construction project. According to Sambasivan and Soon (2007), the quality of material and scarcity of material during the execution of projects are the main material related factors which are responsible for delaying a project. According to Sweis, et al. (2008) the main causes for delay are the shortage of materials and late delivery of material. According to Trendle (2010), due to increase in the demand for labour, shortage of skilled labour occurs. According to Sweis, et al. (2008), less availability of skilled, semi-skilled and unskilled labour also cause delay in the construction projects. This shows that Labour related delaying factors are also very important in delaying a construction project. According to Assaf, S. A., & Al-Hejji, S. (2006), the shortage of labour, unskilled labour, foreign labour, low productivity level of labours and personal conflicts among labours lead to delay in construction projects.

For this study, availability of raw material and labour is looked upon a macro environmental factor which can affect the speed of work and is over and above the the supplychain capability of a firm like Quarry Strikes etc. The measurement items of these macro environmental factors are taken from the scale of Pinto, J.K. & Slevin, D.P. (1988) and (W.P. Lee et al., 2005).

Table 4.7-Measurement items of macro environmental factors

Possible Dimensions	Possible Measurement items	Remark
Change in Demand (for finished products)	Fluctuations in demand for constructed facilities.	@
	Price competition in the construction market	@
	Non price competition in the construction market	@
Availability (of raw materials)	Supply of raw materials	@
	Supply of labour	@
Cost(Escalations)	Rising costs of Materials	@
	Rising cost of Labour	@
	Rising cost of Finance	@

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4.2.9 Operational flexibility

Operations flexibility has come to occupy a central position on how operations can be strategically developed to play an effective part in achieving competitive advantage. Flexibility allows operations to increase the scope for a firm's market positioning. It is even more so now when markets are perceived to be more turbulent, faster moving and more competitive. That is why flexibility has retained its position as an important topic in the operations literature. There is more importance being given to its role as a core operations competence that, over the long-term, can be exploited in almost any market context. Flexibility forms a strong link

between operations strategy and marketing strategy by giving an organization the ability to introduce new products, adjust capacity and volumes, and customize products in accordance with changing circumstances. As operations and marketing functions are integrated, then the purpose of addressing the relationships between marketing and construction functions on the one hand is to achieve company goals Sawhney and Piper (2002) and to avoid conflicting objectives and plans of action on the other hand (Malhotra and Sharma, 2002). Therefore, marketing and operations are interrelated functions in which planning the capacity is aimed at meeting market requirements.

4.2.9.1 Dimensions of Operations flexibility

The different dimensions of Operations flexibility are Volume flexibility, Mix flexibility New product development flexibility, Modification flexibility and Demand management.They enable firms' quick introduction of new products, support fast product customization, make manufacturing lead times shorter, lower the costs for customized products, improve supplier performance, gain inventory reduction and the delivery of products in an efficient and effective way (Day 1994; Zhang et al. 2002).

a) Volume flexibility

It is the ability of the firm to efficiently and effectively operate in different overall output levels (Carlsson 1989; Sethi and Sethi 1990; Gerwin 1993). The range of this flexibility could be established by the variations in the output level, while maintaining profitability under normal circumstances. Jack and Raturi (2002) reviewed the literature on volume flexibility presents the sources of volume flexibility as overtime and temporary workers, cross training, complementary product portfolios, slack resources, improving forecasting and planning systems with information

technology and leveraging the firm's ability to negotiate on volume with suppliers and customers (Jack and Raturi, 2002).

b) Mix flexibility

Mix flexibility is measured by the number of products that a system produces at any point in time (Suarez et al., 1995). Mix flexibility contributes to satisfying customer needs' variations in the target market by producing products and introducing services for all market segmentations. Mix flexibility supports competitive advantage by enabling an organisation to compete on a basis of variety of products and services coupled with reactive and proactive marketing strategies to deal with competitors' actions. According to Gerwin (1993), mix flexibility enables firms to satisfy their customers by producing the product with the features and performance the customer wants. Mix flexibility gives organizations the ability to produce combinations of products economically and effectively, given certain capacity and positively impact customer satisfaction (Sethi and Sethi, 1990; Gupta and Somers, 1992; Zhang et al., 2002).

c) New product development flexibility

New product flexibility means the ability of a manufacturing system to introduce and manufacture new parts and products. An organisation needs new product flexibility to respond to new cycle of the product, which requires producing new products to cope with new changes and situations in the target market segmentations. The following marketing strategies are required when introducing new products into the markets: Customer knowledge; Market segment; and Customer follow-up.

d) Modification flexibility

Modifying existing products asks for different skills and abilities than introducing a new product Olson et al. (1995); Zhang et al. (2002) as the market expectations for new products and the specifications needed are

not clear. Flexibility in modifying existing products and/or in commercializing new products allows firms to better meet the customers' needs by improving current products and maintaining the depth and breadth of a firm's product portfolio. Customers' satisfaction will increase when the products are fulfilling the needs of the customer and are of good quality, obtainable in a short time frame and at reasonable costs:

e) Demand management flexibility

Demand management flexibility enables firms to satisfy their customers by responding quickly and effectively to their needs for service, delivery time and price. It is a market sensing and information sensitive capability that must meet demands quickly by creating and managing close customer relationships (Day 1994; Lee 2001). To gather these customer requirements, firms must maintain direct customer contact, collect information about customer needs and use customer supplied information to design and deliver products and services the customer needs Schneider and Bowen (1999) and Zhang et al. (2005). For this study measurement items of Operational flexibility were taken from the scale of (J. Manders, 2009).

Table 4.8-Measurement items of operational flexibility

Possible Dimensions	Possible Measurement items	Remark
Demand Management	We can effectively respond to multiple customer requirements in terms of repair, installation, and maintenance	@
	We can effectively negotiate with customers, suppliers and contractors in terms of prices, delivery time through long term relationships.	@
	We involve customers to improve our services effectively	@
	We quickly respond to feedback from consumers & marketing dept. effectively.	@
	We can successfully respond to multiple customer delivery time requirements.	@

Modification flexibility	We can quickly modify internal design in response to customer requests before construction as long as the elevations are not affected.	@
	We even accommodate nominal modifications as per customer needs, even during construction.	@
	We can better meet customer needs by modifications.	@
	We can modify existing projects quickly.	@
New project development	We can quickly introduce a new product into the market.	@
	We take the lead in new product introduction.	@
	We can launch new projects easily.	#
	We can launch new projects inexpensively	@
Volume flexibility	We can operate efficiently irrespective of number of projects handled simultaneously.	@
	We can operate profitably at various levels of output	@
	We can control the number of our projects reaching the finish in advance	@
	We can vary aggregate output from one period to the next to aid resource levelling.	@
Mix flexibility	We offer a variety of projects in our portfolio.	@
	We can changeover quickly after finishing one project to another	@
	We pick multiple customer requirements accurately and quickly.	#
	We easily and accurately label & track individual units from planning till hand over and after.	@
	We keep accurate records of quantities & types of materials used in each unit.	@
	We can take different customer orders with accuracy.	#

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4.2.10 Effective Project Management

Effectiveness encompasses the attainment of the organisation's objectives both at the corporate and project level (Maloney, 1990). It can be measured against the objectives earlier set by the client organisations (Abdel-Razek, 1997). According to Pinto and Slevin (1994), effectiveness measures refer to user satisfaction about the project. According to Cameron and Whetten (1983) a system is effective if it achieves its objectives. Based on the literature search, the project effectiveness measures are associated with accomplishing core business and project objectives, users' satisfaction as identified by Pinto and Slevin (1989) and Cooke Davies (2002).

Several authors have pointed out effectiveness measures in several ways. Some of them that are relevant to construction industry are: client satisfaction with service, user satisfaction with product, project functionality, free from defects, value for money, profitability, absence of legal claims, learning and exploitation etc.

a) Customer Satisfaction

According to Globerson (1997), the products in which the customers are satisfied have a higher probability of success. According to Karlsen (2002), the customers are the most important stakeholders in the project. In relation to this, client and user satisfaction depend on pre-determined performance criteria (Walker and Liu, 1998). Developers normally have a special programme to keep their customers well informed about the construction schedule (Jackson, 2003). An early period to occupy is one of the fundamental factors that fascinate most customers followed by affordable and high quality with minimum cost of ownership.

b) Learning and Exploitation

Learning and exploitation can be defined as the process of improving future projects through knowledge gained from experience of the previous ones (Fiol and Lyles, 1985). According to Dalgleish (2003) even a cancelled project or late or overbudget project can offer something to knowledge.

c) Stakeholder Objectives

This grouping is made-up components like: accomplish core business needs, meets stakeholder needs and expectations, and meets corporate missions, high profit margin, and meeting pre-stated objectives. According to Male (1991) and Cox and Townsend (1998), construction needs ought to be aligned with the corporate objectives. According to Sanvido et al. (1992) the effectiveness of the project outcomes is measured when both designers and contractor meet certain profit and fee goals.

d) Operational Assurance

In the construction industry, project commissioning is a systematic process of verification and documentation in accordance with the design documentation, intent and customers' operational needs (Wilkinson, 2001). In addition, warranty programmes and post contract activities such as in-service training, periodic inspections, operator training, etc are required to be implemented soon after the handing over (Spirer and Hamburger, 1988). For this study measurement items of effective project management were taken from the scale of (Roshana Takim et al., 2008).

Table 4.9- Measurement items of Effective project management

Possible Dimensions	Possible Measurement items	Remark
Learning and Exploitation	Develop new knowledge and expertise	@
	Increase level of professional development	@
	Generate positive reputation	@
	New market penetration	#
	Develop new business relationship	@
	Value for money (Value Engineering)	#
	Exploitation of technology	@
	Usable life expectancy	@
Customer Satisfaction	Early occupation	@
	Minimum cost of ownership	@
	Project functionality	@
	Aesthetic value	@
	Pleasant environment	#
	Easy to maintain	@
Stakeholder Objectives	Accomplish core business needs	#
	Meets stakeholders' needs & expectations	@
	Meets corporate missions	@
	High profit margin	@
	Meeting pre-stated objectives	@
Operational Assurance	Supported by warranty programme	@
	Excellent testing and commissioning programmes	@
	The closeout process runs smoothly & efficiently	@
	Fitness for purpose	@
	Fast rectification of defects	@

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4.2.11 Research Hypotheses

The following section presents the six hypothesis of this study, inorder to meet the research objectives stated in section 1.5. It becomes necessary to understand influence of the identified predictor variables namely- Learning culture, Technological capabilities, and Supplychain practices on Operational Flexibility and how the moderating factors namely–Micro environment and Macro environment affect operational flexibility potential. It is also required to know whether the moderated operational flexibility, mediates the influence of its predictors on effective project management.

- **H_1: learning culture has a significant direct impact on Operational flexibility.** This hypothesis can be split into six subhypothesis as follows.
    - $H1_a$: Inter Project Learning has a significant direct impact on Demand Management
    - $H1_b$: Inter Project Learning has a significant direct impact on Modification
    - $H1_c$: Inter Project Learning has a significant direct impact on New Product Development
    - $H1_d$: Intra Project Learning has a significant direct impact on Demand Management
    - $H1_e$: Intra Project Learning has a significant direct impact on Modification
    - $H1_f$: Intra Project Learning has a significant direct impact on New Product Development

- **H_2: Technological Capabilities have a significant direct impact on Operational flexibility.** This hypothesis can be split into **three** subhypothesis as follows.

- $H2_a$: Information Technological Capabilities has a significant direct impact on Demand Management
- $H2_b$: Information Technological Capabilities has a significant direct impact on Modification
- $H2_c$: Information Technological Capabilities has a significant direct impact on New Product Development

- **H_3: Supply chain Practices have a significant direct impact on Operational flexibility.**This hypothesis can be split into **nine** subhypothesis as follows.
  - $H3_a$: Strategic Supplier Partnership has a significant direct impact on Demand Management
  - $H3_b$: Strategic Supplier Partnership has a significant direct impact on Modification
  - $H3_c$: Strategic Supplier Partnership has a significant direct impact on New Product Development
  - $H3_d$: Customer Relations has a significant direct impact on Demand Management
  - $H3_e$: Customer Relations has a significant direct impact on Modification
  - $H3_f$: Customer Relations has a significant direct impact on New Product Development
  - $H3_g$: Information Sharing has a significant direct impact on Demand Management
  - $H3_h$: Information Sharing has a significant direct impact on Modification
  - $H3_i$: Information Sharing has a significant direct impact on New Product Development

- **H_4: Operational flexibility potential (OFP) mediates the effect of Predictors on Effective Project Management.**This hypothesis can be split into **thirty six** subhypothesis.

- $H4_a$: Demand Management mediates the effect of Inter Project Learning on Customer Satisfaction
- $H4_b$: Demand Management mediates the effect of Inter Project Learning on Learning Exploitation
- $H4_c$: Modification mediates the effect of Inter Project Learning on Customer Satisfaction
- $H4_d$: Modification mediates the effect of Inter Project Learning on Learning Exploitation
- $H4_e$: New Product Development mediates the effect of Inter Project Learning on Customer Satisfaction
- $H4_f$: New Product Development mediates the effect of Inter Project Learning on Learning Exploitation
- $H4_g$: Demand Management mediates the effect of Intra Project Learning on Customer Satisfaction
- $H4_h$: Demand Management mediates the effect of Intra Project Learning on Learning Exploitation
- $H4_i$: Modification mediates the effect of Intra Project Learning on Customer Satisfaction
- $H4_j$: Modification mediates the effect of Intra Project Learning on Learning Exploitation
- $H4_k$: New Product Development mediates the effect of Intra Project Learning on Customer Satisfaction
- $H4_l$: New Product Development mediates the effect of Intra Project Learning on Learning Exploitation
- $H4_m$: Demand Management mediates the effect of Strategic supplier Partnership on Customer Satisfaction
- $H4_n$: Demand Management mediates the effect of Strategic supplier Partnership on Learning Exploitation
- $H4_o$: Modification mediates the effect of Strategic supplier Partnership on Customer Satisfaction
- $H4_p$: Modification mediates the effect of Strategic supplier Partnership on Learning Exploitation

- $H4_q$: New Product Development mediates the effect of Strategic supplier Partnership on Customer Satisfaction
- $H4_r$: New Product Development mediates the effect of Strategic supplier Partnership on Learning Exploitation
- $H4_s$: Demand Management mediates the effect of Customer relations on Customer Satisfaction
- $H4_t$: Demand Management mediates the effect of Customer relations on Learning Exploitation
- $H4_u$: Modification mediates the effect of Customer relations on Customer Satisfaction
- $H4_v$: Modification mediates the effect of Customer relations on Learning Exploitation
- $H4_w$: New Product Development mediates the effect of Customer relations on Customer Satisfaction
- $H4_x$: New Product Development mediates the effect of Customer relations on Learning Exploitation
- $H4_y$: Demand Management mediates the effect of Information Sharing on Customer Satisfaction
- $H4_z$: Demand Management mediates the effect of Information Sharing on Learning Exploitation
- $H4_{za}$: Modification mediates the effect of Information Sharing on Customer Satisfaction
- $H4_{zb}$: Modification mediates the effect of Information Sharing on Learning Exploitation
- $H4_{zc}$: New Product Development mediates the effect of Information Sharing on Customer Satisfaction
- $H4_{zd}$: New Product Development mediates the effect of Information Sharing on Learning Exploitation
- $H4_{ze}$: Demand Management mediates the effect of Technological Capabilities on Customer Satisfaction
- $H4_{zf}$: Demand Management mediates the effect of Technological Capabilities on Learning Exploitation

- $H4_{zg}$: Modification mediates the effect of Technological Capabilities on Customer Satisfaction
- $H4_{zh}$: Modification mediates the effect of Technological Capabilities on Learning Exploitation
- $H4_{zi}$: New Product Development mediates the effect of Technological Capabilities on Customer Satisfaction
- $H4_{zj}$: New Product Development mediates the effect of Technological Capabilities on Learning Exploitation

- **H_5: Project Macro Environment moderates the path of Predictors and Operational flexibility.**This hypothesis can be split into **nine** subhypothesis.
  - $H5_a$: Demand Fluctuations moderates the path of predictors and Demand Management
  - $H5_b$: Demand Fluctuations moderates the path of predictors and Modification
  - $H5_c$: Demand Fluctuations moderates the path of predictors and New Product Development
  - $H5_d$: Availability of Raw Materials moderates the path of predictors and Demand Management
  - $H5_e$: Availability of Raw Materials moderates the path of predictors and Modification
  - $H5_f$: Availability of Raw Materials moderates the path of predictors and New Product Development
  - $H5_g$: Rising Cost moderates the path of predictors and Demand Management
  - $H5_h$: Rising Cost moderates the path of predictors and Modification
  - $H5_i$: Rising Cost moderates the path of predictors and New Product Development

- **H_6: Project Micro Environment moderates the path of Predictors and Operational flexibility.**This hypothesis can be split into **nine** subhypothesis.
    - $H6_a$: Cash Flow moderates the path of predictors and Demand Management
    - $H6_b$: Cash Flow moderates the path of predictors and Modification
    - $H6_c$: Cash Flow moderates the path of predictors and New Product Development
    - $H6_d$: Scope Creep moderates the path of predictors and Demand Management
    - $H6_e$: Scope Creep moderates the path of predictors and Modification
    - $H6_f$: Scope Creep moderates the path of predictors and New Product Development
    - $H6_g$: Legal Proceedings moderates the path of predictors and Demand Management
    - $H6_h$: Legal Proceedings moderates the path of predictors and Modification
    - $H6_i$: Legal Proceedings moderates the path of predictors and New Product Development

4.2.12 Pilot Study

Pilot Study was conducted with the objective of verifying the questionnaire, three out of five experts met in the exploratory phase were again met and this helped to ensure that their suggestions were correctly interpreted and incorporated into the questionnaire. In the succeeding one month period fifteen practitioners were met and surveyed and were requested to give feedback on clarity and relevance of the questions. All the interviewees were senior level executives of the member organizations of

the Confederation of Real Estate Developers' Associations of India (CREDAI) which is the apex body for private Real Estate developers in India through 20 State Chapters and 128 City Chapters. Interviewees commented that questionnaire was long.Based on their comments some unclear statements were eliminated reworded to suit the Indian context, particularly the state setting.

4.2.13 Population

This study needs firm level analysis and therefore real estate developers who are members of CREDAI, Kerala Chapter were considered as population. During the time of data collection it had a membership of one hundered and forty members. In order to set the sampling frame, Screening of the companies were done based on the following judgemental criteria:

1. Firms which are member of CREDAI-Kerala chapter.
2. Firms which are more than 5 years old in this industry and
3. Firms who have completed and handed over at least two projects.

Out of one hundered and forty member firms, one hundred and four firms satisfied the above set criteria and thus formed the sampling frame. Respondent of such firms were selected based on the following criteria:

1. Respondents of such firms must be working in the position of project managers /senior project managers/General manager Projects
2. Respondents must have more than 5 years experience
3. Respondents must have more than three years with the present firm
4. Respondents must have completed at least one full project in the present firm.

The researcher followed a census survey and finally could get eighty seven completed questionnaires. An invitation letter explaining the purpose of this study was given along with the questionnaire by hand. The letter requested a suitable time slot for the questionnaire to get filled. A face to

face approach was selected as the data collection method as mentioned in the previous sections. Although it was a slow affair, it could help to answer queries. Also, an effective introduction was given to each of the eleven sections, which could clarify the purpose of those sections.

4.2.14 Key informant retrospective reporting

Relying on the key informant's account is appropriate when the content of the inquiry complete or in depth information. Researchers chose the informants based on the criteria and this could ensure that the respondents were knowledgeable about the issues being researched and willing to communicate them. Key informants exhibit less method variance as shown in many strategic management studies that have reported high reliability and validity of self reported measures. Key informants have access to both objective and subjective information of the company and therefore this approach has gained popularity in organizational studies and also seen in construction management studies (Kale and Arditi, 2001).

Most of the project managers who came forward and participated in the survey have rich experience and their perceptions really matters in the companies' strategic outlook and interpretation of the environment.

Inorder to eliminate weaknesses if any in key informant retrospective reporting, the questions were developed with very little room for ambiguity, the cover letter provided elaborated on the nature and significance of the study, detailing the purpose of the study and its possible contribution to the body of knowledge.

All the interviewees were assured that all information provided would be treated in strictest confidence and their names and organisation details would be kept anonymous, while seeking their candid and accurate responses. The filtering process done to find the key informant was

adequate to find the right respondent with competence to assess the capabilities of the organizations, as they have asses to all information which was necessary to complete the questionnaire.

PART III QUESTIONNAIRE DEVELOPMENT

4.3.1 Introduction

This part is of the methodology is devoted to explaining the steps taken in the development of questionnaire. A three stage procedure was followed to develop the measurement instrument. All interview findings along with the literature review formed the basis for questionnaire development and subsequent data collection. Questionnaire development underwent further refinement through pilot testing for clarity and content. Things that were taken care while developing the questionnaire were- standardization of the questions, so that interpretation is coherent among the sample concerned and emphasis was given to content validity and reliability with most of the measurement items being borrowed from similar studies in construction or manufacturing sector. Construction industry practitioners were not very much interested in participating in the non rewarding exercise of instrument development procedure, but were interested in a onetime survey. So after the first round of discussions a pilot study was conducted to measure the content validity and reliability before the final survey.

4.3.2 Use of multiple item approach

According to Churchill and Peter (1979), multiple-item measures are more reliable because they enable computation of correlations between items and thus may produce a high coefficient alpha, indicating the internal consistency of all the items representing underlying attribute. Also a multiple-item measure captures more information than that can be provided

by a single-item measure as it covers all facets of the construct Baumgartner and Homburg (1996) by offering more response categories than the single-item measure.

4.3.3 Generation of measurement items

Combination of review literature, interviews, personal experience in the project management field, validated obtained from previous studies were subjected to a round of validation and streamlining processes. The questionnaire was further scrutinized for content and wording.

4.3.4 Design of the questionnaire

Questions followed semantic differential scale on a seven point Likert design. This is a simple and easy scale to design and above all previous studies in this domain followed similar designs. Adding scales provide an increase in reliability, but begins to plateau at around 7. There are also arguments that 7 items may be optimal. In his work Miller (1956) noted that "psychologists have been using seven-point rating scales for a long time, on the intuitive basis that trying to rate into finer categories does not really add much to the usefulness of the ratings." According to Lewis (1993) 7-point scales resulted in stronger correlations with *t*-test results.

4.3.5 Organization of questionnaire

The structured questionnaire consists of eleven parts. They are

i. General information
ii. Learning culture
iii. Supply chain capabilities
iv. Technological capabilities
v. Human Resource Management practices
vi. Employee behaviour and skills
vii. Operational flexibility potential

viii. Micro Environmental Conditions
ix. Macro environmental Conditions
x. Effective Project Management
xi. Demographic characteristics

4.3.6 Short Description of each part

Each of the above parts is discussed in detail below.

i. General information

This part has questions on the type of firm, name and age of firm, the number of projects handled and number of employee and business focus.

ii. Learning culture

This part consists of eleven questions; belonging three categories, namely inter project learning, intra project learning and learning support.

iii. Supply chain capabilities

Seventeen questions belonging to five categories, namely strategic supplier partnership, Customer relationship, Level of information sharing, Quality of information sharing and Postponement were asked.

iv. Technological capabilities

Five questions were asked to understand the Technological capabilities under the heads, namely IT capabilities and Construction process capabilities.

v. Human Resource Management practices

Seventeen Questions were asked to know the Human resource management practices followed by the respondent's firm and consisted of questions belonging to four categories, namely

Competence Development, Stress Management, Performance Management, and Relationship Management.

vi. Employee behaviour and skills

Seven questions were asked to find out the employee behaviours and skills that act as source of flexibility and they belong to two main categories namely Behaviour flexibility and Skill Flexibility.

vii. Operational flexibility potential

Twenty questions were asked to understand the operational flexibility potential of the firm under the categories, namely the Demand Management, New Product Development, Modification, Volume and Mix.

viii. Micro Environmental Conditions

Fourteen questions were asked to understand the micro environmental conditions and they belong to the following categories, namely Cash Flow, Scope creep, Litigation, Lack of commitment.

ix. Macro environmental Conditions

Nine questions were asked to understand the macro environmental conditions and they belong to the following categories namely Demand, Supply and Cost.

x. Effective Project Management

Twenty six questions were asked to understand the effective project management constructs and they belong to the following categories, namely learning and exploitation, Client Satisfaction, Stakeholder objectives, Operational Assurance and User Satisfaction.

xi. Demographic characteristics

This part consisted of questions asking designation and job title of the respondent and the number of years in the present firm and construction industry and number of projects handled in the present firm.

PAR IV METHODS OF RESEARCH ANALYSIS

4.4.1 Introduction

This part of the research methodology chapter explains the analytical methods along with justification for selecting the relevant approaches used for this study. This section begins with details of SEM analysis procedure and reasons for selecting Smart PLS software for this study. Then the PLS 5 stage modelling procedure is described, starting with Sample data preparation. The PLS model specification is followed by execution of PLS iterative process, construct validation process and finally evaluation of PLS structural model. The last section presents the moderator analysis approach used to examine the moderating effects of micro and macro project environment.

4.4.2 The SEM analysis procedure

The SEM analysis procedure starts with a review the relevant theory and research literature to support model specification. This is followed by specifying the model interms of diagrams or equations. Next step is to find values for parameter estimation and then selecting the measures for the variables represented in the model. This is to be followed by collection of data and preliminary descriptive statistical analysis (e.g., scaling, missing data and collinearity issues). Then next procedure is to estimate parameters in the model and assess model fit and respecifying the model if necessary. The last stage is interpretation and presentation of results.

Why Smart PLS software used for this study

It is one of the most userfriendly PLS software with better GUI compared to PLS graph. This software is widely used for research related to general management, project management and Information system research (Vance et al., 2008). A web based community monitored by University of Hamburg, helps in addressing queries, providing advice and basic support.

4.4.3 PLS Modelling Procedure-5 Step Procedure

The modelling procedure used in this study can be summarized as follows:

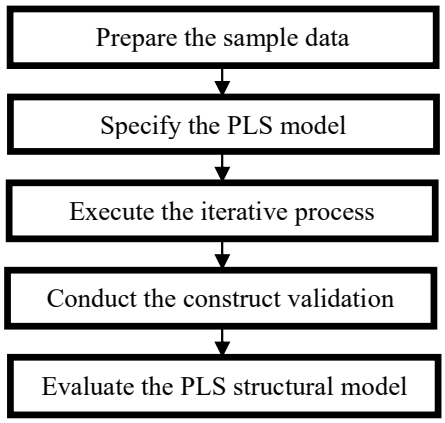

Fig 4.1-PLS Modelling Procedure

4.4.3.1 Step 1-Sample data preparation

Two potential and probable issues in the sample data have to be first addressed. They are common method variance and multi collinearity. The following is an account of the methods adopted to detect the presence of these issues in the data collected.

a) Check for common method variance

According to (Richardson et al., 2009) common-method variance (CMV) can be defined as "systematic error variance shared among variables measured, introduced as a function of the same method and/or source".

Common method variance is a threat to construct validity in studies of this type that involve self-reports as it may inflate or deflate the correlation among the variables. The complexity of judgement introduces systematic variation into the measures, resulting in a distorted assessment of the construct and more common method variance. Common method variance also arises out of the desire to appear consistent and rational in responses when respondent providing the measure of the predictor and criterion variables is the same person.

Efforts have been made in the study to minimize any possible distorted self reports and socially agreeable answers by ensuring complete anonymity. In addition a formal test using the Harman's–one factor test was performed to check this issue, which showed that common method variance has not become an issue in this study.

b) Check for multi collinearity

Multicollinearity is yet another issue, where there is the presence of significant correlation between independent variables in the regression model. This problem has a more likelihood when moderating terms are employed because then the multiplicative effect may produce high levels of multi collinearity. Even though (Cronbach, 1987) had shown that this is not a substantial problem, but can be a practical issue of the possible computational errors that may arise in computer programs. The concern of multicollinearity needs to be addressed in two aspects in this study.

1. Within the individual blocks of measurement items representing underlying constructs
2. Among the predictor constructs in Structural Equation Models

The coefficient of each measurement item in individual blocks under the reflective model is based on simple regression and hence the first aspect of multi collinearity doesn't affect this study (Fornell and Bookstein, 1982).In order to test for the Multicollinearity among the predictor constructs, the test suggested by (Neter et al., 1990) was performed to find out the Variance inflation factors for all predictor constructs and the respective mean VIF values. Since the results of the above tests are below the threshold level of 10 and tolerance above 0.1, no corrective steps are required. Formatted sample data further underwent an inbuilt validation check in Smart PLS 2.0 M3 for data consistency and compatibility before starting the modelling process.

4.4.3.2 Step 2-PLS model specification

The PLS model consists of three types of relations: 1. Inner relation, which specifies the relationship between constructs, 2. Outer relation, which specifies the relationship between constructs and their observed variables and 3. Weight relation, which estimates the construct scores.

The PLS model consists of five predictor constructs (ξ), Operational flexibility Construct (η) and Effective project management constructs (Z). The λ represent the relationships between the predictors and operational flexibility constructs. The parameter estimates are imposed on the model to facilitate development of inner relations among the constructs. Without any loss of generality all observed variables are standardized to have zero means and unit variance so that construct terms can be eliminated.

To illustrate the PLS iterative process let us take the construct supply chain capabilities (ξ_3), its corresponding block of observed variables is selected here to illustrate the parameter estimation between constructs and their corresponding observed variables

4.4.3.3 Step 3-Execution of PLS iterative process

It can be seen that a one-way causal relationship (i.e., path relation) is hypothesized between (ξ_3) and (η_1). In so far as ξ could only explain a portion of the variance in η, the residual variance in this structural level is assumed to reside in $\varepsilon\eta$. Here, the structural relationship among ξ, η and $\varepsilon\eta$ forms the structural model, which is known as the inner relation. The relationships between constructs and their corresponding observed variables form the measurement models; these relationships formed are also known as the outer relations. Both ξ and η are recognized as the constructs that cannot be measured directly. In effect, each of them is indirectly measured by a number of reflective observed variables. In this study, the relationship between constructs and their corresponding observed variables is modelled in a reflective mode.

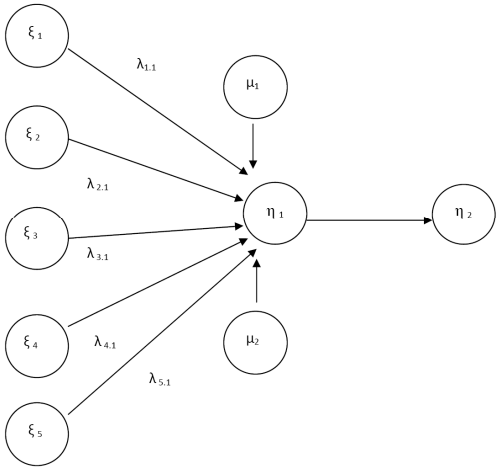

Fig 4.2 PLS model specification

The basic PLS algorithm, as suggested by Lohmoller (1989) which is followed in this study includes the following three stages:

Stage 1: Iterative estimation of latent variable scores, consisting of a four-step iterative procedure that is repeated until convergence is obtained:

(1) Outer approximation of the latent variable scores,

(2) Estimation of the inner weights,

(3) Inner approximation of the latent variable scores, and

(4) Estimation of the outer weights.

Stage 2: Estimation of outer weights/loading and path coefficients.

Stage 3: Estimation of location parameters.

The new weights obtained in Stage 1 provide an exact linear combination of the observed variables for forming the construct score (i.e., outside relation) which is not only maximally correlated with its own set of indicators, but also correlated with other constructs (i.e., inner relation) in accordance with the proposed structural model (Chin and Newstead, 1999). Upon convergence being obtained, a least square criterion is used to estimate all parameters in the models in both Stages 2 and 3. This involves minimizing the residuals on all constructs and their respective observed variables. Here preference is given to the data and the measurement models (outer relations) by staying as close to data as possible while investigating the specified relationships between constructs (inner relations). This leads to optimizing the prediction of the constructs' score that necessarily requires deemphasizing parameter estimation between constructs, since prediction and parameter accuracy cannot be optimized simultaneously (Wold, 1982).
CFA, Path analysis and Bootstrapping are the statistical functions involved in the execution of the PLS algorithm. They are explained below.

1. Confirmatory Factor Analysis

CFA is used to test hypothesis about the relations among a set of observed variables (Hoyle, 2000). The interrelations among variables within a CFA model are specified upfront based on theoretical assumptions. The CFA concerns basically with the relations between individual constructs and their respective block of measurement items. It is known as the outer relation. Each measurement item is affected by two unmeasured influences.

They are: (i) the causal influence that one shares with other measurement items emanating from the construct (ii) the distinct causal influence emanating from the measurement error of respective measurement items.

The causal relationships are translated directly into statistical form through a set of measurement equations given as

$$X_i = \lambda_{Xi}\xi + \varepsilon_X$$

(Where ξ is the construct score) and i_{th} unique factor (or measurement error) ε_{Xi}. Parameter estimates of these direct effects are called weights, and they are generally interpreted as regression coefficients that may be unstandardized or standardized. Associated with the parameter estimate is a standard error, and the ratio of the unstandardized estimate of its standard error provides a test of whether the estimate significantly differs from zero, using the t-test analysis. Thus the statistical power of each individual measurement items can be established based on the t statistic evaluated against the standard one-tailed criterion (i.e., 1.96, 2.58 and 3.30 for $p < .05$, .01 and 0.001, respectively). These t-statistics corresponding to the p values are based on 500 bootstrapping runs used to obtain estimates of standard errors of the parameter estimates. Nevertheless, any removal of insignificant or inconsistent measurement item is subjected to a set of rules-of-thumb that take into consideration, the findings from other related analysis functions. These include the Cronbach's alpha reliability test and exploratory factor analysis, which will be examined in the construct validation process.

2. Path Analysis

Path analysis is a straightforward extension of multiple regression. Its aim is to provide estimates of the magnitude and significance of hypothesised causal connections between sets of variables. Path Analysis determines whether the data are consistent with the model. It allows for the

analysis of more complicated models. In particular, it can examine situations in which there are several final dependent variables and those in which there are 'chains' of influence, for example, variable A influences variable B, which in turn affects variable C, like in the present study. The directional paths drawn between the identified constructs in the PLS model have literature support. To determine the significance of the path coefficient, in-built bootstrapping technique in the Smart PLS2.0 M3 software was used to estimate the standard errors of the path coefficients, which, in turn, determine the t-statistics for hypothesis testing.

Bootstrapping is a technique primarily concerns the reliability of results across samples drawn from a population and is a nonparametric approach to statistical inference that does not make any distributional assumptions of the parameter. Bootstrapping draws conclusions about the characteristics of a population strictly from the sample at hand and therefore is advantages in situations like in this study were underlying distributional assumptions needed for valid parametric inference are violated (Mooney, 1996).The sampling distribution is developed by a re-sampling process of a random sample obtained instead of extracting successive samples repeatedly from a population.

4.4.3.4 O'leary- kelly and Vokurka construct validation process

The relationships between constructs and measures (Schwab, 1980) are crucial to theory development. The construct validity concerns the degree to which a measure captures its intended theoretical construct (Cronbach & Meehl, 1955). The construct validation process is a prerequisite in the PLS modeling techniques, concerning the adequacy of individual sets of measurement items in capturing their corresponding constructs, by assessing the internal consistency, convergent validity and

discriminant validity of constructs. This study follows construct validation process as suggested by O'leary- Kelly and Vokurka. There are three steps in the construct validation process.

1. Also known as face validity, content validity is a step that involves the detection of related groups of measurement items that are thought to measure each construct. Its emphasis is on the adequacy in terms of capturing the characteristics of each constructs by identified groups of measurement items (Churchill and Lacobucci, 2005).

2. Construct validity tries to establish the extent to which the measurement items measure corresponding constructs (Schwab, 1980). Tests namely 1. Unidimensionality 2. Reliability and 3. Validity is used to examine the properties of measurement items.

3. Nomological validity or substantive validity is a step that determines the extent of construct to construct relations in a predictable manner (Schwab, 1980; Venkatraman, 1989).

In the above procedure the content validity has been ensured during the development of measurement items by using multi item measures of established scales for specifying construct domain. The validation of measurement items were done through in depth interview, literature review and pilot testing of the measurement instrument.

Step 2 is discussed here following the classical validation approach which involves Cronbach's alpha and exploratory factor analysis and then contemporary validation which involves confirmatory factor analysis.

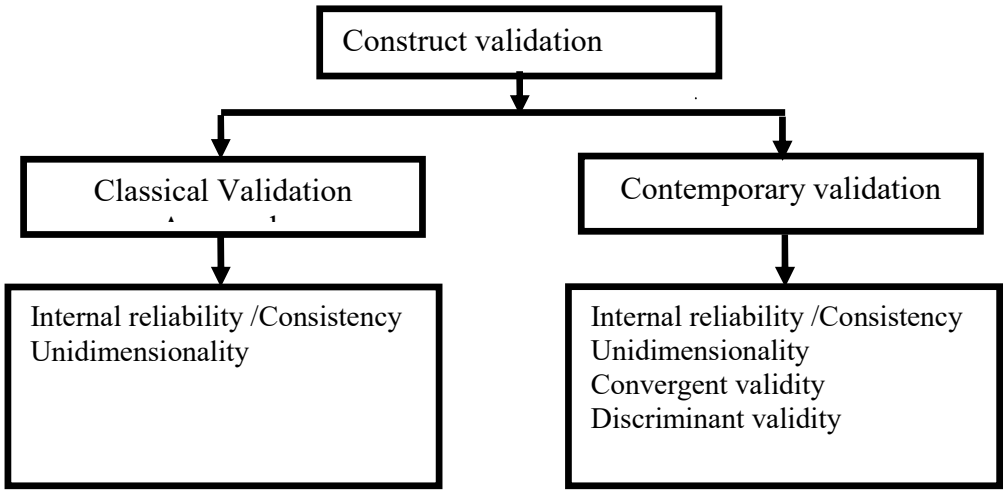

Fig 4.3 Construct validation methods

4.4.3.4.1 Classical validation

a. Internal reliability

It is defined as the extent to which independent measurement items, designed to measure the same trait of a construct, correlate among one another, (Churchill, 1979). According to Cronbach (1970) internal reliability can be looked upon as the extent to which multiple item scales produce consistent and stable scores under a series of repeated tests. Consequently, a higher level of correlation between the measurement items provides greater confidence.

The SPSS 20 software was used to examine the internal reliability of constructs using the Cronbach's alpha reliability test. This test derives the alpha coefficient signifying the estimated systematic variance of individual constructs. The values range from 0 to 1.0. A high alpha coefficient indicates that the measurement items of a construct are highly correlated and vice versa. According to Pedhazur and Schmelkin (1991) and Nunnally (1978) an alpha value of below 0.70 is not acceptable.

The item to total correlation is calculated for both subscales and whole scales. For subscale, data on individual dimensions of respective constructs are used, while for whole scale, a combination of the data of various dimensions within individual constructs is used. The SPSS 20 software has provisions to do item to total correlation under reliability analysis. Here, Nunnally (1978) has pointed out that measurement items having item to total correlation scores for subscale and whole scale, less than 0.30 are considered inconsistent. Deleting the inconsistent items may increase the scores.

Other methods of testing internal reliability ie the test retest and alternative forms methods are unsuitable for this study as they require at least two rounds of data collected at different times.

Moving to contemporary validation approach, the confirmatory factor analysis asks for composite reliability index in PLS to assess the internal reliability of constructs. A high index indicates the high internal reliability and vice versa. A threshold value of 0.70 as suggested by (Hair et al., 1998) is adopted for this study.

b. Uni dimensionality

Both Exploratory and Confirmatory factor analysis was used in establishing the unidimensionality of constructs. It involves establishing whether a set of empirical measurement items relates to an underlying construct (Gerbing and Anderson, 1988; O'Leary-Kelly and Vokurk, 1998). Hair et al., 1998 states the following conditions to be satisfied in order to be considered Uni dimensional measurement items.

1. They must be significantly related to their corresponding constructs
2. They must be related to one and only one construct

In EFA a factor is a construct which is thought to be the super ordinate to a set of measurement items being used to study it. Measurement items with intended properties should exhibit higher factor loadings on their pertinent factors and should exhibit small loadings on factors that they are not designed to measure. According to Comrey (1973), a measurement item with factor loadings of 0.45-0.54, 0.55-0.62, 0.63-0.70 and > 0.70 are considered as fair, good, very good and excellent respectively. Therefore, for this study a factor loading of less than 0.45 is considered inconsistent.

According to Cudeck (2000), two criteria can be used in determining the number of factor structures in the EFA,

1. Eigen values greater than unity rule-Number of factor structures equals the number of eigen values that are greater than unity. It states that there are as many reliable factors as there are eigen values greater than one. The reasoning is that an eigen value less than one imply that the scores on the component would have negative reliability.
2. Scree test- The Scree test involves plotting the eigen values in descending order of their magnitude against their factor numbers and determining where they level off. The break between the steep slope and a levelling off indicates the number of meaningful factors.

4.4.3.4.2 Contemporary validation

a. Convergent validity

Convergent validity tests that constructs that are expected to be related are, in fact, related. It refers to the correlation between different measurement items purporting to measure the same construct (Peter and Churchill, 1986; Crocker and Algina, 1986).

b. Discriminant validity

Discriminant validity, tests that constructs that should have no relationship infact dont have any relationship. Thus, it refers to the extent to which individual constructs are unique and therefore does not correlate highly with other constructs and therefore are not simple reflections of others (Churchill, 1979; Bagozzi et al., 1991).

In CFA, measurement items with good measurement properties should exhibit factor loadings greater than 0.45 on their corresponding factors. Statistically significant high factor loadings (p-value >0.05 based on t-test) of a particular set of measurement items indicate a high convergent validity Anderson and Gerbing (1988). Another measure in CFA for assessing the convergent validity of constructs is the average variance extracted (AVE). Average Variance Extracted was proposed by Fornell and Larker (1981) as a measure of the common variance in a measurement item or Latent Variable Dillon and Goldstein (1984). In different terms, AVE is a measure of the error-free variance of a set of items. Convergent validity is judged to be adequate when average variance extracted equals or exceeds 0.50, when the variance captured by the construct exceeds the variance due to measurement error.

Discriminant validity is present when the variance shared between a construct and any other construct in the model is less than the variance that constructs shares with their corresponding indicators (Fornell et al., 1982). Discriminant validity was assessed by comparing the square root of the average variance extracted for a given construct, with the correlations between that construct and all other constructs. According to Hulland (1999) in a case where adequate Discriminant validity is established the value of the diagonal elements will be significantly greater than the off diagonal elements in the corresponding rows and columns.

Table 4.10 Rules of elimination of incompatible measurement items

Cronbach's alpha, item to total correlation, reliability of linear combination score	• Constructs and Factor structures with Cronbach alpha value less than 0.70. • Measurement items with a threshold level less than 0.30 in item to total scores for both subscale and whole scale.
Exploratory Factor Analysis	• Measurement items with a factor loading less than 0.45 (Comprey, 1973) • Factor structures of constructs that account for variance less than 1 (Kaiser,1960)
Confirmatory Factor Analysis	• Measurement items with a factor loading less than 0.45 (Comprey, 1973) • Constructs and their factor structures with a composite reliability index less than 0.70 • Measurement items' t statistic which are not significant at least at the $p < 0.05$ level. • Constructs with AVE value less than 0.50 • Square root of the AVE value of a construct, if less than that of the correlation between constructs.

Step 5-Evaluation of PLS structural model

The predictive power of the structural model is evaluated by examining the amount of variance accounted for by the predictor constructs, i.e., the coefficient of determinant, R^2 for each predicted construct.

4.4.4 Moderator analysis

The PLS product indicator approach recommended by Chin et al. (2003) was adopted for this study in order to analyse moderating effects caused by turbulence of Micro and Macro environment on the relationship between Operational flexibility and effective project management.

4.4.4.1 PLS product indicator approach

According to Chin et al. (1996; 2003) PLS approach facilitates modeling of structural paths and measurement paths simultaneously. The PLS algorithm treats indicators separately and allows each of them to vary the magnitude of influence on the composite score of individual constructs. Indicators with weaker relationships to other related ones and to their corresponding constructs are given lower weightings and these varied weightings are carried forward for assessment of the estimates. This approach can be used to estimate large complex structural models with standard errors estimated via the bootstrapping technique.The product indicators are generated by multiplying the standardized scores of indicators from the predictor and moderator constructs. In order avoid computational errors by lowering the correlation between the product indicators and their components, standardized or centered indicators are to be used Smith and Sasaki (1979).

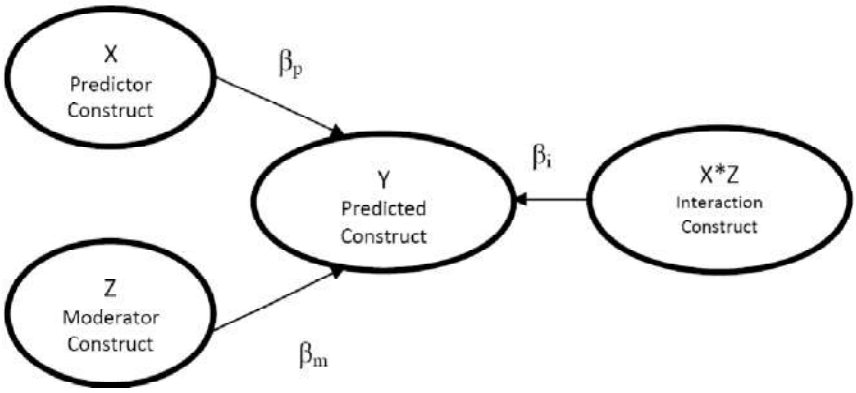

Fig 4.4 A Moderated Model- Predictor, Predicted, Moderator and Interaction Constructs (Adapted from Chin et al. (2003))

A two stage process was adopted to facilitate interpretation of results obtained from PLS product indicator approach. In the stage one a model without interaction construct seeks to find amount of influence of predictor on the dependent construct when only moderator is present. In the next stage, a moderated model is formed with interaction construct. Here we seek

to find out the interaction effect. The path coefficient, β_i of the interaction variable (X*Z) indicates a beta change from β_p to $\beta p + \beta_i$ when z is present. The magnitude of the interaction effect can be calculated,

$$f^2 = \frac{R^2 \text{ (Moderated-Model)} - R^2\text{(Main –Effect-model)}}{[1-R^2\text{(Moderated-model)}]}$$

The f^2 values of 0.02, 0.15, and 0.35 are considered as small, medium and large interaction effects respectively (Cohen, 1983). However, Chin et.al. (2003) takes a view that small f^2 value does not necessarily imply unimportant effect as it can be meaningful if changes in β estimates are found to be statistically significant.

Summary

This chapter comprises of four parts. The first part discusses Research Design and method of study.The Second part discusses Operationalization of Constructs. The third part discusses Questionnaire Development and fourth part explains methods used for research analysis.

The first part could delve deep into the research design used for this study. The phases of Research design are explained, beginning with the first phase-Exploratory Phase in which face to face interview approach with five senior project managers were undertaken. A census survey method was used for this study for data collection. Details of sampling, population and data collection are given along with number of questionnaires successfully answered.

The second part could contextualize and operationalize the proposed model with already existing scales in similar domains. Each of the dimensions in the various scales was explained under this domain. Measurements items indicated as (Δ) were modified based on the exploratory interview and tested in subsequent fieldwork while

measurement items indicated as (#) were omitted from subsequent fieldwork based on the preliminary interviews, because the proposed item overlapped with others or is not applicable to this study. Finally, measurement items indicated as @ were incorporated into the questionnaire without modification, based on the preliminary interviews and pilot study findings.

The third part presents the development of questionnaire with use of multiple Item approach and its superiority with description on design of the questionnaire, with questions following a semantic differential scale on a Likert design. The questionnaire consists of eleven parts.They are: General information, Learning culture, Supply chain capabilities, Technological capabilities, Human Resource Management practices, Employee behaviour and skills, Operational flexibility potential, Micro Environmental Conditions, Macro environmental Conditions, Effective Project Management and Demographic characteristics.

The fourth part begins with a description of Structural equation modelling analysis procedure, Why PLS was preferred and why SMART PLS was used for this study. The PLS modelling procedure is explained in detail next. The five step procedure starts with sample data preparation, under which common method variance needs to be checked and then multi collinearity. The PLS model specification needs to be made and then the PLS model iterative process starts- CFA, Path analysis and Bootstrapping are the statistical functions involved in the execution of the PLS algorithm. O'leary-Kelly and Vokurka construct validation process involving classical and contemporary validation methods are followed in this study with checks for internal reliability/ Consistency, Unidimensionality, Convergent validity, Discriminant validity. Final evaluation of the PLS structural model is made with the Rules by Falk and Miller for evaluating R^2 is used in this study.

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Chapter - 5

DATA VALIDATION

5.1 Introduction

This chapter presents the results of the various test done in order to establish the dependability of the data. The sample profile of interviewees and response rate are first examined, followed by checking for missing data, Outliers, Common, Method Bias, Questionnaire Length Bias, Non Response Bias, Normality, Multicollinearity, Suitability of data for factor analysis and assuming control variables. Next the data underwent classical validation processes in order to ascertain the reliability and validity of the constructs. The last section presents the conclusions drawn about data before model testing in the next chapter.

5.2 Sample Profile

The following table summarizes the sample profile with a description of age of firms participated, the size of theis workforce. The characteristics of the respondents in terms of designation, experience in the firm and industry are also presented.

Table 5.1 General information about the interviewees firms

Description	Frequency	Percentage
Age of firm		
>5 years	87	100.00%
5-10 years	30	34.48%
10-15 years	23	26.44%
15-20 years	15	17.24%
20-25 years	12	13.79%

>25 years	7	8.05%
Mean	17	
Size of Workforce (Supervisory staff and above)		
<50	21	24.71%
51-100	31	36.47%
101-200	28	32.94%
>500	7	8.24%
Characteristics of the respondents		
Designation		
Director	7	8.24%
General Manager Projects	13	15.29%
Senior Project Manager	25	29.41%
Project Manager	42	49.41%
Experience in the industry		
>5 years	87	100.00%
5-10 years	36	41.38%
10-15 years	21	24.14%
15-20 years	15	17.24%
20-25 years	9	10.34%
>25 years	6	6.90%
Experience in the firm		
>3years	87	100.00%
4-10 years	34	39.08%
11-15 years	20	22.99%
16-25 years	23	26.44%
Atleast 25 years	10	11.49%

The sample comprised of a respondent each, from the eighty seven firms. All the firms were more than 5 years old in the industry. There were thirty firms in the age group of 5-10 years, which formed 34.48% of the sample, while there were twenty three firms in the age group of 10-15 years, which formed 26.44% of the sample. There were fifteen firms in the age group of 15-20 years, which formed 7.24% of the sample. There were

twelve firms in the age group of 20-25 years, which formed 13.79% of the sample and finally there were seven firms with more than twenty five years of experience, which formed eight percentage of sample. The mean age of the sample was found to be seventeen. Now considering the size of the firms in terms of workforce employed ie., in terms of supervisory staffs and above; seven of them had more than five hundred employs, twenty eight of them had workforce size in the range 101 to 200, while thirty one of them had workforce size in the range fifty one to one hundred and twenty one firms had workforce size of less than fifty.

Considering the characteristics of respondents, one can find that project managers formed majority of the respondent group with forty two project managers participating in the survey. Twenty five senior project managers, thirteen general manager projects and seven directors of firms participated in the survey. Considering the experience of the respondents in the industry on can find that all of them had more than five years experience in the industry.Thirty six of them had experience in the range of five to nine years, while twenty one of them had experience in the range ten to fourteen years. Fifteen respondents had experience in the range of fifteen to twenty years, while nine respondents had experience in the range twenty one to twenty five, while six respondents had more than twenty five years experience in the industry.

Lastly considering the experience of the respondents in the firms they represent, one can see that all of them had more than three years experience in the firm. Thirty four respondents had experience in range of four to ten years, while twenty respondents have experience in the range of eleven to fifteen years. Twenty three respondents had experience in the range of sixteen to twenty five while ten respondents had atleast twenty five years in their firms.

5.3 Validation Tests

The table below summarizes the data validation tools used, the purpose, required values, software and references from the literature.The researcher considered missing data, outliers, normality, common method bias, questionnaire length bias, multi collinearity, suitability for EFA during the data validation stage.

Table 5.2 –Tests considered in the validation stage of data

Analysis	Purpose	Required Value	Technique	Tool	Reference
Missing Data	Examination of missing data and its possible treatment.	p>0.05 missing patterns are Completely at Random	Expectation maximisation (EM) with the Little's MCAR test	SPSS	Tabachnick & Fidell, 2007
Outliers					
Univariate outliers	To identify a case of an extreme value on single variable	Value <±3.0	Standardised score (z-scores)	SPSS	Hair et al., 2006
Common method bias	To check whether self reporting nature affected data reliability		Harman's one-factor test	SPSS	Podsakoff & Organ 1986
Questionnaire length bias	To ensure that length of the instrument will have no effect on respondents' interest to pay less concentration to the questions in the end	p>0.05 indicates no difference	Mann-Whitney-U-test	SPSS	Pallent, 2007
Normality					
Univariate normality	To ensure that the data distribution of scores at an item-level is linear and normally distributed.	P>0.05	Kolmogorov-Smirnov and Shapiro-Wilk (K-S) test,	SPSS	Shapiro and Wilk (1965)
Multicollinearity	To ensure that none of predictor variables in the model are highly correlated,(so that one can be linearly predicted from the others)	VIF<10, and tolerance >0.1	VIF and Tolerance effect using linear regression		Myer (1997) Menard(1995)
Suitability for EFA	Value> 0.60	Kaiser-Mayer-Olkin (KMO)	KMO	SPSS	Kaiser, 1974
	Value>0.4	Variance/loading	Variance loading	SPSS	Churchill (1979)

5.3.1 Missing Data

According to (Tabachnick & Fidell, 2007), missing data is one of the most common problems of data, affecting the reliability and validity. Within survey research, problem of missing data arises due to the conditions when respondents fail to answer one or more items in instrument. The following steps were suggested by (Hair et al., 2006) to understand and treat missing data. 1) examine the type of missing data, 2) examine the extent of missing data, 3) examine the randomness of missing data, and 4) apply the remedies.

The types of the missing data are classified into two groups as- 'ignorable and not-ignorable'. The not-ignorable missing data arises due to researcher's procedural factors e.g. errors during data entry process or failure to enter all the entries, or even might be result of refusal by respondents to answer some items.

For its treatment, Hair et al. (2006) suggested to identify the patterns and extent of missing data. From the patterns and extent of missing data occurrences, Tabachnick and Fidell (2007) pointed out that there can be three patterns with missing data that can be possible. They are 1. Missing completely at random (MCAR), 2. Missing at random also known ignorable (MAR) and 3. Missing not at random or not-ignorable (MNAR). In the current study, there were eighty seven valid and complete sets of questionnaires with no missing data and therefore were retained for further analysis.

5.3.2 Normality

The normality is considered to be fundamental assumption in multivariate analysis (Hair et al., 2006; Kline, 2005). Normality is characterized by the assumption that the data distribution in each item and in

all linear combination of items is normally distributed (Hair et al., 2006). The assumptions of normality can be examined by the distribution of scores at an item-level and distribution of scores within combination of two or more than two items. According to Tabachnick & Fidell (2007) shape of normal distribution can be ascertained by graphical or statistical methods.

Here we checked it using a statistical method known as the Kolmogorov-Smirnov and Shapiro-Wilk (K-S) statistics Shapiro and Wilk (1965) and results revealed that all the variables were significant (Lower than 0.05), thus it shows that each item of the key constructs deviated from a normal distribution. Because the univariate normality assumptions of the study variable were not met, it can be assumed that data set also deviated from the multivariate normality assumption (De Carlo, 1997).

5.3.3 Outliers

According to Tabachnick and Fidell (2006) an outlier is defined as 'a case with such an extreme value of one variable (a univariate outlier) or a combination of scores on two or more variable (multivariate outlier).' It is observation(s) which is distinct due to high or low scores (Hair et al., 2006). Researchers agreed that outliers can result in non-normality of data and distorted statistical results (Kline, 2005; Hair et al., 2006; Tabachnick & Fidell, 2007). According to rules of thumb in order to find univariate outliers, for a large sample size of 80 and above, a standardized score value +/- 3 can be used as a benchmark to identify outlines' (Hair, Anderson, Tatham & Black, 1998).

In the current study, for detecting the univariate outliers, items were grouped together to represent single variable and analyzed using descriptive statistics in SPSS, the data values of each observation were converted to standardized z scores (Hair et al., 2006; Tabachnick & Fidell, 2007). The

results indicate that the data set contains fewer univariate outliers. Based on this benchmark, 15 responses were found to include one outlier or more. Nine of them had only one outlier, while six responses had two outliers. However, these were retained for further analyses. This outlier analysis didn't eliminate any case leading to a final sample of 87 responses.

According to Hair et al. (2006) outliers have to be retained until and unless there is proof that outliers are truly deviated and are not signifying any observation in dataset. Therefore after observing outliers, researcher decided to retain the observations along with outliers to the next stage.

5.3.4 Common method bias

The common method bias has been considered as a major source of measurement error and thus a threat to the model validity. Following the procedural remedies by Podsakoff and Organ (1986), confidentiality and anonymity of the responses were ensured to all respondents. They were assured that there were no right and wrong answers, and concise, simple terms were used in the questionnaire.

In addition, measuring an item with the mixed - scale of Likert and semantic differential also can reduce the threat of method bias (Podsakoff et al. 2003). In order to detect the existence of common method bias, Harman's single-factor analysis was conducted in which we constrained the number of factors extracted in EFA to be just, then examined the unrotated solution. If CMB was an issue, a single factor will account for the majority of the variance in the model, which was not observed.

5.3.5 Questionnaire length bias

The length of the instrument might decrease respondents' interest to pay equal concentration to the questions at the start of the instrument compared to the question at the end of the instrument. In this regard, the

chances of potential differences were computed by using Mann-Whitney-U-test between first-five questions and last-five questions from the first forty and last forty respondents.

The results presented in table revealed that significant value in all ten variables was higher than 0.05 probability value and suggest no difference. Closely comparing Z score of LC with EPM questions it is noticed that none of construct is totally higher than the other, therefore, it can be inferred that respondents didn't feel difficulty with respect to the length of the instrument.

Table 5.3: Mann-Whitney-U-test results

	LC1	LC2	LC3	LC4	LC5
Mann-Whitney U	134.000	129.000	152.000	146.000	131.000
Wilcoxon W	327.000	268.000	319.000	251.000	322.500
Z	-.823	-.362	-1.021	-.468	-.734
Asymp.Sig.(2-tailed)	.344	.725	.221	.612	.314
	EPM12	EPM13	EPM14	EPM15	EPM16
Mann-Whitney U	134.000	158.000	114.500	124.500	142.500
	234.000	267.000	292.500	246.500	210.500
Z	-.522	-.753	-1.444	-.956	-.332
Asymp. Sig.(2-tailed)	.531	.463	.126	.362	.685
Grouping variable: Respondent (1=early, 2=late)					

5.3.6 Multicollinearity

To check for multicollinearity that might pose a problem among Predictor variables, the unstandardized latent variable scores of the variables were exported into SPSS. The values for the variance inflation factor (VIF) ranged from1.96 for Supply chain capabilities to 4.54 for Learning culture and the average VIF was 2.49, which is far below the common cutoff threshold of 10 (Hair et al., 1998). Therefore, multicollinearity did not represent a serious problem.

5.3.7 Suitability for EFA (Factorability)

The results of a Kaiser-Mayer-Olkin (KMO) statistics, which is measured of sampling adequacy was 0.742, higher than the minimum recommended value of 0.60 Kaiser (1974) for all the constructs. In addition, Levene's test for homogeneity of variance values greater than 0.05 proves equality of variances and hence were suitable for EFA (Hair et al., 2006). The total variance extracted by the questions within construct were higher than 0.60 (Hair et al., 2006). Also factor loading revealed that all the items in these constructs were loaded above 0.5.

Table 5.4: KMO, Variance explained values

Construct	KMO	Sig	Levene's test	Variance Explained
Learning Culture	0.734	sig	0.122	76.268%
Supply chain capabilities	0.863	sig	0.101	84.132%
Technological Capabilities	0.794	sig	0.256	66.423%
HRM practices	0.778	sig	0.231	72.346%
Employee Behaviour and skills	0.875	sig	0.195	60.238%
Operational Flexibility Potential	0.742	sig	0.210	75.578%
Micro Environmental Conditions	0.843	sig	0.191	69.354%
Macro Environmental Conditions	0.822	sig	0.136	73.435%
Effective project Management	0.786	sig	0.173	77.472%

5.4 Results of classical validation

The table given below summarizes 1). Cronbach alpha coefficients, 2). Item to total correlation, 3). Reliability of linear combination scores and 4). Factor loadings of all measurement items within their corresponding dimensions. The factor loadings from the EFA are included in this table so as to provide a comprehensive result from classical validation approach. In the cases of inconsistent items, are written in italics, with scores in parenthesis show values before the removal of inconsistent items.

Table 5.5: Cronbach's alpha values, Item to total correlation and Factor loadings

Item code	Construct and measurement items	Item –Total correlation		
		Subscale	Whole scale	Factor loadings
X1	**Learning culture**			
	Inter project learning (Cronbach's alpha=0.821)			
LC1.1	During planning we review past plans	0.577	0.524 (0.492)	0.711 (0.703)
LC1.2	During the planning, we review past lessons learned	0.654	0.598 (0.555)	0.735 (0.711)
LC1.3	During the planning, we involve the people who have completed similar work in the past	0.548	0.520 (0.498)	0.763 (0.724)
	Intra Project Learning (Cronbach's alpha=0. 832)			
LC2.1	We share what we learn with each other	0.498	0.443 (0.412)	0.731 (0.717)
LC2.2	We produce a detailed project plan discussing cost, schedule, and performance for each project.	0.799	0.642 (0.629)	0.743 (0.731)
LC2.3	When a mistake' ' or failure to meet expectations occurs, we admit the mistake.	0.439	0.411 (0.398)	0.712 (0.691)
X2	**SUPPLY CHAIN CAPABILITIES**			
	Strategic Supplier Partnership (SSP) (Cronbach's alpha=0. 763)			
SC1.1	We consider quality as our number one criterion in selecting suppliers.	0.762 (0.729)	0.739 (0.722)	0.856 (0.839)
SC1.2	We regularly solve problems jointly with our suppliers.	0.735 (0.706)	0.654 (0.620)	0.832 (0.772)
SC1.3	We have continuous improvement programs that include our key suppliers.	0.529 (0.498)	0.510 (0.491)	0.762 (0.756)
SC1.4*	We include our key suppliers in our planning and goal-setting activities.	(-0.588)	(0.024)	(0.319)
SC1.5*	We actively involve our key suppliers in new product development processes.	(0.178)	(0.332)	(0.240)
	Customer Relationship (CR) (Cronbach's alpha=0.848)			
SC2.1*	We frequently interact with customers to set reliability, responsiveness, and other standards for us.	(0.239)	(0.314)	(0.167)
SC2.2	We frequently measure and evaluate customer satisfaction.	0.776 (0.762)	0.752 (0.736)	0.839 (0.821)
SC2.3	We frequently determine future customer expectations.	0.680 (0.665)	0.632 (0.620)	0.730 (0.719)

SC2.4	We facilitate customers' ability to seek assistance from us.	0.710 (0.702)	0.628 (0.613)	0.767 (0.753)
	The level of information Sharing (IS) **(Cronbach's alpha=0. 720)**			
SC3.1	We inform suppliers' & contractors in advance of changing needs.	0.590	0.525 (0.513)	0.714 (0.701)
SC3.2	Our suppliers, contractors keep us fully informed about issues that affect our business.	0.628	0.597 (0.586)	0.736 (0.714)
SC3.3	We and our suppliers, contractors exchange information that helps the establishment of business planning.	0.574	0.536 (0.529)	0.774 (0.710)
X3	**TECHNOLOGICAL CAPABILITIES** **(Cronbach's alpha=0.793)**			
ITC1	Our firm has the ability to communicate and share real time information among supply chain parties regardless of geographic dispersion		0.619 (0.593)	0.721 (0.716)
ITC2*	Our firm has the ability to communicate and share real time information among all decision makers and employees regardless of geographic dispersion		(0.248)	(-0.227)
ITC3	Our firm has the ability to retrieve information is existing/past projects, from a company database in a timely manner regardless of geographic dispersion		0.495 (0.448)	0.599 (0.578)
CPC1*	Our firm has the ability to apply different process technology software (eg: estimating and purchasing software) to improve firms operational process.		(0.251)	(0.164)
CPC2*	Our firm has the ability to lead in process technology innovation (eg: in house research done in core processes)		(-0.252)	(0.165)
X4	**HRM practices** **(Cronbach's alpha=0. 823)**			
	Competence development			
HR1.1	Organizing training on the latest issues (e.g. A change in regulations and safety requirements) that have direct impact on firms operational processes	0.665 (0.629)	0.616 (0.592)	0.718 (0.702)
HR1.2	Organizing training to upgrade knowledge and skills in using software (e.g. MS project, AutoCAD and accounting software).	0.738 (0.715)	0.683 (0.667)	0.779 (0.767)
HR1.3*	Organizing training to upgrade knowledge and skills on the application of different construction methods and technologies.	(0.144)	(0.330)	(0.238)
HR1.4	Offering on the job training	0.793 (0.772)	0.745 (0.731)	0.851 (0.832)
HR1.5	Offering job enrichment programme	0.730 (0.712)	0.753 (0.713)	0.795 (0.782)
HR1.6*	Subsidizing tuition fees of self upgrading courses and seminars attended by employees	(0.324)	(0.115)	(0.099)
	Stress Management			

	(Cronbach's alpha=0. 831)			
HR2.1	Organizing stress coping and management courses	0.532	0.498 (0.451)	0.656 (0.612)
HR2.2	Implementing personal counselling program	0.514	0.531 (0.514)	0.627 (0.619)
	Performance management **(Cronbach's alpha=0.896)**			
HR3.1	Organizing informal gatherings, trips to recognize employees' achievements and to foster team building.	0.750	0.712 (0.693)	0.838 (0.812)
HR 3.2	Providing flexible compensation plans (e.g.: performance bonus)	0.521	0.525 (0.498)	0.674 (0.650)
HR 3.3	Conducting staff performance appraisal exercise as a formal means of discussing, identifying and recording their training need	0.724	0.704 (0.692)	0.886 (0.846)
HR 3.4	Offering career development and promotion opportunities	0.747	0.729 (0.692)	0.829 (0.814)
X5	**Employee Behaviour and Skills** **(Cronbach's alpha=0.864)**			
EBS1	Our employees have the ability to adopt an open mindset to all alternatives		0.758 (0.724)	0.843 (0.815)
EBS2	Our employees have the ability to work in a team environment		0.546 (0.511)	0.838 (0.812)
EBS3	Our employees have the ability to learn and adapt to different business conditions		0.521 (0.506)	0.757 (0.724)
EBS4*	Our employees have the ability to perform a diverse range of tasks and responsibilities.		*(-0.215)*	*(-0.076)*
EBS5	Our employees have the ability to gain customer satisfaction.		0.735 (0.714)	0.789 (0.729)
EBS6*	Our employees have the ability to perform highly sophisticated tasks.		(-0.296)	(-0.474)
EBS7*	Our employees have the ability to work independently.		(-0.397)	(-0.512)
Y	**Operational Flexibility**			
	Demand Management (Cronbach's alpha=0. 754)			
OF1.1	We can effectively respond to multiple customer requirements in terms of repair, construction and maintenance	0.734	0.722 (0.711)	0.783 (0.736)
OF1.2	We can effectively negotiate with customers, suppliers and contractors in terms of prices, delivery time through long term relationships	0.756	0.736 (0.721)	0.784 (0.762)
OF1.3	We involve customers to improve our services effectively.	0.721	0.734 (0.711)	0.817 (0.798)
OF1.4	We quickly respond to feedback from consumers & marketing dept. effectively.	0.620	0.615 (0.595)	0.752 (0.710)
OF1.5	We can successfully respond to multiple Project delivery	0.728	0.715	0.824

	requirements.		(0.698)	(0.810)
	Modification (Cronbach's alpha=0.721)			
OF2.1	We can quickly modify internal design in response to customer requests before construction as far as the elevations are un affected.	0.633 (0.610)	0.626 (0.608)	0.736 (0.731)
OF2.2	We even accommodate nominal modifications as per customer needs even during construction.	0.625 (0.593)	0.614 (0.552)	0.701 (0.635)
OF2.3	We can better meet customer needs by modifications.	0.682 (0.654)	0.673 (0.641)	0.743 (0.738)
OF2.4*	We can modify existing projects quickly.	(0.165)	(-0.262)	(0.368)
	New project development (Cronbach's alpha=0.734)			
OF 3.1*	We can quickly introduce new projects into the market.	(-0.150)	(0.132)	(0.253)
OF 3.2	We take the lead in new product introduction.	0.720 (0.640)	0.684 (0.632)	0.762 (0.734)
OF 3.3	We can launch new projects easily.	0.742 (0.672)	0.682 (0.632)	0.746 (0.711)
OF 3.4	We can launch new projects inexpensively	0.723 (0.692)	0.731 (0.673)	0.756 (0.716)
	Volume (Cronbach's alpha=0.710)			
OF 4.1	We can operate efficiently irrespective of number of projects handled simultaneously.	0.736 (0.672)	0.675 (0.643)	0.657 (0.642)
OF 4.2*	We can operate profitably at various levels of output	(0.112)	(-0.136)	(0.315)
OF 4.3	We can control the number of our projects reaching finish in advance	0.657 (0.621)	0.598 (0.556)	0.732 (0.682)
OF 4.4	We can vary aggregate output from one period to the next to aid resource levelling.	0.640 (0.601)	0.612 (0.527)	0.716 (0.679)
	Mix			
OF 5.1	We have variety of projects in our portfolio.	0.559	0.542 (0.536)	0.775 (0.732)
OF 5.2	We can changeover quickly after finishing one project to another	0.732	0.742 (0.721)	0.765 (0.747)
OF 5.3	We easily and accurately label & track individual units from planning till hand over and after.	0.692	0.582 (0.565)	0.739 (0.714)
OF 5.4	We keep accurate records of quantities & types of materials used in each units.	0.580	0.533 (0.504)	0.592 (0.572)
M1	**Micro environmental Factors**			
	Cash flow (Cronbach's alpha=0.821)			
MI1.1	Failure to meet the delivery date promises	0.689	0.584	0.731
MI1.2	Delay in commencement of projects	0.740	0.716	0.824
MI1.3	Lack of adequate cash flow affecting the pace of work	0.543	0.526	0.687
MI1.4	Projects exceeded budgets beyond satisfactory limits due to cost escalations	0.465	0.459	0.578
	Scope creep (Cronbach's alpha=0.749)			
MI2.1	Scope /Design changes leading to reworks	0.673	0.632	0.725

MI2.2	Reworks due to poor workmanship	0.536	0.515	0.693
	Legal proceedings (Cronbach's alpha=0. 887)			
MI3.1	Legal proceedings with customers	0.611	0.562	0.676
MI3.2	Legal procedures with neighbours	0.749	0.715	0.791
	Macro Environmental factors (Reliability of linear combination=0.834)			
	Demand(Cronbach's alpha=0.755)			
MA1.1	Fluctuations in demand for constructed facilities.	0.743	0.726	0.834
MA1.2	Price competition in the construction market	0.693	0.630	0.762
MA1.3	Non price competition in the construction market.	0.710	0.679	0.753
	Supply(Cronbach's alpha=0.898)			
MA2.1	Supply of raw materials	0.722	0.685	0.752
MA2.2	Supply of labour	0.795	0.746	0.877
	Cost (Cronbach's alpha=0.913)			
MA3.1	Rising costs Materials	0.674	0.637	0.722
MA3.2	Rising cost of Labour	0.753	0.737	0.815
MA3.3	Rising cost of Finance	0.763	0.694	0.788
Z	**EFFECTIVE PROJECT MANAGEMENT**			
	Learning (Cronbach's alpha=0.915)			
EPM1.1	Develop new knowledge and expertise	0.549 (0.521)	0.492 (0.453)	0.707 (0.674)
EPM1.2	Increase level of professional development	0.538 (0.513)	0.525 (0.482)	0.738 (0.699)
EPM1.3	Generate positive reputation	0.768 (0.742)	0.711 (0.698)	0.851 (0.824)
EPM1.4	Develop new business relationship	0.603 (0.589)	0.553 (0.524)	0.776 (0.753)
EPM1.5*	Exploitation of technology	(0.232)	0.173)	(0.053)
EPM1.6*	Usable life expectancy	(-0.537)	(0.206)	(0.172)
	User Satisfaction (Cronbach's alpha=0.934)			
EPM2.1	Project functionality	0.684	0.630 (0.619)	0.722 (0.601)
EPM2.2	Aesthetic value	0.639	0.586 (0.548)	0.674 (0.628)
EPM2.3	Easy to maintain	0.796	0.741 (0.726)	0.829 (0.801)
EPM2.4	Early occupation	0.737	0.682 (0.655)	0.762 (0.732)
EPM 2.5	Minimum cost of ownership	0.687	0.624 (0.610)	0.788 (0.728)

5.4.1 Cronbach's alpha coefficient, Item -total correlation-Subscale, Whole scale - Factor loadings

Internal reliability of measurement items of individual constructs was ascertained using Cronbach's alpha tests and item to total correlation tests. The Cronbach's alpha values of multidimensional and single dimensional constructs have exceeded the threshold level of 0.70 (Nunnally, 1978). The reported Cronbach's alpha value ranges from 0.710 to 0.934. These relatively high values of Cronbach's alpha scores indicate high internal reliability giving confidence in the reliability of the measurement items.In the case of multidimensional constructs, subscale score was calculated from each factor structure. The whole scale score was then calculated by collective values of sub constructs. From the table above it can be seen that subscale and whole scale scores of single and multidimensional constructs are well above the threshold level of 0.30 (Nunnally, 1978). The subscale and whole scale values range from 0.439 to 0.835 and 0.578 to 0.886 respectively. This again provides strong evidence for the internal reliability within constructs.

5.5 Exploratory factor analysis

Following (Wang et al., 2007) for exploring the unidimensionality of measurement items of eight constructs, the six multidimensional constructs are first analysed independently by conducting six sets of EFA on each individual blocks of data of individual constructs. Again for the two single dimensional constructs, the corresponding data were analyzed by combining all data obtained for those as a group.

5.5.1 Factor analysis of Project learning culture

The table below shows that two factors have satisfied the eigenvalue greater than one criterion, further this finding is supported by the scree plot. This finding agrees with scree plot.

Table 5.6 Total variance explained for Project learning culture

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	6.407	64.070	64.070
2	1.177	11.772	75.842
3	.669	6.691	82.533
4	.510	5.099	87.631

Note: Extraction method-Principal component analysis

From the above table it is clear that the identified factors jointly explain 75.842% of the total variance with inter project learning culture identified with an eigenvalue 6.407, representing 64.070 % of the explained variance. Subsequently, the intra project learning factor was identified with an eigenvalue of 1.177 and accounts for 11.772% of the explained variance.

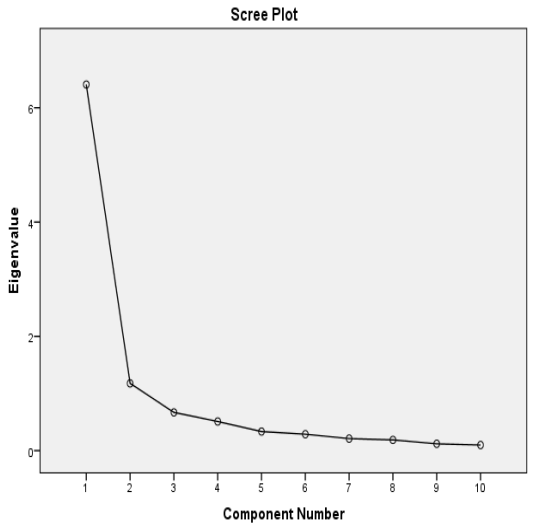

Fig 5.1-Scree plot for Project Learning Culture

From the table 5.7 below it is clear that all measurement items loaded adequately on the corresponding factors showing a minimum factor loading of 0.711. The high factor loadings establish high convergent validity of individual measurement items on three factors of project learning culture

construct. Also the table below proves that measurement items did not cross load excessively on other factors that they were not build to measure, showing adequate Discriminant validity of individual factors, with cross loading well below the 0.45 level.

Table 5.7 Project learning culture-Factor matrix

Measurement Items	Factor	
	1	2
LC1.1	**0.711**	0.264
LC1.2	**0.735**	0.157
LC1.3	**0.763**	0.215
LC2.1	0.162	**0.731**
LC2.2	0.294	**0.743**
LC2.3	0.173	**0.712**

Extraction Method: Principal component analysis; Rotation Method: Varimax with Kaiser normalization

5.5.2 Factor analysis of Supply Chain Capabilities (X2)

Three factor structures have met with Eigen value greater than one and scree plot criteria. The three factors jointly account for 73.806 % of the total variance explained. These factors are denoted as factors 1 to 3 in table 5.8 given below. The factors are **Strategic Supplier Partnership (SSP), Customer Relationship (CR), Level of information Sharing (IS).**

Table 5.8 Total variance explained for Supply Chain Capabilities

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	8.062	57.584	57.584
2	1.244	8.883	66.467
3	1.028	7.340	73.806
4	.838	5.989	79.795
5	.741	5.296	85.091

Note: Extraction method-Principal component analysis

Nine measurement items loaded highly on their respective factors with loadings ranging from 0.714 to 0.856. The loading are well above the cutoff value of 0.45 indicating a high degree of convergent validity of measurement items. It is also found that all the measurement items did not cross load excessively (all below 0.45) on other factors that they were not purported to measure indicating sufficient Discriminant validity.

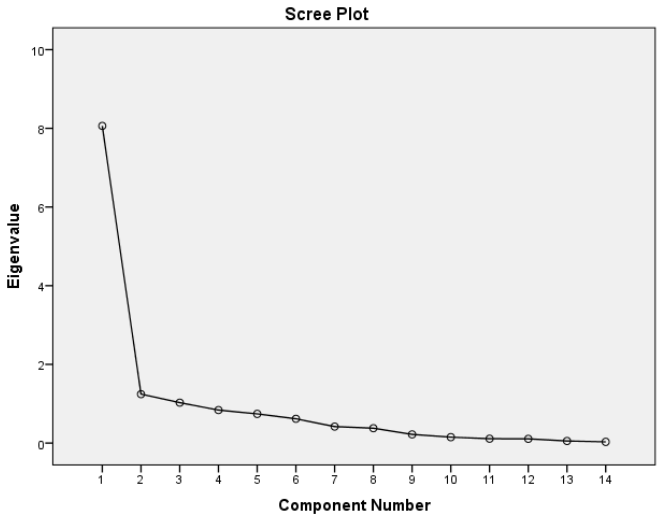

Fig 5.2-Scree plot for Supply Chain Capabilities

Table 5.9 Supply Chain Capabilities –Factor matrix

Measurement Items	Factor		
	1	2	3
SC1.1	**0.856**	-0.024	0.241
SC1.2	**0.832**	0.157	0.192
SC1.3	**0.762**	0.215	0.113
SC2.1	0.132	**0.839**	0.117
SC2.2	0.314	**0.730**	0.078
SC2.3	0.331	**0.767**	0.263
SC3.1	0.112	0.182	**0.714**
SC3.2	-0.042	0.204	**0.736**
SC3.3	0.162	0.025	**0.774**

Extraction Method: Principal component analysis; Rotation Method: Varimax with Kaiser normalization.

5.5.3 Factor analysis of HRM practices (X4)

Three factors matrix has met with an eigenvalue greater than one and scree plot criteria. The three factors jointly account for 71.873 % of the total variance explained. . These factors are denoted as factors 1 to 3 in table 5.10 given below. The factors are **Competence development, Stress Management, Performance management.**

Table 5.10 Total variance explained for Human Resource Management Practices

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	6.232	47.940	47.940
2	1.720	13.232	61.172
3	1.391	10.701	71.873
4	.900	6.922	78.795
5	.762	5.862	84.657

Note: Extraction method-Principal component analysis

Ten measurement items loaded highly on their respective factors with loadings ranging from 0.656 to 0.851. The loading are well above the cutoff value of 0.45 indicating a high degree of convergent validity of measurement items. Here, it is also found that none of the measurement items cross load excessively (all under 0.45) on other factors that they were not purported to measure indicating sufficient Discriminant validity.

Table 5.11 Human Resource Practices –Factor matrix

Measurement Items	Factor		
	1	2	3
HR1.1	**0.718**	0.0253	-0.182
HR1.2	**0.779**	-0.013	0.156
HR1.3	**0.838**	0.129	0.265
HR1.4	**0.851**	0.019	0.095
HR2.1	0.321	**0.656**	0.242
HR2.2	0.346	**0.627**	0.297
HR3.1	0.151	0.222	**0.838**
HR 3.2	-0.092	0.164	**0.674**
HR 3.3	0.176	-0.031	**0.886**
HR 3.4	-0.024	0.228	**0.829**

Extraction Method: Principal component analysis; Rotation Method: Varimax with Kaiser normalization.

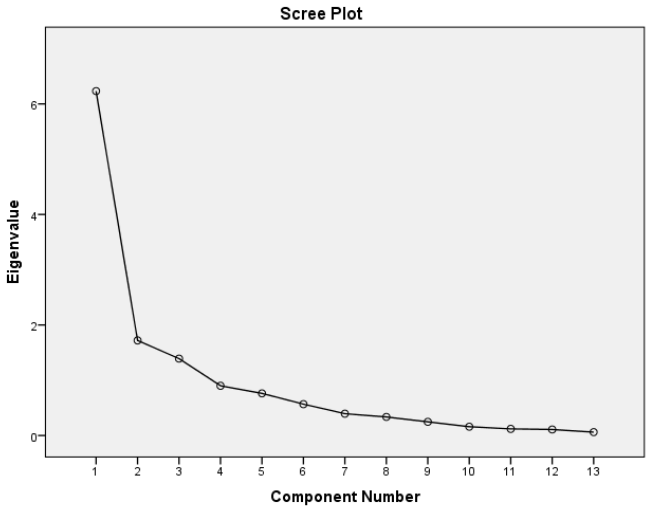

Fig 5.3-Screeplot for HRM Practices

5.5.4 Factor analysis of Operational Flexibility

Five factor matrix has met with an eigenvalue greater than one and scree plot criteria. The Five factors jointly account for 79.79 % of the total variance explained. . These factors are denoted as factors 1 to 5 in table 5.12 given below. The factors are Demand Management flexibility, New Product

development flexibility, Modification flexibility, Volume flexibility, Mix Flexibility.

Table 5.12 Total variance explained for Operational Flexibility

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	7.990	44.391	44.391
2	2.256	12.535	56.926
3	1.666	9.254	66.180
4	1.318	7.320	73.500
5	1.132	6.291	79.790
6	.884	4.911	84.702
7	.677	3.760	88.461

Note: Extraction method-Principal component analysis

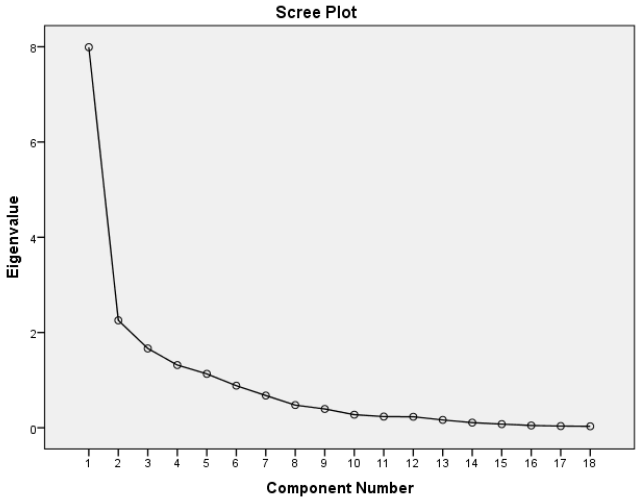

Fig 5.4- Scree Plot for Operational Flexibility

All the eighteen measurement items loaded highly on their respective factors with loadings ranging from 0.535 to 0.827. The loading are well above the cutoff value of 0.45 indicating a high degree of convergent validity of measurement items. It is also found that all the measurement items did not cross load excessively (all under 0.45) on other factors that they were not purported to measure indicating sufficient Discriminant validity.

Table 5.13: Operational Flexibility Factor Matrix

Measurement Items	Factor				
	1	2	3	4	5
OF 1.1	**0.783**	0.321	0.252	0.113	0.151
OF1.2	**0.784**	0.215	0.211	0.232	-0.162
OF1.3	**0.817**	0.114	0.162	0.254	0.272
OF1.4	**0.752**	0.317	0.231	0.174	0.189
OF1.5	**0.824**	0.183	-0.101	-0.122	0.121
OF 2.1	0.324	**0.736**	0.145	0.262	0.192
OF 2.2	0.223	**0.701**	0.111	0.321	0.108
OF 2.3	0.126	**0.743**	-0.014	-0.123	0.213
OF 3.1	0.352	0.165	**0.762**	0.250	0.178
OF 3.2	0.334	0.213	**0.746**	0.301	0.222
OF 3.3	0.336	0.110	**0.756**	0.182	0.150
OF 4.1	-0.152	0.252	0.234	**0.657**	-0.231
OF 4.2	0.128	0.313	0.182	**0.732**	0.114
OF 4.3	0.107	0.135	0.148	**0.716**	0.175
OF 5.1	0.190	0.119	-0.162	0.148	**0.775**
OF 5.2	0.200	0.292	0.242	0.232	**0.765**
OF 5.3	0.232	0.223	0.256	0.188	**0.739**
OF 5.4	0.254	0.177	0.243	0.172	**0.592**

Extraction Method: Principal component analysis; Rotation Method: Varimax with Kaiser Normalization.

5.5.5 Factor analysis of Micro Environmental Factors (M1)

Three factors matrix has met with an eigenvalue greater than one and scree plot criteria. The three factors jointly account for 64.910 % of the total variance explained. These factors are denoted as factors 1 to 3 in table 5.14 given below. The factors are **Cash flow, Reworks, and legal proceedings.**

Table 5.14: Total Variance explained for Micro Environmental Factors

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.217	32.174	32.174
2	1.987	19.867	52.041
3	1.287	12.869	64.910
4	.885	8.853	73.763
5	.829	8.295	82.058

Eight measurement items loaded highly on their respective factors with loadings ranging from 0.676 to 0.824. The loading are well above the cutoff value of 0.45 indicating a high degree of convergent validity of measurement items. Here also found that none of the measurement items cross load excessively (all under 0.45) on other factors that they were not purported to measure indicating sufficient Discriminant validity.

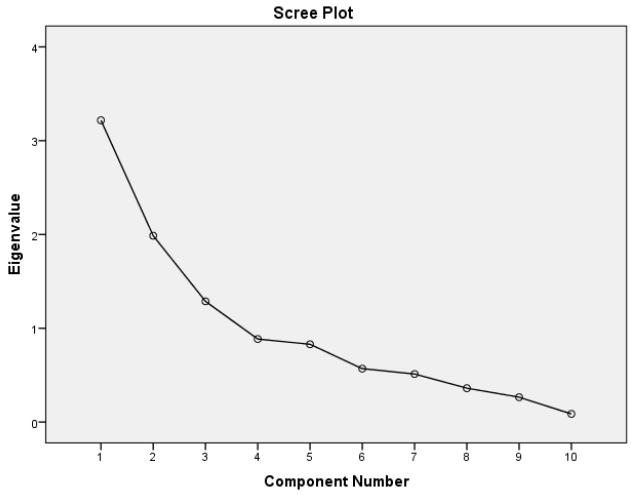

Fig 5.5-Scree plot for Micro Environmental Factors

Table 5.15: Micro Environmental Factors Factor matrix

Measurement Items	Factor		
	1	2	3
MI1.1	**0.731**	0.139	0.159
MI1.2	**0.824**	0.321	-0.183
MI1.3	**0.687**	0.132	0.315
MI1.4	**0.678**	0.320	-0.161
MI2.1	0.113	**0.725**	0.231
MI2.2	-0.017	**0.693**	0.178
MI3.1	0.227	-0.010	**0.676**
MI3.2	0.148	0.231	**0.791**

Extraction Method: Principal component analysis; Rotation Method: Varimax with Kaiser normalization.

5.5.6 Factor analysis of Macro Environmental Factors (M2)

Three factors structures have met with eigen value greater than one and scree plot criteria. The three factors jointly account for 73.93 % of the total variance explained. These factors are denoted as factors 1 to 3 in table 5.16 given below. The factors are **Demand, Supply, Cost, and Regulations.**

Table 5.16: Total Variance explained for Macro Environmental Factors

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.518	43.971	43.971
2	1.263	15.787	59.758
3	1.134	14.174	73.933
4	.935	11.689	85.621
5	.475	5.932	91.553

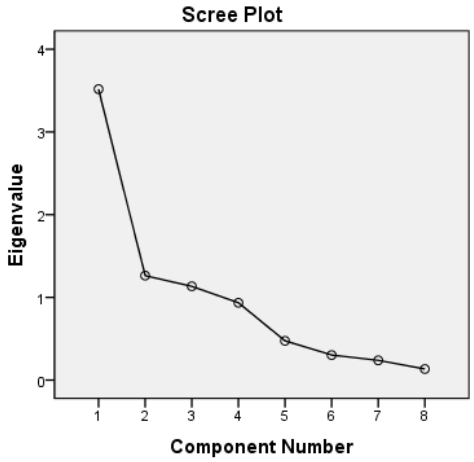

Fig 5.6-Scree Plot for Macro Environmental Factors

All the Eight measurement items loaded highly on their respective factors with loadings ranging from 0.722 to 0.877. The loading are well above the cutoff value of 0.45 indicating a high degree of convergent validity of measurement items. Here also found that none of the measurement items cross load excessively (all under 0.45) on other factors that they were not purported to measure indicating sufficient Discriminant validity.

Table 5.17: Macro Environmental Factors Factor Matrix

Measurement Items	Factors		
	1	2	3
MA1.1	**0.834**	0.232	0.157
MA1.2	**0.762**	0.354	0.332
MA1.3	**0.753**	-0.192	-0.034
MA2.1	-0.087	**0.752**	0.185
MA2.2	0.192	**0.877**	-0.156
MA3.1	0.168	0.399	**0.722**
MA3.2	0.243	0.375	**0.815**
MA 3.3	-0.032	0.193	**0.749**
MA3.4	0.264	0.098	**0.788**

Extraction Method: Principal component analysis; Rotation Method: Varimax with Kaiser normalization

5.5.7 Factor analysis of Effective Project Management (Z)

Two factors structures have met with eigen value greater than one and scree plot criteria. The two factors jointly account for 73.647 % of the total variance explained. . These factors are denoted as factors 1 and 2 in table 5.18 given below. The factors are **Learning and exploitation and Client Satisfaction.**

Table 5.18: Total Variance explained Effective project management

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	9.820	61.373	61.373
2	1.964	12.274	73.647
3	.955	5.971	79.619
4	.687	4.293	83.912

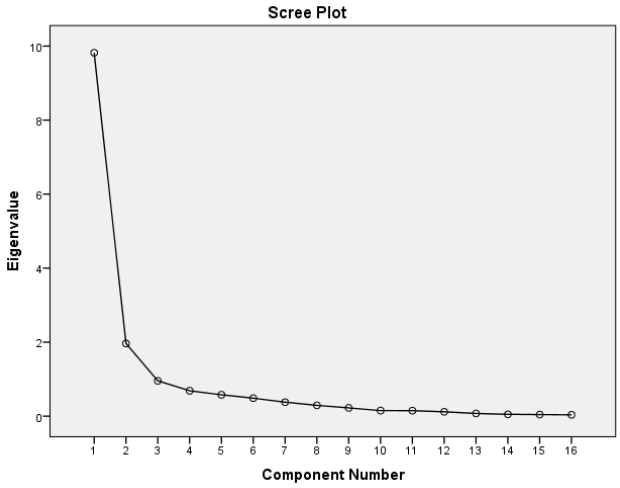

Fig 5.7- Screeplot for Effective Project Management

Nine measurement items loaded highly on their respective factors with loadings ranging from 0.674 to 0.859. The loading are well above the cutoff value of 0.45 indicating a high degree of convergent validity of measurement items. Here also found that none of the measurement items cross load excessively (all under 0.45) on other factors that they were not purported to measure indicating sufficient Discriminant validity.

Table 5.19: Effective Project Management Factor Matrix

Measurement Items	Factor	
	1	2
EPM1.1	**0.707**	0.321
EPM1.2	**0.738**	0.222
EPM1.3	**0.851**	0.152
EPM1.4	**0.786**	0.182
EPM2.1	0.340	**0.722**
EPM2.2	0.044	**0.674**
EPM2.3	0.280	**0.829**
EPM2.4	0.068	**0.821**
EPM2.5	0.352	**0.783**

Extraction Method: Principal component analysis; Rotation Method: Varimax with Kaiser normalization.

5.5.8 Factor analysis of Technological Capabilities (X3) and Employee Behaviour and skills (X5)

Treating the single dimensional constructs together, the two factor structures have met with Eigenvalue greater than one criteria and scree plot criteria. They jointly account for 78.681 % of the total variance explained. These factors are denoted as factors 1 and 2 in table 5.20 given below.

Table 5.20 Total variance explained for Single dimensional constructs

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.671	61.183	61.183
2	1.050	17.499	78.681
3	.633	10.555	89.236
4	.401	6.686	95.923

Note: Extraction method-Principal component analysis

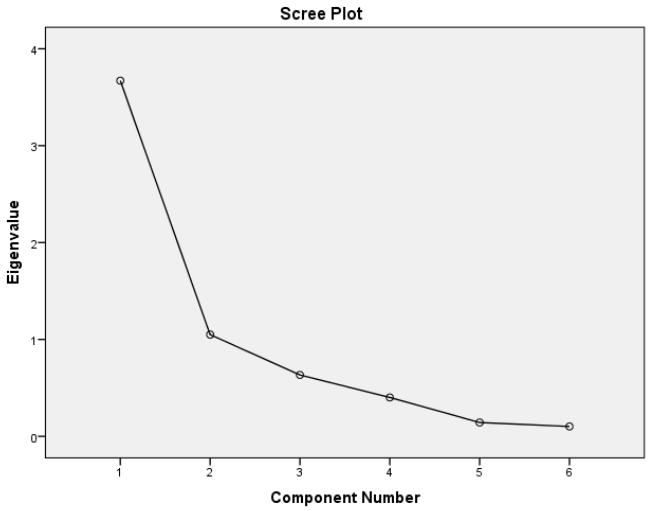

Fig 5.8- Screeplot for Technological Capabilities & Employee Behaviour and skills

All the six measurement items loaded highly on their respective factors with loadings ranging from 0.702 to 0.856. The loading are well above the cutoff value of 0.45 indicating a high degree of convergent validity of measurement items. It is also found that all the measurement items did not cross load excessively (all under 0.45) on other factors that they were not purported to measure indicating sufficient Discriminant validity.

Table 5.21 Single dimensional constructs –Factor matrix

Measurement Items	Factor	
	1	2
TC1.1	**0.721**	0.236
TC1.3	**0.599**	0.337
EBS 1.1	-0.012	**0.843**
EBS1.2	0.1629	**0.838**
EBS1.3	0.2371	**0.757**
EBS1.4	0.325	**0.789**

Extraction Method: Principal component analysis; Rotation Method: Varimax with Kaiser normalization

The table below shows the categorization of constructs based on the results obtained from the classical validation. Removal of inconsistent measurement items in the CFA is subjected to the rules set earlier.

Table 5.22: Categorization of constructs based on classical validation

Item	Constructs	No. of factors	No. of measurement items
1	Project Learning culture	2	6
2	Supply chain capabilities	3	9
3	Technological Capabilities	1	2
4	HRM practices	3	10
5	Employee Behaviour and skills	1	4
6	Operational Flexibility Potential	5	18
7	Micro Environmental Conditions	3	8
8	Macro environmental Conditions	3	8
9	Effective project Management	2	9
		23	74

5.6 Standard deviation of measurement items

The table below shows the item code and standard deviation values of each of the items.

Table 5.23: Standard Deviation of measurement items

Item Code	Std. Dev.	Item Code	Std. Dev.	Item Code	Std. Dev.	Item Code	Std. Dev.	Item Code	Std. Dev.
LC1.1	1.13	ITC1	1.31	OF1.1	1.11	OF5.2	0.74	MA2.1	0.76
LC1.2	1.08	ITC3	1.42	OF1.2	1.26	OF5.3	0.65	MA2.2	0.84
LC1.3	1.28	EBS1	0.64	OF1.3	1.04	OF 5.4	0.53	MA3.1	1.45
LC2.1	0.94	EBS2	0.72	OF1.4	0.95	MI1.1	1.17	MA3.2	1.26
LC2.2	1.02	EBS3	0.67	OF1.5	0.99	MI1.2	0.89	MA3.3	1.53
LC2.3	1.15	EBS5	0.45	OF2.1	1.35	MI1.3	0.94	EPM1.1	0.79
SC1.1	0.87	HR1.1	1.62	OF2.2	1.26	MI1.4	0.87	EPM1.2	0.82
SC1.2	0.93	HR1.2	0.92	OF2.3	1.52	MI2.1	1.28	EPM1.3	0.92
SC1.3	0.86	HR1.3	1.18	OF3.2	1.09	MI2.2	1.02	EPM1.4	0.93
SC2.2	1.14	HR1.4	1.22	OF3.3	0.94	MI3.1	0.67	EPM2.1	0.47
SC2.3	1.28	HR2.1	0.95	OF3.4	1.15	MI3.2	0.76	EPM2.2	0.65
SC2.4	1.11	HR2.2	0.89	OF4.1	1.53	MA1.1	1.11	EPM2.3	0.53
SC3.1	1.32	HR3.1	1.35	OF4.3	1.26	MA1.2	1.05	EPM2.4	0.73
SC3.2	1.15	HR3.2	1.17	OF4.4	1.44	MA1.3	0.94	EPM2.5	0.42
SC3.3	1.03	HR3.4	1.04	OF5.1	0.89				

The standard deviation (SD) values were computed it shows that the SD values for all measurement items range from 0.42 to 1.62.

Summary

This chapter is devoted for data validation which started analysing sample profile, where age of firms, size of work force, experience of respondents in the industry and in the firms were assessed. Then a sequence of tests were conducted starting with test of missing data where, it was found to cause no significant issues to the validity of data set. It was followed by test of normality where statistical values of K-S test and S-W test proved that data to be non normal, however it is expected due to low sample size and the PLS analysis is capable of handling non normal data therefore non normality didn't pose a problem. Tests for number of outliers, multicollinearity, common method bias, questionnaire length bias were conducted and found the data to be valid, not affected by such threats. The data set also passed Kaiser-Meyer-Olkin Measure of Sampling Adequacy which proved as the value of the KMO Measure of Sampling Adequacy for this set of variables were all above 0.745, which would be meets the minimum criteria therefore eligible for factor analysis. Then we found Cronbach alpha coefficients, item to total correlation, factor loadings of all measurement items within their corresponding dimensions. Items with less than recommended values were removed. Then EFA was done on the constructs with Project Learning culture emerged with two factors, Supply chain capabilities with three factors,HR practices with three factors ,Employee Behaviour and skills with one factor,Operational flexibility potential with five factors, Technological capabilities with one factor, Micro environment with three factors, macro environment with three and Effective project management with two factors. The standard deviation of items was also calculated and found to be between 0.42 to 1.62.

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Chapter - 6

MODEL & HYPOTHESIS TESTING

6.1 Introduction

This chapter presents the results of Partial Least Square tests in an attempt to test the hypothesis stated. This involves the assessment of the path coefficients that describe the hypothesized relationships among constructs.

The path coefficient is known as the standardized regression weight and the significance of regression coefficient (β) is ascertained on the basis of statistically significant t-value, obtained through PLS Bootstrap process to support hypothesized relationships. Inorder to investigate the moderating effects of micro and macro environment on the relationships between the determinants and operational flexibility, a two stage approach was used. The mediation effect of Operational flexibility on the path between predictors and effective project management was also tested.

6.2 Statistical Methods for Testing Hypotheses

As already mentioned two statistical software programs were employed to analyze the data collected in this study. SPSS 20.0 was used for descriptive statistics, reliability testing, exploratory factor analysis and regression analysis and SMARTPLS V2.0 M3 Ringle et al. (2005), which use partial least squares (PLS), was employed for confirmatory factor analysis and hypotheses testing presented in this chapter.

As mentioned earlier, the data set of 87 responses was used for the PLS analysis. PLS comprises a measurement model and a structural model. The measurement model specifies the relations between observed indicators and their corresponding latent constructs, whereas the structural model specifies relationships between latent constructs. Influenced by the covariance-based structural equation modelling (CBSEM), the PLS model is typically interpreted in two stages (Chin, 2010).

The reliability and validity of the measurement model are first assessed to ensure that the constructs' measures are reliable and valid before assessing the nature of the relationships between the constructs in the structural model (Chin, 2010). As such, the methods used to evaluate the measurement model are discussed first, followed by those used in the examination of the hypothesized relationships.

6.3 Model Evaluation

The hypothesized model of Operational flexibility and Effective project management is composed of formative and reflective constructs. Model evaluation must start with identifying formative and reflective constructs. The fundamental difference between reflective and formative constructs is that the latent variable determines the indicators for reflective constructs whereas the indicators determine the latent variable for formative constructs.

According to Bisbe et al. (2007), a reflective construct implies that: (1) changes in the construct are expected to cause changes in the indicators, (2) indicators are expected to covary, (3) indicators are interchangeable and removing specific indicators does not alter the conceptual domain of the construct, and (4) all indicators are assumed to have the same antecedents and consequences.

On the other hand, a construct should be modelled as a formative construct if: (1) changes in the indicators are expected to cause changes in the construct, (2) indicators are not expected to covary, (3) indicators are not interchangeable and omitting an indicator may alter the conceptual domain of the construct, and (4) indicators should not be expected to have the same antecedents and consequences Bisbe et al. (2007).

Therefore, in this study Predictor constructs and Micro and Macro moderators are reflective while, Operational flexibility and Effective project management constructs are formative in nature.

6.4 Assessment of the Outer / Measurement model

It is suggested to assess reflective measurement models with regard to their reliability and validity Henseler, Ringle, & Sinkovics (2009). Here composite reliability (for each latent variable‘s indicator jointly) and individual item reliability are introduced as measures for reliability, whereas convergent validity and discriminant validity are considered as measures for validity.

The criteria for the measurement model fitting are presented in the table 6.1. Based on criteria stepwise analysis is given as follows:

6.4.1 Reliability

The reliability measures for the individual indicators (item reliability) and for each latent variable‘s indicator jointly ie. Composite reliability and Cronbach’s alpha Martensen & Gronholdt (2006) were considered in the previous chapter.

Table: 6.1: Criterion and acceptable fit of validities

Criterion	Description	Acceptable fit
Construct reliability Composite reliability	Is measure of internal consistency and is calculated by formula $\rho c = (\sum \lambda \iota)^2 var\ F / (\sum \lambda \iota)^2\ var\ F + \sum \Theta u$, Where, $\lambda \iota$, F, and Θu are the factor loadings, factor variance, and error variance respectively (Werts et al., 1974)	Value > 0.6 (Hair et al., 2006; Bagozzi & Yi, 1991)
Construct reliability Cronbach's α	Measures the indicators uni-dimensionality (inter-correlation) with their latent construct. It is calculated by $\alpha = \left(\frac{N}{N-1}\right) * \left(1 - \frac{\sum_{i=1}^{N} \sigma_i^2}{\sigma_t^2}\right)$ Where, N is number of indicators, σ_i^2 indicates variance of indicator i, and σ_t^2 represents the variance of the sum of all the indicators scores (Cronbach, 1951)	Value > 0.6 (Hair et al., 2006), and value > 0.8 or 0.9 is better (Nunnally & Bernsein, 1994)
Indicator reliability	Is absolute standardised outer loading. It indicates the variance explained by the observed variable towards underlying latent construct (Churchill, 1979)	Value > 0.7($\cong \sqrt{0.5}$) is better (Henseler et al., 2009), and value> 0.4 is acceptable (Hulland, 1999; Churchill, 1979)
Convergent validity	Is the degree to whic two measures of the same concepts are correlated. It is demonstrated by the uni-dimensionality using average variance extracted (AVE)= $(\sum \lambda \iota^2)\ var\ F / (\sum \lambda \iota^2)\ var\ F + \sum \Theta u$, Where, $\lambda \iota$, F, and Θu are the factor loadings, factor variance, and error variance respectively (Fornell & Larcker, 1981)	Value > 0.5 (Fornell & Larcker, 1981)
Discriminant validity Construct-level	Is the degree to which two conceptually similar concepts are distinct (Hair et al., 2006). It ensures that each latent variable shares more variance with its own block of indicators that with another latent variable	$\sqrt{AVE}$>latent variable correlation (Fornell & Larcker, 1981)
Discriminant validity Item-level	Is the degree to which two conceptually similar concepts are distinct from each other (Hair et al., 2006)	Loading of each indicator > cross loadings (Chin, 1998; Gotz et al., 2010), and Cross loading <0.4 (Hair et al., 2006)

Source : Muhammad Sharif Abbasi (2011).

6.4.1.1 Individual item reliability

Since the reliability of indicators varies, it is also suggested to test their individual item reliability. Researchers agree that at least 50% of an unobservable variable should be explained by its indicators and thus the absolute standardized outer loadings should at least be higher than 0.7. Individual reliability enables us to assess which items to remove from our research. Hence, items with loadings of 0.5 and below should not be taken into consideration and will be removed from the model (Hulland, 1999).

6.4.1.2 Composite reliability

After looking at individual item's reliability, we have to focus on reliability tests assuring that items posited to measure a construct are sufficiently related to be reliable (i.e., low on measurement error). The general practice of assessing reflective measurement models suggests checking internal consistency reliability (Henseler, Ringle & Sinkovics, 2009). Traditionally, Cronbach‘s alpha is used to provide an estimate for the reliability as a criterion for internal consistency.

However, Cronbach‘s alpha, which assumes equal reliability for all indicators, underestimating the internal consistency reliability of latent variables (Henseler, Ringle, & Sinkovics, 2009). Alternatively, composite reliability is more relevant than Cronbach‘s alpha since it takes indicators with different loadings and therefore considers their unequal reliability. Therefore, we will use both methods in order to complemen each other. Both coefficients have the same reliability threshold.

A lack of reliability is normally attested at values below 0.6, whereas values above 0.7 in early research development stages and 0.8 or 0.9 in more advanced scenarios are satisfactory to show that internal consistency exists (Henseler, Ringle, & Sinkovics, 2009).

6.4.2 Results

Measurement of the reliability (Item-level): Item-reliability indicates that which part of the item’s variance can be explained by the underlying latent variable (Gotz et al., 2010). A common postulate is that absolute correlation (i.e. Standardised outer loadings) should be more than half (i.e. 50%) explained by the latent construct (Chin, 1998). However, a value above 0.7, i.e. (√0. 5) Henseler et al. (2009) and value no less than 0.4 Churchill et al. (1979) are recommended. Based on PLS measurement,

analysis, table 6.2 shows that the absolute correlation between the construct and its measuring manifest items (i.e. Factor loading) was above than the minimum threshold criterion 0.4. From the table given below, we can see that the factor loading was ranging from 0.58 to 0.95 and satisfied the requirements of the psychometric reliability test (Henseler et al., 2009; Churchill, 1979).

Measurement of the reliability (Construct-level): The construct-level reliability check ensured that items assigned to the same constructs revealed higher relationship with each other. Even though, earlier calculated individual-level item reliability was adequate enough, but it was still recommended to observe the constructs reliability measured jointly by the group of items within the same construct (Bagozzi & Baumgartner, 1994).

In this study, construct level reliability was examined by using Cronbach's α and by composite reliability. Where, Cronbach's α measured the uni-dimensionality of multi-item scale's internal constancy (Cronhach, 1951), and composite reliability measured that how well construct were measured by its assigned items (Fornell & Larcker, 1981; Gotz et el., 2010). In the previous chapter we have seen that the Cronbach's α was higher than the required value of 0.6 Cronbach (1951) and composite reliability was higher than the recommended 0.7 value Nunnally and Bernstein (1994).

Table 6.2: Outer/factor loading with cross-loadings

	LC	SC	ITC	HR	EBS	MA	MI	OFP	EPM
LC1.1	**0.826**	0.12	0.18	0.31	0.10	-0.017	0.375	0.096	0.212
LC1.2	**0.852**	0.24	0.11	0.28	0.23	0.035	0.283	0.298	0.123
LC1.3	**0.768**	0.08	0.15	0.17	0.18	0.195	0.320	0.283	0.017
LC2.1	**0.782**	0.22	0.19	0.27	0.15	0.345	0.111	0.155	0.149
LC2.2	**0.832**	0.36	0.09	0.20	0.230	0.294	0.141	0.148	0.246
LC2.3	**0.721**	0.21	0.20	0.15	0.120	0.207	0.154	0.180	0.132
SC1.1	0.294	**0.716**	0.201	0.096	0.149	-0.095	0.120	0.148	0.059
SC1.2	0.173	**0.698**	-0.079	0.201	0.351	-0.342	-0.234	0.312	0.421
SC1.3	0.235	**0.642**	-0.336	0.282	0.143	0.225	0.111	0.151	0.342
SC2.2	0.185	**0.867**	0.050	0.072	0.221	0.147	0.121	0.124	0.146
SC2.3	0.180	**0.629**	0.021	-0.100	0.155	0.182	0.145	0.251	0.221
SC2.4	0.072	**0.836**	0.230	0.330	0.109	0.235	0.229	0.312	0.192
SC3.1	0.233	**0.733**	-0.331	-0.215	0.178	0.142	0.180	0.165	0.142
SC3.2	0.284	**0.824**	-0.402	-0.262	0.126	0.132	0.323	0.321	0.315
SC3.3	0.284	**0.873**	0.155	0.371	0.233	0.221	0.128	0.259	0.230
ITC1	0.239	0.093	**0.741**	-0.150	0.219	0.252	0.282	0.324	0.421
ITC2	0.107	0.212	**0.812**	0.054	0.167	0.182	0.127	0.140	0.124
HR1.1	0.216	0.137	0.377	**0.789**	0.154	0.112	0.212	0.320	0.294
HR1.2	0.168	0.235	0.321	**0.699**	0.125	0.115	0.171	0.452	0.124
HR1.4	0.234	0.159	0.326	**0.874**	0.169	0.182	0.189	0.120	0.332
HR1.5	0.365	0.178	0.235	**0.865**	0.151	0.259	0.513	0.333	0.534
HR2.1	0.237	0.244	0.261	**0.617**	0.310	0.347	0.116	0.224	0.343
HR2.2	0.141	0.126	0.231	**0.583**	0.262	0.283	0.239	0.246	0.291
HR3.1	0.172	0.115	0.137	**0.756**	0.218	0.157	0.217	0.316	0.423
HR3.2	0.346	0.116	0.165	**0.839**	0.298	0.428	0.459	0.237	0.221
HR3.3	0.231	0.252	0.225	**0.684**	0.129	0.213	0.280	0.123	0.128
HR3.4	0.193	0.189	0.131	**0.762**	0.359	0.278	0.262	0.023	0.098
EBS1	0.235	0.289	0.274	0.268	**0.561**	0.109	0.131	0.143	0.091
EBS2	0.345	0.197	0.167	0.189	**0.693**	0.193	0.178	0.162	0.198
EBS3	0.234	0.465	0.147	0.253	**0.735**	0.174	0.168	0.153	0.128
EBS4	0.167	0.145	0.158	0.349	**0.868**	0.274	0.317	0.173	0.129
MA1.1	0.192	0.263	0.435	0.148	0.285	**0.736**	0.182	0.435	0.173
MA1.2	0.124	0.173	0.148	0.156	0.172	**0.636**	0.125	0.175	0.182
MA1.3	0.139	0.324	0.356	0.234	0.321	**0.602**	0.238	0.275	0.213
MA2.1	-0.211	0.227	0.128	0.187	0.232	**0.774**	0.192	0.289	0.281
MA2.2	0.342	0.227	0.273	0.426	0.221	**0.837**	0.192	0.124	0.157
MA3.1	0.193	0.126	0.231	0.128	0.11	**0.757**	0.154	0.118	0.132
MA3.2	0.192	0.247	0.191	0.172	0.312	**0.783**	0.197	0.287	0.221
MA3.3	0.248	0.234	0.225	0.029	0.192	**0.692**	0.019	0.018	0.012
MI1.1	0.129	0.012	0.124	0.114	0.183	0.172	**0.691**	-0.121	-0.142
MI1.2	-0.291	0.186	0.128	-0.012	0.185	0.324	**0.684**	0.216	0.341
MI1.3	0.190	-0.129	0.192	0.128	0.215	0.132	**0.601**	0.511	0.129

MI1.4	0.127	0.112	-0.198	0.187	0.129	0.132	**0.582**	0.125	0.182
MI2.1	0.104	0.121	0.148	0.103	0.132	-0.129	**0.728**	0.213	0.123
MI2.2	0.213	0.174	0.325	0.219	0.193	0.184	**0.752**	0.231	0.065
MI3.1	0.347	0.435	0.295	0.081	0.152	0.169	**0.627**	0.139	0.167
MI3.2	0.119	0.189	0.176	0.134	0.061	0.159	**0.691**	0.123	-0.137
OF1.1	0.237	0.126	0.099	0.087	0.029	0.123	0.121	**0.775**	0.181
OF1.2	0.167	0.138	0.129	0.122	0.118	0.182	0.216	**0.611**	0.192
OF1.3	-0.092	-0.099	-0.029	-0.078	-0.029	-0.095	0.213	**0.857**	-0.128
OF1.4	0.132	0.193	0.183	0.129	0.192	0.274	0.236	**0.776**	0.119
OF1.5	0.032	0.347	0.132	0.193	0.173	-0.176	-0.232	**0.831**	-0.192
OF2.1	-0.223	0.023	0.124	0.114	-0.292	0.224	0.294	**0.643**	0.193
OF2.2	0.117	0.109	0.192	0.183	0.113	0.119	0.148	**0.519**	0.123
OF2.3	0.211	0.222	0.264	0.014	0.321	0.213	0.290	**0.657**	0.229
OF 3.2	-0.192	0.094	-0.029	0.128	0.118	0.523	0.325	**0.687**	0.195
OF 3.3	0.094	-0.151	0.145	0.256	0.239	0.289	0.332	**0.739**	0.371
OF 3.4	-0.01	-0.09	0.193	0.129	0.173	0.118	0.425	**0.678**	0.290
OF 4.1	0.193	-0.222	0.021	0.125	0.183	0.150	0.190	***0.192****	0.126
OF 4.3	0.110	0.192	0.138	0.183	0.335	0.452	0.562	***0.121****	0.112
OF 4.4	0.213	0.192	0.254	0.118	0.234	0.543	0.145	***0.284****	0.431
OF 5.1	0.128	0.182	0.245	0.112	0.134	0.108	0.127	***0.187****	0.123
OF 5.2	0.192	0.167	0.245	0.177	0.194	0.436	0.178	***0.139****	0.110
OF 5.3	0.277	0.244	0.341	0.107	0.109	0.153	0.182	***0.178****	0.142
OF 5.4	0.345	0.435	0.156	0.256	0.126	0.345	0.154	***0.192****	0.121
EPM1.1	0.542	0.190	0.432	0.213	0.342	0.211	0.231	0.115	**0.672**
EPM1.2	0.421	0.123	0.119	0.122	0.237	0.292	-0.092	0.122	**0.734**
EPM1.3	0.112	0.118	0.124	0.332	0.112	0.236	0.225	-0.193	**0.877**
EPM1.4	0.234	0.327	0.256	0.098	0.323	0.114	0.092	0.039	**0.742**
EPM2.1	0.294	0.091	0.253	0.092	0.192	0.123	0.119	0.313	**0.759**
EPM2.2	-0.442	-0.139	-0.129	-0.125	0.098	0.237	0.091	0.442	**0.785**
EPM2.3	0.192	-0.311	0.317	0.191	0.292	0.321	0.183	-0.543	**0.893**
EPM2.4	-0.192	0.118	0.076	0.058	0.021	0.159	0.311	0.253	**0.783**
EPM2.5	0.229	0.198	0.092	0.059	0.058	0.023	0.362	0.238	**0.763**

The results as shown in table factor loadings and cross loading of all constructs explain the loading and cross loading figures, indicating insufficient loading only in OF4 and OF5. Subsequently those items were removed from further analysis.

6.4.3 Validity

For assessing the validity of the PLS path model, both convergent validity and discriminant validity are measured. Convergent validity ensures that indicators actually represent their underlying unobservable construct. It can be tested using average variance extracted (AVE) as proposed by (Fornell & Larcker, 1981). AVE is defined as—the average variance shared between a construct and its measures Hulland (1999), the variance being a measure of the average distance between each of the set of data points and their mean value. The average variance extracted (AVE) indicates what percentage of the variance of the construct is explained by its items. It measures the shared or common variance in a latent variable. If a latent variable is able to explain at least half of an indicator's variance on average, convergent validity is considered to be sufficient. Thus, AVE scores above 0.5 are required. Discriminant validity is a complementary concept in which two conceptually different variables should be sufficiently different, (Henseler, Ringle, & Sinkovics, 2009). To assess the complementary concept of discriminant validity, the literature postulates different concepts. The Fornell-Larcker criterion relies on variance to assess discriminant validity. Discriminant validity is considered to be adequate enough if a latent variable and its respective indicators share more variance than the latent variable does with any other latent variable. Thus, the AVE of each latent variable should be greater than the latent variable's highest squared correlation with any other latent variable (Henseler, Ringle, & Sinkovics, 2009). Accordingly, the Fornell-Larcker criterion helps to assess discriminant validity on the construct level. On the contrary, cross loadings evaluate discriminant validity on the indicator level by comparing indicators' loadings with cross-loadings. This comparison expects loadings of each and every indicator to be greater than all of its cross loadings (Henseler, Ringle, & Sinkovics, 2009).

6.4.3.1 Measurement of validity (Convergent validity)

The validity is the extent to which a set of measuring items correctly represents the underlying theoretical proposed concept (Hair et al., 2006). Specifically, convergent validity signifies that set of items should represent one and same underlying construct that can be demonstrated through their uni-dimensionality (Henseler, 2009). In this study, convergent validity was examined using widely accepted method 'average variance extracted (AVE)' (e.g. Hair et al., 2006; Tabachnick & Fidell, 2007; Henseler, 2009). Table 6.3 shows that AVE extracted for the each construct was higher than the required value 0.5 (50%) Fornell & Larcker (1981) except for EBS and HRP because of which they were not retained in further analysis and rest of constructs have capability to explain more than half of the variance to its measuring items on average.

6.4.3.2 Measurement of validity (Discriminant validity):

The discriminant validity is the complementary concept of convergent validity, which signifies that two conceptually different constructs should exhibit differently, i.e. the set of measuring items are expected not to be uni-dimensional (Henseler, 2009).

In this study, discriminant validity at construct-level was examined using Fornell and Larcker (1981) criterion, while at item level were examined using Chin (1998) criteria. Fornell and Larcker criterion suggest that square-root of AVE for each construct should be greater than correlation with any other (i.e. Inter-construct correlation). The table 6.4 shows that, except for EBS and HRP none of the inter-construct a correlation value was above the square-root of the AVE and satisfied the criterion of the discriminant validity. At item-level discriminant validity, Chin (1998) suggested to examine the cross-loading within the factor loading. The cross loading table above shows that except for OF4 and

OF5, rest of measuring item within construct was higher than all of its cross-loadings in row and column.Results of testing for convergent and discriminant validity show OF4, OF5, EBS and HRP construct failing in convergent and discriminant validity criteria and therefore removed from further analysis of the study.

Table 6.3: Convergent validity of constructs

Constructs	No. of items	CR	AVE
PLC	6	0.926752	0.824942
SC	9	0.952664	0.793583
EBS	4	0.926214	***0.283263***
ITC	2	0.903153	0.682157
HRP	10	0.983617	***0.393678***
OFP	10	0.975836	0.864318
MI	8	0.924769	0.816862
MA	8	0.936572	0.873227
EPM	9	0.916379	0.732862

Table 6.4: Assessment of Discriminant Validity

	PLC	SC	EBS	ITC	HRP	OFP	MI	MA	EPM
PLC	**.908**								
SC	**.878**	**.890**							
EBS	**.735**	**.752**	***.5322****						
ITC	**.758**	**.809**	**.809**	**.825**					
HRP	**.661**	**.774**	**.786**	**.789**	***.627****				
OFP	**.656**	**.687**	**.750**	**.798**	**.672**	**.929**			
MI	**.727**	**.629**	**.783**	**.752**	**.783**	**.568**	**.903**		
MA	**.735**	**.785**	**.797**	**.781**	**.844**	**.847**	**.682**	**.934**	
EPM	**.549**	**.793**	**..712**	**.603**	**.739**	**.569**	**.784**	**.836**	**.856**

Diagonal elements are square roots of AVE.

6.4.4 Reliability of formative constructs

As formative constructs in the measurement model must undergo separate set of analysis, the reliability test composited of different aspects of a construct that their indicators are not necessary to correlate with each other (Diamantopoulos and Winklhofer, 2001). Heart et al. (2009)

conclude that construct reliability of formative construct should be performed by multicollinearity, test of indicator validity (path coefficients significance), and optionally, if appropriate, test retest. Thus, reliability evaluation for formative constructs is to assess the assumption of no multicollinearity Diamantopoulos and Siguaw (2006), for which Variance Inflation Factor (VIF) is evaluated. There are some guidelines that can be applied: VIF less than 3.3 shows an excellent value Diamantopoulos and Siguaw (2006) and if VIF is less than 10, then no collinearity is commonly accepted (Hair et al., 1995). In this study there are two formative measurement constructs: Effective project management and Operational flexibility potential that are evaluated for VIF.

6.4.4.1 Results

The table shows VIF of each formative indicator. The VIF values of all indicators are less than 3.5, indicating that multicollinearity problem is not a concern.

Table 6.5: Reliability test results

Item Level	Weights	VIF
Operational Flexibility		
We can effectively respond to multiple customer requirements in terms of repair, construction and maintenance.	0.1485	1.26
We can effectively negotiate with customers, suppliers and contractors in terms of prices, delivery time through long term relationships	0.1655	1.43
We involve customers to improve our services effectively	0.1363	1.26
We quickly respond to feedback from consumers and marketing dept. effectively.	0.2085	1.18
We can successfully respond to multiple Project delivery requirements.	0.362	1.43
We can quickly modify the internal design in response to customer requests before construction as far as the elevations are unaffected.	0.1571	1.55
We even accommodate nominal modifications as per customer needs, even during construction.	0.2063	2.34
We can better meet customer needs by modifications.	0.2321	3.25
We take the lead in new product introduction.	0.4122	1.36
We can launch new projects easily.	0.1778	1.75
We can launch new projects inexpensively	0.3868	1.85
Effective Project Management		

Develop new knowledge and expertise	0.3325	1.43
Increase level of professional development	0.2415	1.56
Generate positive reputation	0.4325	1.23
Develop new business relationship	0.3435	1.86
Project functionality	0.4355	1.34
Aesthetic value	0.3423	1.45
Easy to maintain	0.2526	1.87
Early occupation	0.3252	1.56
Minimum cost of ownership	0.3532	1.46

The result shows that all the VIF values of OF and EPM constructs are within the range and hence can be retained for further analysis of this study.

6.5 Assessment of the Inner / Structural Model

Assessment of the structural model was performed in the tests of hypotheses. PLS was used to estimate the path coefficients (β) between the paths of the exogenous and endogenous constructs within the combined data set. The coefficient of determination (R^2) is said to be the most essential criterion for estimating the structural model. The table 6.10 illustrates an overview of R^2 values for the latent variables of the model. Since the coefficient of determination R^2, measures to what extent a latent variable is explained by the model, it can only be calculated for endogenous variables.

According to Chin (1998) the evaluation of the PLS structural model should begin by examining the R^2 for each dependent variable. According to Henseler, et al. (2009) a moderate level of R^2 (0.33) is acceptable for a small structural model with 1-2 independent variables, whereas a substantial R^2 (0.67) is desired for a larger structural model. Further, (Chin, 1998) suggests that the change in R^2 (i.e., the effect size or f^2) can be explored to assess the impact of a particular independent variable on a dependent variable. Following Cohen (1988)'s recommendation, the effect

size of 0.02, 0.15, and 0.35 can indicate small, medium, and large effect of an independent variable, respectively (Chin, 1998).

Path estimation (β): The path estimation also known as nomological validity was performed to examine the significance of the path relations in inner-model (e.g. Chin, 1998). In other words, each path relationship presented in the framework was examined, though the regression coefficient (β). The significance of regression coefficient β is based on t-value, which was obtained using PLS Bootstrap process. The t statistic shows the significance of the path in the outer and inner model. The t value should be greater than 1.96 so as to ensure the significance of the path in the model (Vinzi et al, 2010). The criterion, description and fit values of R^2, β, f^2, q^2, GoF are as given in the table 6.6.

Table: 6.6 Criterion and Acceptable limit of Structural Model Estimation

Criterion	Description	Acceptable fit
R^2 of endogenous (dependent) latent variable	Is coefficient of determination which is measures of how much variability in outcome is accounted by the exogenous (independent) observed variables (Tabachnick & Fidell, 2007; Hair et al., 2006). It is similar to squared multiple correlation (SMC) coefficient into covariance-based approach	Value 0.67, 0.33, 0.19 are substantial, moderate, and weak respectively (Chin 1998)
β coefficient	Is measure of multiple correlation coefficients between exogenous and endogenous variables (Tabachnick & Fidell, 2007). Value evaluated in terms of sign, magnitude and significance (t-test).	Value t=2.58 p<0.01, t=1.96 p<0.05, and t=1.64 p<0.10(Hair et al., 2006, p.390), and t=2.326 p<0.01 (Keil et al., 2000, p.312)
Effect size f^2	Is measure of representing the ratio of the improvement in prediction that results from the fitting the model (Tabachnick & Fidell, 2007). It is calculated by $f^2 = (R^2_{incl} - R^2_{excl})/(1- R^2_{incl})$ (Cohen, 1988)	Value 0.02,0.15, and 0.35 are weak, medium and large effect respectively (Cohen, 1988; Chin, 1998)
Prediction relevance q^2	Is an assessment of model's capability to predict R^2 through sample reuse/cross-validation (Henseler et al., 2009). It is calculated using $q^2 = (F^2_{incl} - F^2_{excl})/(1- F^2_{incl})$	Value 0.02,0.15, and 0.35 are weak, medium and large effect respectively (Chin, 1998)
Goodness of fit (GoF)	It is criterion of global goodness of fit, which is computed through the geometric mean of the average communality and average R^2. Formula is = $\sqrt{R^2 * average\ communality}$	Value closer to 1 is better (Tenenhaus et al., 2005)

Source : Muhammad Sharif Abbasi (2011).

6.5.1 Results of path estimation (β) and (t) statistic

In explaining the relationships between predictors and operational flexibility potential, the figure 6.4 explains eighteen path relations, out of which eleven were significant and remaining was insignificant.

Results of paths towards dependent variable DM revealed that Inter Project Learning, and the Strategic Supplier Partnership were positively significant. The highly significant path ($p<0.001$) was between SSP and DM ($\beta=0.564$ or 56% and $t= 9.6940$) while least significant ($p<0.05$) was between IEP and DM ($\beta=0.24$ or 24% and $t= 2.9976$).

While considering the paths towards dependent variable Modification flexibility, customer relationship and information sharing, Information Technology capabilities form significant paths with ($\beta=0.635$ or 63% and $t= 10.983$), ($\beta=0.62$ or 62% and $t= 9.644$), ($\beta=0.539$ or 62% and $t= 2.231$) respectively.

Considering paths towards NPD, Intra project learning, Inter Project learning, Supply chain capabilities, Customer Relationship, Information Sharing, Information Technology capabilities form significant paths with t values 9.320, 4.6940, 4.539, 3.2153, 7.4288, 5.9813 respectively. The highest significant path was between IAP and NPD ($\beta=0.69$ or 69%, followed by ITC and NPD ($\beta=0.645$ or 64%).

6.6 Results of Coefficient of determination (R^2)

Determination of coefficient (R^2): R^2 provides the percentage of variation in dependent variable(s) explained by independent variable(s) (Keil et al., 2000). According to the Bakhaus et al. (2003) R^2 represents the level of the latent construct's explained variance and therefore measures the regression function's 'goodness of fit' against the empirically obtained observed items. The value of R^2 varies according

to the number of measuring independent variable(s) i.e. higher number of independent variable needs to produce higher value of R^2 and vice-verse (Chin, 1998). Furthermore, according to Chin (1998) model having R^2 as 0.67, 0.33, and 0.19 are considered as substantial, moderate, and weak respectively. Table 6.10 indicates that Learning and exploitation (LE) shared highest variance (R^2) = 0.712, 71%) followed by NPD (R^2) = 0.690 or 69%, MOD (R^2) = 0.682 or 68%, CS (R^2) = 0.673 or 67 %, DM (R^2) = 0.662 or 66%.

6.7 Results of Predictive relevance (q^2), CV-Communality (H^2) and CV-Redundancy (F^2)

The q^2 is computed using Stone-Geisser Stone (1974); Geisser (1975) criterion which suggests that the model must be able to provide a prediction of the dependent variable's measuring items. The criterion of q^2 facilitates to assess the cross validation (CV) of the model Chin (1998); Wold (1982). According the (Fornell & Cha,1994) if the q^2 is larger than zero the model is considered to have predictive relevance.

In PLS, two kinds of predictive validities are estimated for the measurement model i.e. CV- communality (H^2) and CV-redundancy (F^2). Where, CV-communality is calculated through the measurement model's capability to assess the path model, such that, block of measuring items are directly derived from their own latent variable (Tenenhaus et al., 2005). The CV-communality is obtained if the prediction of the omitted data points in the measuring variable block is made of an underlying construct or latent variable (Chin, 1998). On the other hand, CV-redundancy measures the capability of the path model to predict the dependent or endogenous measuring items indirectly from the prediction of their own latent variable using the related structural relation, by cross-validation (Tenenhaus et al., 2005).

In this study, q^2, H^2, F^2 were computed using 'blindfolding' procedure. It was Gotz et al. (2010) who defined blindfolding procedure, as a parameter estimation method where systematically some data for the particular block (a block is set of measuring items for a construct) is removed from the sample and is treated as missing data. In the next step, a block of the missing data is treated as part of the estimation process by ignoring another part of the data, and the procedure is repeated until every data point is omitted and estimated. The omission and estimation of the data points in blindfolding procedure are dependent on the omission distance (G) (Chin, 1998).

The indices for the q^2 are explained in the table 6.10. As can be seen that the significant paths towards the dependent variable DMF, NPD, MOD explained (i.e. $q^2>0$ and $q^2 >0.15$) predictive relevance and presented medium impact. Finally, the predictive relevance for the significant path towards LE and CS also reflected the medium predictive relevance impact. Like the R^2, CV-redundancy is only computed for the path model to predict the endogenous or dependent variable. Results show that all the blocks presented an acceptable CV redundancy index and CV-communality index.

Goodness-of-fit index (GoF): Finally, after examining the effect size of path estimation and predictive relevance capability, last criterion was remained to see the overall fit of the model. Researchers like Tenenhaus et al. (2005) and Amato et al. (2004) proposed a global criterion of goodness-of-fit (GoF) index, which is the geometric mean of the average communality and the average of R^2 (i.e. The variance explained into dependent variable). The GoF is normed between 0 to 1, where the higher value represents a better path model estimation (Heneseler et al., 2009). The GoF for the current study model was 0.6973 (69%) and can be accepted at a substantial level (Chin, 1998).

6.8 Mediating effects

A meditational model hypothesizes that the independent variable influences the mediator variable, which in turn influences the dependent variable. To test this mediation effect, four rules of mediation were followed (Baron & Kenny 1986). For instance, in order for the DM to mediate the effect of SSP on LE, the following four conditions must hold true: (1) the SSP → LE path should be significant; (2) the SSP → DM path should be significant; (3) the DM→ LE path should be significant after controlling SSP and; (4) the SSP→LE path should become insignificant after controlling DM. In other words, the original research model with full mediation effect of operational flexibility needed to be compared with a partial mediation model and a no-mediation model in order to test the mediation effect. For example, in the partial mediation model, an additional path from SSP to LE has been included, whereas in a no-mediation model an additional SSP→LE path was included while omitting the originally assumed DM → LE path.

Partial mediation implies that there is not only a significant relationship between the mediator and the dependent variable, but also some direct relationship between the independent and dependent variable.In order for either full or partial mediation to be established, the reduction in variance explained by the independent variable must be significant as determined by one of several tests like Sobels' test.

The effect of an independent variable on the dependent variable can become nonsignificant when the mediator is introduced simply because a trivial amount of variance is explained (i.e., not true mediation). Thus, it is imperative to show a significant reduction in variance explained by the independent variable before asserting either full or partial mediation. It is possible to have statistically significant indirect effects in the absence of a total effect.

Steps in Smart PLS for mediation analysis can be summarised as follows:

1. Find direct effect with no mediation
2. Find direct Effect with mediation
3. Do bootstrap
4. Find Independent Variable to Mediator path coefficient
5. Find Mediator to Dependent variable Path coefficient
6. Find Independent variable to mediator –Standard Error
7. Mediator to Dependent Variable Standard Error

The Sobel's test requires values of steps 4, 5, 6 and 7. Sobel statistics should have absolute value greater than 1.96 for a two tailed probability less than 0.05, direct effect must reduce in strength, and t statistics must still be significant.

The relative size of the mediating effect was decided by calculating the variance accounted for (VAF) based on (Shrout and Bolger, 2002). VAF>0.80 full mediation, $0.20 \leq VAF \leq 0.80$ partial mediation, VAF < 0.20 no mediation.

6.9 Results-Mediation

Table 6.7: Hypotheses testing with direct, indirect effect with VAF and mediation type

Hypothesis	D.E w/o Med	D.E with Med	Indirect Effect	VAF	Mediation type
P-OF-EPM					
P-Mod-LE					
SSP-Mod-LE	0.437	0.293	0.389	0.128	No
IS-Mod-LE	0.332**	0.140**	0.278**	0.259	Partial
CR-Mod-LE	0.523***	0.158**	0.329**	0.282	Partial
INE-Mod-LE	0.321	0.248	0.310	0.102	No
INA-Mod-LE	0.269	0.234	0.194	0.192	No
TCC-Mod-LE	0.427**	0.103*	0.239**	0.189	Partial
P-Mod-CS					
SSP-Mod-CS	0.393	0.354	0.320	0.451	No
IS-Mod-CS	0.310***	0.128***	0.253**	0.224	Partial
CR-Mod-CS	0.439 ***	0.073^{ns}	0.366**	0.820	Full
INE-Mod-CS	0.235	0.141	0.189	0.532	No
INA-Mod-CS	0.392	0.119	0.342	0.430	No

TCC-Mod-CS	0.492***	0.134**	0.353**	0.340	Partial
P-DM-LE					
SSP-DM-LE	0.387***	0.033**	0.129**	0.339	Partial
IS-DM-LE	0.420	0.228	0.333	0.113	No
CR-DM-LE	0.293	0.102	0.235	0.163	No
INE-DM-LE	0.422***	0.102***	0.223**	0.224	Partial
INA-DM-LE	0.223	0.041	0.134	0.159	No
TCC-DM-LE	0.282	0.098	0.192	0.146	No
P-DM-CS					
SSP-DM-CS	0.310**	0.103**	0.336**	0.492	Partial
IS-DM-CS	0.302	0.024	0.190	0.532	No
CR-DM-CS	0.242	0.054	0.160	0.482	No
INE-DM-CS	0.166	0.024	0.171	0.413	No
INA-DM-CS	0.345	0.103	0.121	0.439	No
TCC-DM-CS	0.455	0.150	0.132	0.451	No
P-NPD-LE					
SSP-NPD-LE	0.525***	0.121**	0.252**	0.340	Partial
IS-NPD-LE	0.539**	0.027**	0.345**	0.594	Partial
CR-NPD-LE	0.620**	0.035**	0.356**	0.492	Partial
INE-NPD-LE	0.591**	0.139**	0.521**	0.596	Partial
INA-NPD-LE	0.462**	0.150**	0.265**	0.533	Partial
TCC-NPD-LE	0.640***	0.113**	0.333**	0.391	Partial
P-NPD-CS					
SSP-NPD-CS	0.519 ***	0.082^{ns}	0.366**	0.843	Full
IS-NPD-CS	0.532**	0.095^{**}	0.194**	0.530	Partial
CR-NPD-CS	0.510**	0.132**	0.345**	0.408	Partial
INE-NPD-CS	0.445**	0.123**	0.430*	0.562	Partial
INA-NPD-CS	0.565**	0.025**	0.342**	0.433	Partial
TCC-NPD-CS	0.492**	0.039**	0.316**	0.364	Partial

VAF>0.80 full mediation, 0.20 ≤ VAF ≤ 0.80 partial mediation, VAF < 0.20 no mediation

***p<0.001, **p<0.01, *p<0.05

The table shows the results of mediation analysis done with no meditiation in the cases of SSP-Mod-LE,INE-Mod-LE,INA-Mod-LE,INE-Mod-CS,INA-Mod-CS,IS-DM-LE,CR-DM-LE,INA-DM-LE,TCC-DM-LE,IS-DM-CS,CR-DM-CS,INE-DM-CS,INA-DM-CS,TCC-DM-CS as they didn't satisfy the criteria of significance and VAF atleast 0.20.These paths couldn't satisfy the criteria of partial or full mediation.

While the paths IS-Mod-LE,CR-Mod-LE, TCC-Mod-LE,IS-Mod-CS, TCC-Mod-CS,SSP-DM-LE,INE-DM-LE, SSP-DM-CS, SSP-DM-CS, SSP-NPD-LE, IS-NPD-LE, CR-NPD-LE,INE-NPD-LE,INA-NPD-LE,TCC-NPD-LE,IS-NPD-CS,CR-NPD-CS,INE-NPD-CS, INA-NPD-

CS,TCC-NPD-CS satisfied the criteria of significance and VAF between 0.20 to 0.80, thus satisfied the criteria of partial mediation only.

The path SSP-NPD-CS satisfied the criteria of significance and VAF above 0.80 there by satisfying the criteria of full mediation.

6.10 Moderated Mediation

Moderated mediation is when the effect of the treatment *A* on the mediator and/or the partial effect *B* on the dependent variable depend in turn on levels of another variable (moderator). Essentially, in moderated mediation case, mediation is first established, and then investigated if the mediation effect that describes the relationship between the independent variable and dependent variable is moderated by different levels of another variable (i.e., a moderator). This definition has been outlined by (Muller, Judd, and Yzerbyt, 2005) and (Preacher, Rucker, and Hayes, 2007).

6.10.1 Models of Moderated Mediation

There are five possible models of moderated mediation

1. In the first model, the independent variable also moderates the relationship between the mediator and the dependent variable.
2. In the second model, a new variable which moderates the relationship between the independent variable and the mediator (the *A* path).
3. In the third model, a new moderator variable which moderates the relationship between the mediator and the dependent variable (the *B path*).
4. In the fourth model, one moderating variable affects both the relationship between the independent variable and the mediator (the *A* path) and the relationship between the mediator and the dependent variable (the *B* path).

5. In the fifth model, two new moderator variables, one moderating the *A* path and the other moderating the *B* path.

The Proposed model fits to the second possibility and therefore further tests are done with that model.

6.10.2 Testing Moderating Effects

The most important theoretical underpinnings of moderation can be found in Baron & Kenny (1986) and Venkatraman (1989), while Henseler (2010) presents the applicability of moderation to PLS modelling. A moderator is a qualitative or quantitative variable that affects the direction and/or strength of a relationship between an independent and dependent variable (Henseler, 2010). In this research, the complexity of the model offers several opportunities for testing a large amount of possible moderating effects, but because of the enormous capacity requirements of the computer test runs, it was required to narrow down the focus and concentrate on certain effects. The significance of these moderating effects was checked by bootstrapping, using 500 samples in each case.

If the exogenous variable and/or the moderator variable are formative, the pair wise multiplication of indicators is not feasible. "Since formative indicators are not assumed to reflect the same underlying construct (i.e., can be independent of one another and measuring different factors), the product indicators between two sets of formative indicators will not necessarily tap into the same underlying interaction effect" (Chin et al., 2003). Therefore, instead of using the product indicators approach, they recommend two-stage PLS approach for estimating moderating effect, thereby made use of PLS path models' advantage of explicitly estimating latent variable scores.

The two stages are built up as follows:

Stage 1: The main effect PLS path model is run in order to obtain estimates for the latent variable scores. Stage 2: The interaction term X x M is built up as the element wise product of the latent variable scores. This interaction term LV, the latent variable scores of X and M are used as independent variables in a multiple linear regression on the latent variable scores of Y.

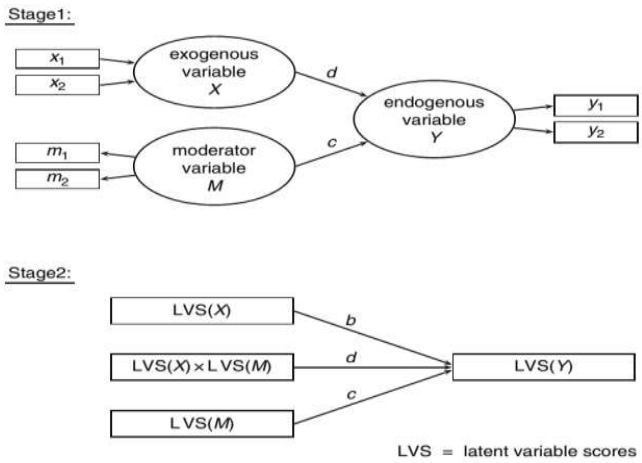

Fig. 6.1: Two Stage approach of testing Moderating Effects

To assess the significance of each interaction term, the significance of the path coefficient between the interaction term and the dependent variable was examined through 500 bootstrap re samples. In addition, following a hierarchical process similar to that used in moderated regression, the results of the main effect only model and the main effect plus the interaction term model were compared (Chin et al., 2003). The moderating effect can be assessed by comparing the proportion of variance explained (determination coefficient R^2) of the main effect model (i.e. the model without moderating effect) with the R^2 of the full model (i.e. the model including the moderating effect). This idea also underlies the effect size. It was (Cohen, 1988) who suggested calculating the effect size f^2 with the following formula:

$$f^2 = \frac{R^2_{\text{model with moderator}} - R^2_{\text{model without moderator}}}{1 - R^2_{\text{model with moderator}}}$$

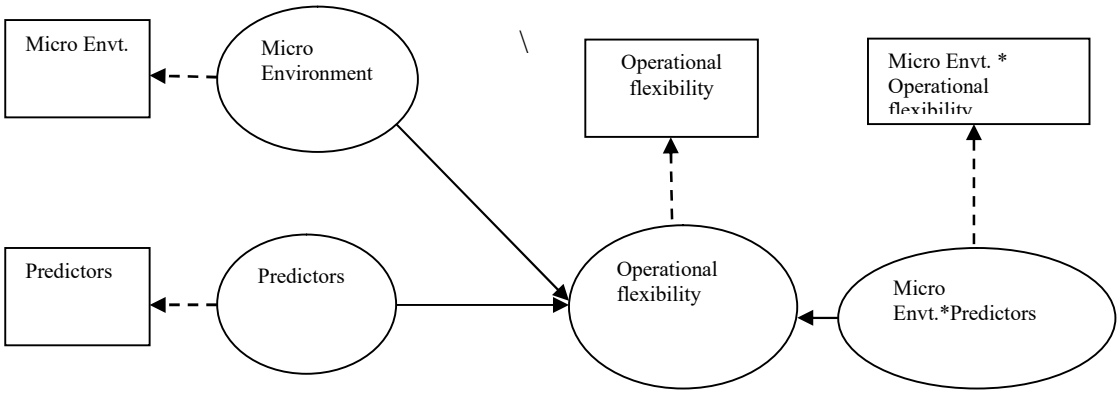

Fig: 6.2: Two Stage Approach-Micro Environment-Moderating Effect

6.11 Results of Micro Environment moderating effect

The table shows the results of testing the moderating effect of micro environment on predictor-operational flexibility relationship. According to the two stage approach by (Chin, Marcolinn & Newsted, 2003), adopted for the study which is not same as original product indicator approach. Here the elementwise product of the latent variable scores of the exogenous variable and the moderator variable serves as the indicator of the interaction term. Here the Scope creep-demand management flexibility path is not having significant t value- i.e.-1.653) also, Legal proceeding-Modication flexibility path with t value = -1.8845). Therefore were excluded from the current analysis. The moderation effect is found for all the remaining paths as they have negative latent variable scores and t value greater than 1.96 at $p<0.05$. Hence the moderating effect of Micro moderators like Insufficient Cash flow, Scope creep, Legal proceedings in seven paths out of nine are proved.

Table 6.8: Latent variable scores and t values-

Micro Environment Moderating Effect

Variables	Latent variable scores	T
SSP-DM	0.344	2.624
SSP-NPD	0.7377	2.745
IS-MOD	0.2432	2.962
IS-NPD	0.2235	3.432
INEPL-DM	0.1941	2.773
INEPL-NPD	0.2325	2.693
INAPL-NPD	0.1941	2.835
CR-MOD	0.1255	2.867
CR-NPD	0.412	2.895
ITC-MOD	0.512	2.875
ITC-NPD	0.246	2.885
Moderators		
Insufficient Cash flow-DM	-1.4522	-5.596
Insufficient Cash flow-NPD	-1.3264	-4.234
Insufficient Cash flow-MOD	-1.6378	-4.566
Scope creep -DM	-0.6310#	-1.653
Scope creep -NPD	-0.6526	-2.425
Scope creep -MOD	-0.8738	-3.246
Legal proceedings-DM	-1.045	-3.673
Legal proceedings-NPD	-1.7737	-2.847
Legal proceedings-MOD	-1.7047#	-1.8845
Interaction Terms		
SSP*Cash Flow-DM	-0.4996	3.536
SSP*Cash Flow-NPD	-0.5043	-3.078
IS*Cash Flow-MOD	-0.3532	4.363
IS*Cash Flow-NPD	-0.3632	10.424
INEPL*Cash Flow –DM	-0.2355	13.692
INEPL*Cash Flow –NPD	-0.4632	7.626
INAPL*Cash Flow –NPD	-0.6236	9.738
CR*Cash Flow –MOD	-0.3522	8.234
CR*Cash Flow –NPD	-0.3672	6.242
ITC*Cash Flow –MOD	-0.2314	-9.2352

ITC*Cash Flow –NPD	-0.2627	-10.4244
SSP*Scope Creep-DM	-0.2145	5.4244
SSP* Scope Creep –NPD	-0.3463	-9.2342
IS* Scope Creep –MOD	-0.1545	-5.242
IS* Scope Creep –NPD	-0.2414	12.515
INEPL* Scope Creep –DM	-0.2424	11.622
INEPL* Scope Creep –NPD	-0.6343	-4.626
INAPL* Scope Creep –NPD	-0.3212	9.242
CR* Scope Creep –MOD	-0.1245	-10.525
CR* Scope Creep –NPD	-0.4245	4.626
ITC* Scope Creep –MOD	-0.3682	3.252
ITC* Scope Creep –NPD	-0.2577	6.733
SSP*Legal Proceedings-DM	-0.6633	8.234
SSP* Legal Proceedings -NPD	-0.3246	5.744
IS* Legal Proceedings –NPD	-0.2819	-3.054
INEPL* Legal Proceedings -DM	-0.3376	-4.135
INEPL* Legal Proceedings -NPD	-0.2819	3.346
INAPL* Legal Proceedings -NPD	-0.2171	2.561
CR* Legal Proceedings –NPD	-0.1418	-3.434
ITC* Legal Proceedings -NPD	-0.1467	-3.546

With p<0.05, # not significant

6.12 Results of Macro Environment Moderating Effect

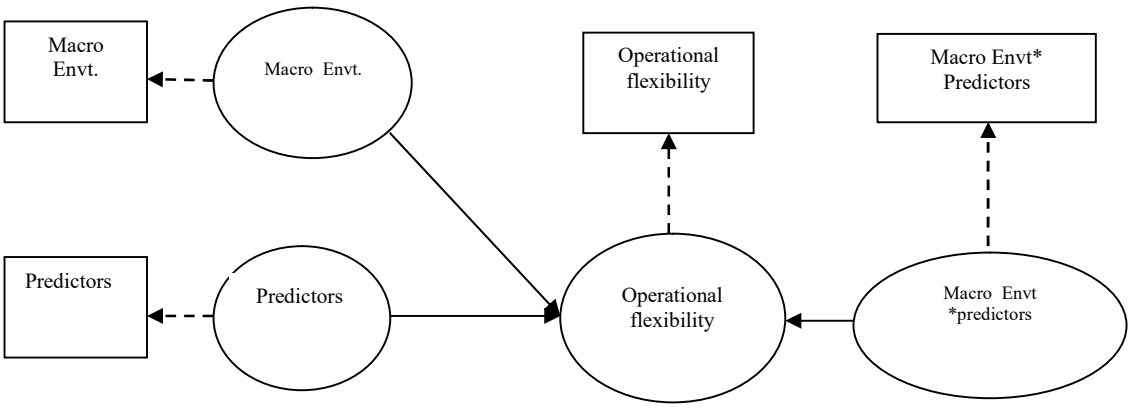

Fig: 6.3: Two Stage Approach-Macro Environment

The table below shows the results of testing the moderating effect of macro environment on predictor-operational flexibility relationship. According to the two stage approach by Chin, Marcolinn & Newsted (2003) the elementwise product of the latent variable scores of the exogenous variable and the moderator variable serves as the indicator of the interaction term. Here the Demand for facilities-demand management flexibility path is not having significant t value- i.e.-1.445) also, Demand for facilities-Modification flexibility path with t value = -1.537, availability of raw materials-Modification flexibility with t value = -1.362, Rising cost and Modification flexibility with t value = -1.748. Therefore were excluded from the current analysis. The moderation effect is found for all the remaining paths as they have negative latent variable scores and t value greater than 1.96 and with $p<0.05$. Hence the moderating effect of Macro moderators like Demand for facilities, Availability of raw materials and Rising Cost are proved in five out of total nine paths.

Table 6.9-Latent variable score and t values

Macro Environment Moderating Effect

Variables	**Latent variable scores**	**T**
SSP-DM	0.344	2.624
SSP-NPD	0.7377	2.745
IS-MOD	0.2432	2.962
IS-NPD	0.2235	3.432
INEPL-DM	0.1941	2.773
INEPL-NPD	0.2325	2.693
INAPL-NPD	0.1941	2.835
CR-MOD	0.1255	2.867
CR-NPD	0.4142	2.895
ITC-MOD	0.5123	2.875
ITC-NPD	0.2463	2.885
Moderators		
Demand fluctuations-DM	-0.0674#	-1.445

Demand fluctuations-NPD	-0.2455	-7.437
Demand fluctuations-MOD	-0.0452#	-1.537
Availability of raw materials-DM	-0.5531	-9.442
Availability of raw materials-NPD	-0.5326	-10.887
Availability of raw materials-MOD	-0.1626#	-1.362
Rising Cost-DM	-0.2366	-3.738
Rising Cost-NPD	-0.3967	-4.474
Rising Cost-MOD	-0.1727#	-1.748
Interaction Terms		
SSP*Demand fluctuations-NPD	-0.8322	6.346
IS*Demand fluctuations –NPD	-0.4859	5.437
INEPL*Demand fluctuations –NPD	-0.2853	-3.475
INAPL*Demand fluctuations –NPD	-0.5592	2.378
CR*Demand fluctuations –NPD	-0.6532	4.547
ITC*Demand fluctuations –NPD	-0.2523	2.477
SSP*Availability of raw materials-DM	-0.269	3.366
SSP* Availability of raw materials –NPD	-0.3525	4.764
IS* Availability of raw materials –NPD	-0.3525	4.743
INEPL* Availability of raw materials –DM	-0.2599	3.134
INEPL*Availability of raw materials –NPD	-0.1539	5.134
INAPL*Availability of raw materials-NPD	-0.1554	4.133
CR*Availability of raw materials –NPD	-0.5353	5.353
ITC*Availability of raw materials –NPD	-0.2963	5.235
SSP*Rising Cost-DM	-0.5342	4.636
SSP* Rising Cost-NPD	-0.6632	9.366
IS* Rising Cost –NPD	-0.3553	4.346
INEPL*Rising Cost –DM	-0.4535	5.378
INEPL*Rising Cost –NPD	-0.4367	6.357
INAPL*Rising Cost-NPD	-0.3456	7.368
CR*Rising Cost-NPD	-0.2494	5.478
ITC* Rising Cost –NPD	-0.2375	5.478

With $p<0.05$, # not significant

Following the two-stage PLS moderating approach described, main effect and moderated models were developed in stages 1 and 2 of the moderating procedure. Subsequently, these two models were compared to determine the overall size (f^2) of interaction effect. The bootstrapping re-sampling method was used to compute the standard errors for significance testing of path coefficients in the developed moderated structural models. Moderating effects of environmental conditions on the relationship between significant determinants and firms' operational flexibility are analyzed as follows. Supply chain capabilities, Information sharing, Customer relationship, Intra project learning, Inter project learning, Technological capabilities are included in the moderated structural model in testing the effect of environmental conditions (i.e., micro and macro environment) on the relationships between the predictor constructs and firms' operational flexibility as shown in Figure 6.4. The moderated model comprises of the predictor, product (i.e., interaction between predictor and moderator) and predicted constructs. Table shows the individual PLS path analysis for the developed moderated structural model. In stage 1, the majority of the constructs have significant influences ($p<0.05$) on firms' operational flexibility, namely (i) Supply chain capabilities; (ii) Intra project learning; (iii) Inter project learning (iv) Information sharing (v) Customer Relationship (vi) Technological capabilities. All the moderators have significant impact negative impacts on predictors of operational flexibility. The moderator constructs are found to have a negative influence on a firm's operational flexibility. This means that a high degree of micro and macro volatility is likely to hamper the firm's operational flexibility.

Table 6.10: Composite Reliability and Communality Values

Constructs	Comp Reliability	R^2	Communality	H^2	Redundancy	f^2
PLC	0.873		0.672	0.378	0.021	
SCP	0.895		0.782	0.532	0.029	
TC	0.783		0.725	0.526	0.022	
DM	0.915	0.662	0.893	0.482	0.059	0.153
MOD	0.824	0.682	0.860	0.451	0.063	0.169
NPD	0.873	0.690	0.842	0.420	0.048	0.148
MI	0.867		0.825	0.462	0.063	
MA	0.745		0.793	0.346	0.035	
LE	0.882	0.712	0.732	0.537	0.025	0.157
CS	0.843	0.673	0.723	0.435	0.038	0.186
Avg.		0.6838	0.775		0.036	
GoF	0.6973					

Results show that all the construct presented an acceptable CV-redundancy index and CV-communality index. The GoF for the proposed model was 0.6973 (69%) and can be accepted at a substantial level (Chin, 1998).

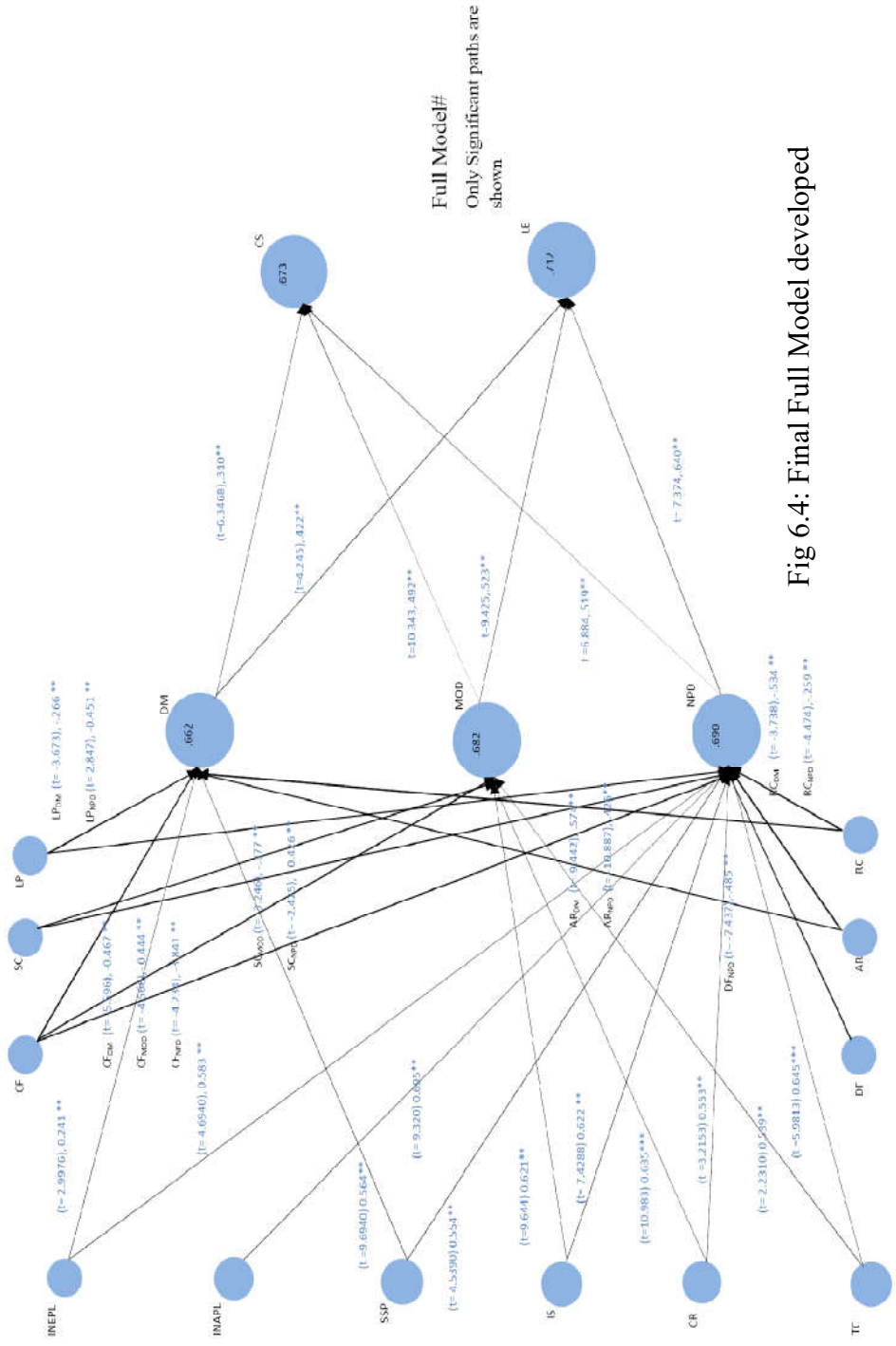

Fig 6.4: Final Full Model developed

6.13 Results of Hypotheses Testing *(Refer Page 90 for hypotheses)*

H_1: Project learning culture has a significant direct impact on Operational Flexibility.

H_1 can be split into sub hypotheses- H_{1a}, H_{1b}, H_{1c}, H_{1d}, H_{1e} and H_{1f}. The six paths are tested and in the full model (H_{1a}) INEPL-DM with t value 2.9976 and β value 0.241, (H_{1c}) NEPL-NPD with t value 4.6940 and β value 0.583, (H_{1f}) INAPL-NPD with t value 9.320 and β value 0.695 were found significant and hence **H_{1a}, H_{1c}, H_{1f}** were supported.

Table 6.11: Sub Hypothesis testing results of Project Learning Culture

Sub Hypothesis			**Supported**
H_{1a}	Inter Project Learning	Demand Management	Yes
H_{1b}	Inter Project Learning	Modification	No
H_{1c}	Inter Project Learning	New Product Development	Yes
H_{1d}	Intra Project Learning	Demand Management	No
H_{1e}	Intra Project Learning	Modification	No
H_{1f}	Intra Project Learning	New Product Development	Yes

H_2: Technological capabilities have a significant direct impact on Operational Flexibility.

H_2 can be split into sub hypothesis-H_{2a}, H_{2b}, H_{2c}. The paths corresponding to (**H_{2b}**) TC-NPD with t-2.2310 and β value 0.539 and (**H_{2c}**) TC-MOD with t-5.9813 and β value 0.645 were found significant and hence supported.

Table 6.12: Sub Hypothesis and results of Technological capabilities

Sub Hypothesis			**Supported**
H_{2a}	Information Technological Capabilities	Demand Management	No
H_{2b}	Information Technological Capabilities	Modification	Yes
H_{2c}	Information Technological Capabilities	NewProduct Development	Yes

H_3: Supply chain Practices have a significant direct impact on Operational flexibility

H_3 can be split into sub hypotheses H_{3a}, H_{3b}, H_{3c}, H_{3d}, H_{3e}, H_{3f}, H_{3g}, H_{3h} and H3i. The paths corresponding to **H_{3a}** (SSP-DM) with t-9.6940 and β value 0.5640, **H_{3c}** (SSP-NPD) with t-4.5390 and β value 0.554, **H_{3e}** (CR-MOD) with t-10.983 and β value-0.635, **H_{3f}** (CR-NPD) with t value-3.2153 and β value 0.553 were found significant and hence supported

Table 6.13: Sub Hypothesis and results of Supplychain Practices

Sub Hypothesis			**Supported**
H_{3a}	Strategic Supplier Partnership	Demand Management	Yes
H_{3b}	Strategic Supplier Partnership	Modification	No
H_{3c}	Strategic Supplier Partnership	New Product Development	Yes
H_{3d}	Customer Relations	Demand Management	No
H_{3e}	Customer Relations	Modification	Yes
H_{3f}	Customer Relations	New Product Development	Yes

H_{3g}	Information Sharing	Demand Management	No
H_{3h}	Information Sharing	Modification	Yes
H_{3i}	Information Sharing	New Product Development	Yes

H_4: Operational Flexibility Potential mediates the relationship between Predictors and Operational Flexibility.

Testing of this hypothesis is done in section 6.9 with table 6.7. Consequently the following results can be derived regarding the subhypothesis.

Table 6.14 Sub Hypothesis testing results for Mediation of Operational Flexibility

Sub Hypothesis				Supported
H_{4a}	Inter Project Learning	Demand Management	Customer Satisfaction	No
H_{4b}	Inter Project Learning	Demand Management	Learning Exploitation	Yes
H_{4c}	Inter Project Learning	Modification	Customer Satisfaction	No
H_{4d}	Inter Project Learning	Modification	Learning Exploitation	No
H_{4e}	Inter Project Learning	New Product Development	Customer Satisfaction	Yes
H_{4f}	Inter Project Learning	New Product Development	Learning Exploitation	Yes
H_{4g}	Intra Project Learning	Demand Management	Customer Satisfaction	No
H_{4h}	Intra Project Learning	Demand Management	Learning Exploitation	No

H_{4i}	Intra Project Learning	Modification	Customer Satisfaction	No
H_{4j}	Intra Project Learning	Modification	Learning Exploitation	No
H_{4k}	Intra Project Learning	New Product Development	Customer Satisfaction	Yes
H_{4l}	Intra Project Learning	New Product Development	Learning Exploitation	Yes
H_{4m}	Strategic supplier Partnership	Demand Management	Customer Satisfaction	Yes
H_{4n}	Strategic supplier Partnership	Demand Management	Learning Exploitation	Yes
H_{4o}	Strategic supplier Partnership	Modification	Customer Satisfaction	No
H_{4p}	Strategic supplier Partnership	Modification	Learning Exploitation	No
H_{4q}	Strategic supplier Partnership	New Product Development	Customer Satisfaction	Yes
H_{4r}	Strategic supplier Partnership	New Product Development	Learning Exploitation	Yes
H_{4s}	Customer relations	Demand Management	Customer Satisfaction	No
H_{4t}	Customer relations	Demand Management	Learning Exploitation	No
H_{4u}	Customer relations	Modification	Customer Satisfaction	Yes
H_{4v}	Customer relations	Modification	Learning Exploitation	Yes
H_{4w}	Customer relations	New Product Development	Customer Satisfaction	Yes
H_{4x}	Customer relations	New Product Development	Learning Exploitation	Yes

H_{4y}	Information Sharing	Demand Management	Customer Satisfaction	No
H_{4z}	Information Sharing	Demand Management	Learning Exploitation	No
H_{4za}	Information Sharing	Modification	Customer Satisfaction	Yes
H_{4zb}	Information Sharing	Modification	Learning Exploitation	Yes
H_{4zc}	Information Sharing	New Product Development	Customer Satisfaction	Yes
H_{4zd}	Information Sharing	New Product Development	Learning Exploitation	Yes
H_{4ze}	Technological Capabilities	Demand Management	Customer Satisfaction	No
H_{4zf}	Technological Capabilities	Demand Management	Learning Exploitation	No
H_{4zg}	Technological Capabilities	Modification	Customer Satisfaction	Yes
H_{4zh}	Technological Capabilities	Modification	Learning Exploitation	Yes
H_{4zi}	Technological Capabilities	New Product Development	Customer Satisfaction	Yes
H_{4zj}	Technological Capabilities	New Product Development	Learning Exploitation	Yes

H_5: Project Macro Environment moderates the path of Predictors and Operational Flexibility.

Testing of this hypothesis is done in section 6.12 with table 6.9 and interpretations. Consequently the following results can be derived regarding the subhypothesis.

Table 6.15 Sub Hypothesis testing results of Macro environment factors as moderators

Sub Hypothesis			Supported
H_{5a}	Demand Fluctuations	Demand Management	No
H_{5b}	Demand Fluctuations	Modification	No
H_{5c}	Demand Fluctuations	New Product Development	Yes
H_{5d}	Availability of Raw Materials	Demand Management	Yes
H_{5e}	Availability of Raw Materials	Modification	No
H_{5f}	Availability of Raw Materials	New Product Development	Yes
H_{5g}	Rising Cost	Demand Management	Yes
H_{5h}	Rising Cost	Modification	No
H_{5i}	Rising Cost	New Product Development	Yes

H_6: Project Micro Environment moderates the path of Predictors and Operational Flexibility.

Testing of this hypothesis is done in section 6.11 with table 6.8 and interpretations. Consequently the following results can be derived regarding the subhypothesis.

Table 6.16 Sub Hypothesis testing results of Micro Environmental factors as moderators

Sub Hypothesis			Supported
H_{6a}	Cash Flow	Demand Management	Yes
H_{6b}	Cash Flow	Modification	Yes
H_{6c}	Cash Flow	New Product Development	Yes
H_{6d}	Scope Creep	Demand Management	No
H_{6e}	Scope Creep	Modification	Yes
H_{6f}	Scope Creep	New Product Development	Yes
H_{6g}	Legal Proceedings	Demand Management	Yes
H_{6h}	Legal Proceedings	Modification	No
H_{6i}	Legal Proceedings	New Product Development	Yes

Summary

This chapter describes testing of hypothesis and model in which Smart PLS software was employed. PLS comprises a measurement model and a structural model. The measurement model specifies the relations between observed indicators and their corresponding latent constructs, whereas the structural model specifies relationships between latent constructs. The reliability and validity of the measurement model were assessed. The reliability (Item-level) showed that the absolute correlation between the construct and its measuring manifest items (i.e. Factor loading)

was above than the minimum threshold criterion 0.4. The construct level reliability was examined by using Cronbach's α and by composite reliability. Where, Cronbach's α measured the uni-dimensionality of multi-item scale's internal constancy Cronbach (1951), and composite reliability (similar to factor reliability) measured that how well construct were measured by its assigned items, the Cronbach's α was higher than the required value of 0.6 Cronbach (1951) and composite reliability was higher than the recommended 0.7 values (Nunnally and Bernstein, 1994). For assessing the validity of the PLS path model, both convergent validity and discriminant validity are measured.

Convergent validity ensures that indicators actually represent their underlying unobservable construct. AVE extracted for the each construct was higher than the required value 0.5 (50%) (Fornell & Larcker, 1981) except for EBS and HRP because of which they were not retained in further analysis and rest of constructs have the capability to explain more than half of the variance to its measuring items, therefore, except for EBS and HRP none of the inter-construct correlation value was above the square-root of the AVE and satisfied the criterion of the discriminant validity. At item-level discriminant validity, Chin (1998) suggested to examine the cross-loading within the factor loading. The cross loading table above shows that, except for OF4 & OF5, rest of measuring items within construct were higher than all of its cross-loadings in row and column. Results of testing for convergent and discriminant validity show OF4, OF5, EBS, HRP constructs failing in convergent and discriminant validity criteria and therefore removed from further analysis of the study.

Formative constructs in the measurement model underwent a separate set of analysis of reliability. In this study there are two formative measurement constructs: Effective project management and Operational

flexibility potential that are evaluated for VIF. The VIF values of all indicators are less than 3.5, indicating that multicollinearity problem is not a concern. Assessment of the structural model was performed for the tests of hypotheses. PLS was used to estimate the path coefficients (β) between the paths of the exogenous and endogenous constructs within the combined data set. The coefficient of determination (R^2) is said to be the most essential criterion for estimating the structural model. Based on the (β) and t values the model presents twenty nine significant paths in the process hypothesis testing, details of which are given in the table above. Mediation analysis was conducted, followed by moderated mediation. In this study, q^2, H^2, F^2 were computed using 'blindfolding' procedure. The predictive relevance for the significant path towards LE and CS also reflected the medium predictive relevance impact. Like the R^2, CV-redundancy is only computed for the path model to predict the endogenous or dependent variable. Results show that all the blocks presented an acceptable CV-redundancy index and CV-communality index. The GoF for the proposed model was 0.6973 (69%) and can be accepted at a substantial level (Chin, 1998).

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Chapter - 7

FINDINGS AND DISCUSSIONS

7.1 Introduction

This chapter presents the findings from the results of model and hypotheses testing. The chapter is divided into the following sections 1) Findings 2) Discussions 3) Theoretical implications 4) Practical implications 5) Limitations and 6) Directions of future research.

7.2 Findings

In project learning culture, inter-project learning has a significant relationship with demand management flexibility and new product development; Intra-project learning has a significant relationship with new product development.

Employee Behaviour and Skills couldn't be retained as it failed in discriminant validity test. Technological Capabilities have a significant relationship with Modification Flexibility (MOD) and New Product Development (NPD).

Supply chain capability of Strategic Supplier Partnership (SSP), Information Sharing (IS) and Customer Relationship (CR) has emerged as most important predictor of operational flexibility. SSP holds a significant relationship with Demand Management Flexibility and NPD. IS has a significant relationship with the MOD and NPD. CR has a significant relationship with MOD and NPD.

Human Resource Management Practices are not visible in this industry, and that can be a reason for failure of the construct in convergent validity.

Micro (3) and Macro (3) Moderators have moderated the relation between Predictors & Operational flexibility types. Significance was not found in the relationships between Demand Fluctuations (DF) and Demand Management, DF and MOD, Rising Costs (RC) and MOD, which were macro moderators.

Out of 36 paths in the mediated model, new product development flexibility mediated twelve paths; making it the most significant of operational flexibility types followed by modification flexibility (6 paths) and finally demand management flexibility which mediated only three paths.

The coefficient of determination (R^2) values of DM-0.662, Mod-0.682, NPD-0.690, CS-0.673, LE-0.712 was found to be substantial. GoF, of the final model= 0.6973. The GoF for the proposed model was 0.6973 (69%) and can be accepted at a substantial level (Chin, 1998).

7.3 Discussions

In this study, the mediating role of operational flexibility on customer satisfaction and learning exploitation is determined by testing the relationship between six constructs of capabilities or practices with operational flexibility and then to customer satisfaction and learning exploitation. The capabilities that are studied in this research are intra project learning; inter project learning, strategic supplier partnership, information sharing, customer relations and technological capabilities. Modification, new product development and demand management flexibility types of operational flexibility are being tested. When these types

are tested in a direct one to one relationship with customer satisfaction and learning exploitation, the results show that all predictors in the final model have a significant positive relationship with customer satisfaction and learning exploitation. A possible reason for failure of employee behaviour and skill construct in discriminant validity test could be that, team members send to a project site are invariably having complementary skill sets & expertise, with the nature of work itself demanding a high degree of physical,emotional and intellectual exhaustion and labour. They are moulded to a high degree of flexibility and the respondents recognize it as a must have, rather than a desirable trait.

Availability of skilled workforce is a serious concern of this industry coupled with poaching of workers by contractors, poor labour management at the site, accommodation and transportation. There are seasonal workers who are actually farmers and their seasonal engagements create additional woe of labour availability. Regional Festivals in northern states affects the labour availability in Kerala. Reworks due to poor work quality of workmanship has been reported as a cause of project delay as well as project cost variance. The Learning Exploitation happening through knowledge management in construction industry is through written documents commonly known as "work profiles" which is a record of failures and successes out of the day to day operations, discussed in a daily meeting of project team members.

7.3.1 Hypothesised relationships

Testing the research model for hypothesis one, testing project learning culture and operational flexibility, the sub hypotheses except inter project learning and modification, intra project learning and demand management, intra project learning and modification were proved. For hypothesis two testing technological capabilities and operational flexibility,

sub hypothesis except information technological capabilities and demand management were proved. For hypothesis three testing supply chain practices and operational flexibility, sub hypothesis except strategic supplier partnership and modification, customer relations and demand management, information sharing and demand management were proved.

For hypothesis four, testing the mediating role of operational flexibility the paths except SSP-Mod-LE, INA-Mod-CS, INE-Mod-LE, INA-Mod-LE, SSP-Mod-CS, INE-Mod-CS, IS-DM-LE,CR-DM-LE,INA-DM-LE, TCC-DM-LE, IS-DM-CS, CR-DM-CS, INE-DM-CS, INA-DM-CS,TCC-DM-CS were proving the mediating role of operational flexibility.

For hypothesis five, stating the moderating role of macro environment on operational flexibility- demand fluctuations was not found to moderate modification flexibility and demand management flexibility but moderated new product development flexibility, availability of raw materials was not found to moderate modification flexibility but moderated demand management and new product development, rising cost was not found to moderate modification flexibility but moderated demand management and modification flexibility.

For hypothesis six, testing the moderating role of micro environment on operational flexibility, cash flow moderated demand management, modification and new product development, scope creep didn't moderate demand management but moderated modification and new product development, legal proceeding moderated demand management and new product development but not modification. As there is no previous research on this topic in which a comprehensive model with all flexibility capability types in relation to customer satisfaction and learning exploitation are tested at once, no comparisons with model based results can be made using previous literature.

7.3.2 Operational flexibility

May be the results of the study of this model can be explained by the fact that flexibility types are evidently promoting learning and exploitation and customer satisfaction and therefore indicate the importance of mass customization by which the customer wants a individually customized product (product modification flexibility Gerwin (1993); Koste and Malhotra (1999); Petroni and Bevilacqua (2002), delivered suitable to their purpose on the right time (demand management flexibility), Das and Narasimhan (2000); Kumar et al. (2006), based on the information given by the customer (Day 1994; Hart 1995;Feitzinger and Lee 1997; Gilmore and Pine 1997; Beach et al. 2000; Da Silveira et al. 2001;Stevenson and Spring 2007).

The reason why new product development flexibility mediated twelve paths can be because of the fact that, a new product can foresee the needs and which is only possible with a stronger relationship with customers and this is evident from the fact that new products mostly have a short time to the market and most of the projects have repeated customers (Sanchez 1995; Gunasekaran et al. 2001; Zhang and Doll, 2001). In the real estate sector, the customer appreciates new concept and themes and many like to identify themselves with its identity and uniqueness Olson et al. (1995) and therefore product variety lead to satisfied customers (Gerwin 1993; Hart 1995; Gunasekaran et al.2001; Zhang et al. 2009).

Volume and mix flexibility are less visible and therefore were removed before the development of the final model as the customers see an end product delivered on time and not the mechanism used to achieve this target. So the customers do not see mix or volume flexibility, but it's consequences, for instance in terms of delivery capability or demand management (De Toni and Tonchia 1998; Jack and Raturi 2002; Olhager

and West 2002; Oke 2005; Hallgren and Olhager 2009). The customers do receive the results of demand management flexibility and therefore recognizes the consequences or results from the activities executed to achieve their demand resulting in meeting the promised dates of delivery of finished products. In short, customers do care how an order is met, as well as whether it fulfil their needs Hart (1995) and Oke (2005) i.e. a delivery in the right shape and at the right time.

According to the findings in this research to improve customer satisfaction by delivering the right product at the right time based on the information the customer had given, new product development and product modification, are important and should therefore be stimulated in the project context to reach higher customer satisfaction levels up to a trade off level.

Operational flexibility type actually exhibits the customer orientation of companies and they should invest in new product development flexibility first, then on Modification and demand management flexibility. Innovation thus contributes to effective project management in a big way. The results showed that supply chain capabilities have a positive effect on effectiveness measures of customer satisfaction and learning exploitation, resulting in project effectiveness.

Thus, if managers are looking at flexibility they often must look for a particular part of flexibility from a particular managerial situation or problem (Upton 1994; Lau 1999; Chang et al. 2007). Which flexibility type is important depends on the situation. Each time a new decision must be made on the basis of what is important under those specific circumstances. Often, flexibility itself is not the most important thing in this decision, but the results that must be obtained (Narain et al. 2000; Oke 2005). So the situation and the chosen strategy influence the adoption of the operational flexible types (Vokurka and O'Leary-Kelly 2000).

This test helped to prove that operational flexibility types are important in relation to customer satisfaction, learning and exploitation. These capabilities are tested separately with customer satisfaction, but also all together in one model. The results of the tests between every flexibility capability and customer satisfaction and learning exploitation in this thesis are all positive. This is almost the same as the outcome of different studies of flexibility in relation to customer satisfaction from Zhang et al. (2006), where the result of all flexibility types of customer satisfaction is significant and positive.

When testing all flexibility, leading capabilities in one model from a broad perspective on operational flexibility, only a few capabilities seems to be important as revealed during the literature review and from expert opinions. Again during the course of analysis of this study it got revealed that out of five flexibility types in the research model, only modification flexibility, new product development, demand management flexibility could be retained in the final model and have a significant positive impact on customer satisfaction and learning exploitation. So to satisfy a customer it is important to deliver the right modified product in the right purpose at the right time, based on the information given by the customer.

These results show that in this industry, the other flexibilities such as volume, mix seems to be less important in relation to customer satisfaction. This does not mean that these flexibilities should not be part of the model or consideration at all, because they could also be needed to support and fulfil other more important flexibilities. For instance delivery flexibility can hardly be achieved without any demand management, volume and mix flexibility activities (De Toni and Tonchia 1998; Jack and Raturi 2002; Olhager and West 2002; Oke 2005; Hallgren and Olhager 2009). In the

same way managers need to understand that depending on their situation and their own firm's relationship with the entire supply chain they must strive for the right selection of flexibility types, to make a good choice to reach their predetermined goal. This is important because not every flexibility types is equally related to a specific project effectiveness measure and it is meaningless to develop a flexibility strategy which increases flexibility but not reaches the goal (De Treville and Vanderhaeghe, 2003; Sánchez and Pérez, 2005) or like Golden and Powell (2000) describe it interpreting Suarez et al. (1992): "an organization can be flexible in some way and less flexible in others".

To obtain flexibility a firm cannot buy flexibility, it must be planned, developed from within and managed according to the changing circumstances to gain its benefits (Oke, 2003; Boyle, 2006). This is only possible from a broad perspective on flexibility and when taking all important flexibility types for that particular situation together into consideration and building capabilities and practices taking time.

The study developed and tested the structural model and the final model consisted of six key predictors for achieving operational flexibility, which were specified based on the review of the literature and expert opinions. The results show that the six predictors have direct impacts on operational flexibility. Despite these findings, it is acknowledged that the models could be: further refined by: (i) considering other organizational attributes, and (ii) exploring possible relationships between them and the three flexibility types, which were not tested in this study. This limitation leads to the future research possibility. The measurement models developed in this study have considered complex constructs that are intangible, dynamic and 'soft' assets of a construction firm. Although the results showed an acceptable level of construct reliability and validity, it is

acknowledged that measurement items of respective constructs should be continuously updated for improved understanding about achieving operational flexibility.

The structural model was developed based the perception of 87 construction firms. It follows that the form and strength of the proposed relationships between constructs are likely to differ in different industry contexts. Though the findings of this study provide valuable insights into operational flexibility management in construction, its application could have limitations in countries with different cultural and economic background from India. Also, the model developed has not been further tested on Indian construction firms that had gone into liquidation during the economic downturn, due to the difficulties encountered in contacting and persuading the relevant personnel of those firms. All these limitations lead to future research possibilities. The study found that supply chain capabilities are a significant determinant of operational flexibility.

This study considered two major factors namely micro and macro moderators which composed project inherent uncertainty elements. Uncertainty is a complex construct and sub constructs under these two factors might not have captured every aspect of project inherent uncertainty. Other facets of inherent uncertainty should be investigated in future research. Finally, this study empirically analyzed the relationships between predictors, moderators, operational flexibility and project Effectiveness from a builder's perspective. More research is needed to examine whether the contingency relationships found here also apply from a contractor or vendor perspective and to analyze the differences between vendor and builder/client perspectives.

The moderating factors should be considered of potential interest to researchers and practitioners. Moreover, the results shed some light on the

relative degrees of significance of the environmental uncertainty on a project. This result is consistent with the results in previous studies (e.g., Zacharia and Mentzer 2004; Fynes et al. 2006). According to Fynes et al. (2005), the effect of supply chain relationship quality and environmental uncertainty on supply chain effectiveness is very significant.

In contrast, for firms reporting high uncertainty, predictors do not impact project effectiveness. The findings could be explained by the following arguments. First, effective implementation of predictors like supply chain practices especially in construction industry will need the existence of commitment, shared visions among internal functions as well as suppliers and customers under stable business environment. In other words, the empirical results of this study demonstrate that obtaining favourable results in project is based on building the effective relationship with business partners under low environmental uncertainty on one side and developing operational flexibility to counter uncertainty under medium to high level of environmental uncertainty. This finding supports the work of Morris and Carter (2005), who suggest that firms should invest their resources in both reducing uncertainty and increasing cooperation in their relational exchanges.

Second, management in firms with perceived high uncertainty compared to peers are found to be more reluctant to integrate internally and externally to their business partners since those integrative practices comes from a gradual learning and experience which is uncommon in such firms. In other words, firms may emphasize their practices only on the condition of low uncertainty, but do not prepare themselves for high uncertainty condition. It is here, such firms can develop operational flexibility ahead of the learning curve and achieve effectiveness enjoyed by well experienced counterparts. The results of this study pinpoint an important implication for

practitioners by highlighting the importance of environmental uncertainty in implementing various capabilities. Although firms tend to focus on practices, they have not given enough attention to the effect of external factors such as environmental uncertainty. The results of this study demonstrate to the practitioners that to achieve high level of project effectiveness it is imperative to understand uncertainty before investing in practices. The basic concept is that the implementation of practices is not a rigid. Here, success can be attributed to the way in which various practices are combined and organized based on the uncertainty or business condition factors.

7.4 Theoretical implications

This study contributes to knowledge in construction business management by developing and successfully testing the theoretical framework of operational flexibility that emphasizes the collective efforts of firms' resources, capabilities and strategies towards achieving operational flexibility, in a business environment fuelled by macro and micro forces. The study empirically demonstrates the influence of organizational resources, capabilities and strategies towards achieving different operational flexibility types. It offers a new plausible explanation for the factors influencing operational flexibility management in construction. This, not only broaden the focus of firms' flexibility practices but also enhances the understanding of the nature and constitution (i.e., flexibility types) of operational flexibility.

Another contribution to theory is that this study applied and tested the theories of organizational learning Cyert and March (1963) and dynamic capabilities Teece et al. (1997) on the concept of operational flexibility by examining the effects of learning culture on construction firms' project effectiveness. First, it establishes empirical evidence to support the claim

that learning-orientation is important towards developing firms' dynamic capabilities evident through operational flexibility; and second, this study discovered that a firm's commitment to learning revealed through intra project and inter project learning positively influences operational flexibility, in which the latter is an important organizational asset that influences other organizational attributes.

The next contribution is that this study examined Thompson (1967) dynamic contingency theory on organizational flexibility, by exploring the moderating effects of two environmental conditions (i.e., micro and macro conditions) on the relationships between construction firms' resources, capabilities, strategies (i.e., determinants) and operational flexibility. Significant moderating effects of micro and macro conditions were found on the relationships concerned. The findings show strong evidence concerning the direct impact of micro and macro conditions on firms' operational flexibilities.

From another perspective, these findings may suggest that the dynamic contingency theory is sufficient to explain how Indian construction firms behave flexibly in a changing business environment, thus firms would need to engage themselves in a continuous learning process for improved responsiveness to environmental changes. This phenomenon may partly be explained in relation to the business conditions of the Indian construction industry, where construction firms had undergone five years of unprecedented economic changes following an unstable market condition during the research period, due to the increasing prices of raw materials and soaring construction demand.

Lastly, this study examined the complexity theory Prigogine and Stengers (1984) on operational flexibility, and proved that construction

firms could be seen as complex adaptive systems comprising many interrelated elements (i.e., resources, capabilities and strategies), which learn and adapt to their environment in their efforts to remain viable. Hence, further work on construction business management should consider these elements in the development of theoretical frameworks.

An overview of the flexibility theory is given describing the elements of flexibility, the perspectives on flexibility, the types of flexibility and the different aspects of flexibility. A definition of operational flexibility was stated to determine which operational flexibilities are important in relation to customer satisfaction and learning exploitation. Three customer facing flexibility types could be retained in the model that served as a testable framework to relate operational flexibility to customer satisfaction and learning exploitation.

This appears to be the first empirical research in India which integrated the unique characteristics of the Indian construction industry, ways to achieve operational flexibility and attain effective project management. This study models effective project management through operational flexibility from its predictors integrating them to a comprehensive model. Application of Structural equation in model building and testing the moderating effects by PLS approach is not very common in construction industry but use of Smart PLS 2.0 M3 for the above proved to be very useful given the exploratory nature of the study and for the model.

The empirical evidence supports the view that all measured flexibility types have a positive relationship with customer satisfaction and learning exploitation when tested one at a time. This is comparable with the results of different researches on this topic by (Zhang et al., 2006). When testing the comprehensive model all hypotheses are at least partly

confirmed, even though the not all sub hypothesis were proved. Thus only product modification flexibility, new product development flexibility and demand management flexibility have a significant positive impact on customer satisfaction. From this point of view it is extremely important that to consider which flexibility is important in a particular situation to reach a particular predetermined goal, a broad view on flexibility and a model testing approach is used.

The results showed that, project inherent uncertainty (as expressed in this study through moderators) had a direct negative effect on project operational flexibility and therefore on effectiveness. The significant path between customer relation-new product development, modification, demand management and customer satisfaction, learning and exploitation reveals that, it is not in agreement with the studies of Yetton et al. (2000) that user participation tends to increase budget variance by encouraging suggestions for changes to specifications and the empirical finding of Nidumolu (1995) that increased interaction between users and project staff does not necessarily lead to a project that converges well (i.e., improved project Effectiveness).

Customer relation is necessary for project success and participation in the requirements analysis stage can decrease the risk of final product with insufficient requirements. However, too much customer relations may have a negative effect on project success and delivery time. Clients/users will continually shift their requirements, which can result in overbudget and late project with far too many conflicts. Therefore, project managers need to be aware of the trade-offs in customer relation and project constraints.

The results of the full model with the interaction effects revealed that moderators or project inherent uncertainty can moderate the effect of

capabilities and practices on operational flexibility. More specifically, the negative path coefficient from the interaction term between capabilities/practices and operational flexibility indicated that project operational flexibility makes a smaller contribution to project effectiveness when inherent uncertainty at a very high level or we can say operational flexibility is being utilized for fighting uncertainty so that there is less left for project effectiveness, but without which project effectiveness would have been less.

Although the overall interaction effect size (f^2) is medium Chin et al. (2003) emphasized that a medium f^2 imply an important effect. Even a small interaction effect can be important under extreme moderating conditions and with beta changes also being significant, then the conditions must be taken into account.

The project management can be looked upon as system heavy on capital, expertise and skills of many different people over a definite period of time. Given the nature of the construction project, communication and coordination between team members is necessary for project success. The results of this study reveal that the moderators make different impacts on different types of operational flexibility and therefore on project effectiveness and therefore projects happening during different times will be affected by moderators in unique ways, which has important implications for practitioners. It implies that proper management strategies must be developed based on type and effectiveness criteria of projects. Customer relations can be influenced if not managed by the project manager. Project managers must take reasonable steps to ensure that they have the support and commitment needed to deliver a successful project. Accordingly, project managers require skills in relationship management, trust building, and business politics. In addition, communication and coordination between

development team members need to be strengthened, independent of the Effectiveness criterion and the level of project inherent uncertainty.

7.5 Practical implications

The empirical findings of this study have implications for managerial actions in construction firms. These are now presented.

1. The empirical findings show that, it is important for firms to foster a learning culture that emphasizes intra project learning and inter project learning; given that each of these has a varying impact on other operational flexibility.For example, firms have to foster a shared vision and continuous improvement in order to improve their operational flexibility and project effectiveness. This is consistent with Project Management Institute's (PMI, 2004) recommendation that managers should be proactive in creating a shared vision and learning culture, improving the feelings of trust and cohesiveness among team members, in their attempts to raise productivity through greater teamwork, as learning will not happen without teamwork. Likewise, firms have to be open-minded, in terms of encouraging employees to generate new ideas and adapt freely to changes without being restrained by past practices and routines, in their project management and new product development endeavours. Nevertheless, it is necessary for them to recognize the constructive impact of their commitment to learning on business operations. It follows that firms must continually assess their commitment to learning.

2. The study found that employee' skills and behaviour is often an overlooked predictor that could have influenced operational flexibility and effective project management. It follows that construction firms may consider seriously, implementing various human resource management

practices, in their continuous efforts to monitor, develop and nurture their employees' skills and behaviour and thereby unleash the power of HRM making a revolutionary change in the way this industry treats its employees. Some suggested practices as highlighted by (PMI,2004) includes managers continually monitoring and developing the skills of their team members, by implementing appropriate human resource management practices, in order to improve their competencies to complete allocated activities for better project Effectiveness. Also, firms should recognize that individual practices should be collectively considered and implemented for better realization of behaviour change and skill improvement of their employees. For example, firms may provide on-the-job training to improve employees' skills, while conducting effectiveness appraisal to identify employees' training need and offering career opportunities and promotion, in their efforts to improve the firms' employees' skills and gain behavioural commitment.

3. Firms' supply chain capability is an important determinant of operational flexibility. Therefore, firms could place greater emphasis on building their supply chain capabilities, by: (i) providing prompt after-sales services to customers; (ii) organizing training for supply chain parties; (iii) organizing their informal gatherings and (iv) keeping constant contact with customer (e.g., end users and consultants) to keep track of their needs. An important implication is that, although the development of supply chain capabilities involves relationship building with external parties (for example, clients and contractors),this study found that firms have to consider suppliers through information sharing and more transparency along with customer intimacy initiatives.

4. Firms should learn from their counterparts who were forced out of the industry, mainly due to: (i) overlooking environmental influences and

risks within their business environment; and (iii) overstretching firms' resources and capabilities. They should be more prudent and vigilant against threats; in addition, they may place greater emphasis on their cost control endeavours, and consider it as a proactive response by establishing, monitoring and reviewing their cost control protocols regularly.

5. The findings show that product leadership initiative by new product development has a big influence on project effectiveness. It follows that firms need to recognize the risks involved in product or business development, and be 'disciplined aggressive' in their business ventures and learn how to stay adequately lean in managing their business in order to be flexible and responsive to changes in the environment.

   Rather than venturing into unfamiliar business areas, firms should focus on the fundamentals of their business and stick to the basics (Drucker, 1980). As such, when engaging in a cycle of building and developing their resources and capabilities within existing markets, firms should plan strategically and iteratively in line with the business environment taking into account opportunities and threats in potential markets. Upon identifying their target, they should familiarize themselves with and invest incrementally into the targeted market. To further mitigate risks, firms may consider forming partnerships with previous clients in their product development endeavours.

6. The study shows that firms' good relationship with clients and established reputation play important roles in shaping their firms' ability to obtain sufficient jobs to tide over an economic downturn. This is especially applicable in the private sector where the established relationships and firms' reputation could often present firms with quick

sales of projects. Also, it is found that some firms formed partnerships with other parties with substantial landed properties to undertake residential developments, in their endeavour to keep their resources occupied and sustain business operation during a downturn. All these further imply the importance for firms to proactively and continuously engage themselves in relationship and reputation management regardless of whether times are good or bad.

7. The findings indicate that operational flexibility management in this study comprises three types (i.e., modification, new product development and demand management) in which each has unique constituents. Therefore, firms should not only include them in decision making on the development and management of operational flexibility, but also differentiate them and set specific objectives for each type. They may use the checklists as instruments, in their strategic planning for the type of resources and capabilities desired towards building and strengthening their operational flexibility potential.

8. The study found that firms should consider the effects of micro and macro conditions on their operational flexibility development. Failure to consider them may undermine the firms' flexibility potential, which may, in turn, result in slow response and inability to react to marketplace changes.

7.6 Limitations

The study presented empirical evidence that contribute to knowledge about operational flexibility management in construction. However, the research findings need to be interpreted within the limitations of this study which is exploratory in nature; especially since some measurement items of

the respective constructs were borrowed from cross-discipline studies and then re-contextualized into construction context. The limitations of this study are now discussed.

The unit of analyses are construction firms in Kerala, India, who are members of CREDAI hence generalisability can be questioned but its practicality cannot be. The information is collected using questionnaires, which rely on the interpretation of the respondent and his/her view of the situation. During the preliminary stages enquiries were made on availability of project performance data which could substantiate the opinions of the respondents; but received a very cold response, as many of them mentioned lack of time to get into the task of retrieving informations and nonavailability of records except for few recent projects.

This is a cross sectional study taking all limitations of the inherent of the period of data collection. The questionnaire with constructs of operational flexibility along with capabilities like IT and HR practices and customer satisfaction are filled in by project managers only as they are the group who gets feedbacks and reports from other stakeholders and are in a constant interaction with those entities.

A limitation for this study might be the period this study was undertaken. The Indian market has seen a bit of everything from recessions, RBI rate changes, sluggish economic growth coupled with inflation and gradual recovery. These changes could have influenced results obtained.

The study used the key informant retrospective reporting approach (i.e., selfreporting) whereby all questions, relating to both independent and dependent variables, were assessed by one key personnel from each of the targeted group of firms. Measures were taken to minimize the possibility of

social desirability bias and common method variance problems: (i) questions relating to independent and dependent variables were structured and arranged in the way that interviewees were not aware of the proposed relationships and (ii) assurances of anonymity were provided in the cover letter and highlighted to the interviewees during the interview surveys. Besides these, the (Harman,1967) one factor test results and the respectable degree of reliability and validity obtained for respective constructs indicate that common method variance is not a significant problem in this study. Despite all these efforts, it is acknowledged that the results can be contaminated by common method variance, although not to a significant level. This limitation leads to the future research possibility. The sample size of this research was not as large. The completed data were obtained from 87 executives of large and medium-sized Indian firms.

7.7 Directions of future research

This study lays the groundwork for future research concerning operational flexibility management in construction. Future research could replicate the principle features of this study with a larger sample within different industries, regions or countries. Such comparative studies would be useful to test and refine the developed models, and to identify the differences in the constituents of operational flexibility and their differentiated contributions to firms' project effectiveness. This may offer a new insight for researchers and practitioners into the effects of project learning culture and other specific factors on operational flexibility.

Non members of CREDAI were not included in this study, this however does not mean that those firms are not flexible, but rather, they may exhibit a different configuration of the organizational attributes for achieving operational flexibility. It follows that future studies could examine how those firms attain operational flexibility and then conduct a

comparative study in exploring the differences and similarities of these two groups of firms in achieving operational flexibility. Likewise, future studies could conduct a comparative study involving public listed and non public listed firms, extending the scope of the developed models and identifying the difference and similarity on the predictors of achieving operational flexibility.

Given that this study focuses on the periods from 2010 - 2014, a direction for future research is to validate and extend the empirical findings by collecting and analyzing longitudinal data. It is strongly believed that the longitudinal studies may provide a better understanding of how the predictors and operational flexibility change over time and their resultants dynamically influence firms' project effectiveness. Indeed, the importance of longitudinal studies can be supported by the increasing level of environmental turbulence.

Although this study provides a useful insight into the functioning of firms' resource-based predictors in attaining operational flexibility, a direction for future research might be to explore the value creation and delivery process of operational flexibility such as how to build, leverage and upgrade a firm's operational flexibility potential with limited or minimum resources in order to realize the full potential advantages of operational flexibility. This emphasizes the dynamics of operational flexibility in response to the increasing level of environmental turbulence.

Considering the exploratory nature of this study, another possible direction for future research is a thorough exploration of how the predictors, operational flexibility and environmental conditions interact effectively among each other, and in turn determine a firm's project effectiveness. For example, future studies could explore whether and which predictors are indispensable to achieve operational flexibility in different environmental

settings, and in turn affect a firm's project effectiveness. Furthermore, studies may explore the weight ratio of different flexibility types corresponding to firms' Effectiveness. This may in turn lead to the development of a single operational flexibility index for construction firms.

This study developed the structural model based on the six key resources and capabilities identified from the literature and preliminary interviews. Future studies could explore the effect of other resources and capabilities (for example, management leadership, financial resources, firms' reputation and firms' size) on operational flexibility.

Further research can be accomplished taking the projects as a unit of analyses instead of the firm perspective used in this study, possibly by using semi-structured interviews; using a longitudinal study to determine how it develops over time, can give more insights. The study can be repeated for small and medium sized firms; testing this model using a survey investigation of project managers and customers at the same time to prevent bias.Testing if there is a relationship between the different operationa flexibility types can be another direction of future studies. Besides this it would be interesting to test the importance of service activities in customer care of construction companies, testing the model incorporating service flexibility types or test this model in service related firms.

Summary

The major findings section describes retained predictor constructs, sub constructs and their significant relationships in moderated and mediated model. Discussion part throws light on why the need for operational flexibility arises as a result of changes in the business environment within the construction industry and how this study tries to answer this need through operational flexibility types, which are critical for achieving

customer satisfaction and learning exploitation. The theoretical implication part explains how this study contributes to knowledge in construction project management by developing and successfully testing the theoretical framework of operational flexibility that emphasizes the collective efforts of firms' resources, capabilities and strategies towards achieving operational flexibility, in a business environment fuelled by macro and micro forces. The study empirically demonstrates the influence of organizational resources, capabilities and strategies towards achieving different operational flexibility types and thereby effectiveness of projects. The limitations of this study can be attributed to geographical area under consideration. The information is collected using questionnaires, which rely on the interpretation of the respondent and his/her view of the situation can also bring weakness to this study. The practical implications of this study are many, providing reasons why there must be conscious efforts and commitment on the part of management towards learning, information sharing and more transparency with customers and suppliers alike. Monitoring and reviewing of cost control measures and efforts towards relationship and reputation management are also to be given consideration, regardless of whether times are good or bad. This study thus lays the groundwork for future research concerning operational flexibility management in construction industry.

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Chapter - 8

SUMMARY AND CONCLUSION

Summary

Project Management in developing countries like India is in fact challenging and tough. It can be summarized that poor infrastructure, low growth level of technology, low ability of implementing institutions, scarcity of resource, unreliable communication, poor documentation, high turnover of key personnels, political instability, low accountability and transparency and delayed decision-making are typical conditions in developing countries. Projects in developing countries are highly influenced by their external environment which is unstable and characterized by rapid change of markets, shortage of funding sources, frequent change of government policies and the business environment. Flexibility in general and operational flexibility in particular, is more about a potential to change. This leads us to a natural question: how can we obtain flexibility and what are the determinants of operational flexibility in construction project management.

The purpose of this study is to findout ways to utilize flexibility in order to manage uncertain project environment and ultimately achieve effective project management. In what configuration these operational flexibility determinants are demanded by construction project environment in order to achieve project success.

The project success is a multi dimensional concept, which is context dependent. At a basic level, project success is seen as achieving deliverables on time, budget and quality; satisfying stakeholders, meet requirements,

quality expectations /requirements, within cost and deadline, along with professional satisfaction and learning. Success has got efficiency and effectiveness dimensions. Flexibility is a construct that adds to effectiveness. Effectiveness is linked to the longer-term effects of the project or to do the right things. Effectiveness is an external measure and is related to how the results of a project contribute to the value added for owners and users. Thus, there is a need for comprehensive frameworks of the theoretical and practical aspects of flexibility that will help decision makers to assess actual flexibility and assist management to create it where ever necessary in response to environmental change.

This research was conducted in three phases, namely: (i) exploratory phase (ii) questionnaire development phase; and (iii) data collection and analysis phase. The study needs firm level analysis and therefore real estate developers who are members of CREDAI, Kerala Chapter were considered.

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The reliability (Item-level) showed that the absolute correlation between the construct and its measuring manifest items (i.e. Factor loading) was above than the minimum threshold criterion 0.4. The construct level reliability was examined by using Cronbach's α and by composite reliability. The Cronbach's α was higher than the required value of 0.6 Cronbach (1951) and composite reliability was higher than the recommended 0.7 values (Nunnally and Bernstein, 1994). For assessing the validity of the PLS path model, both convergent validity and discriminant validity are measured. AVE extracted for the each construct was higher than the required value 0.5 (50%), Fornell & Larcker (1981) except for EBS and HRP because of which they were not retained in further analysis and rest of constructs have the capability to explain more than half of the variance to its measuring items, therefore, except for EBS and HRP none of

the inter-construct correlation value was above the square-root of the AVE and satisfied the criterion of the discriminant validity. The cross loading showed that, except for OF4 & OF5, rest of measuring item was higher than all of its cross-loadings in row and column. Results of testing for convergent and discriminant validity show OF4, OF5, EBS, HRP constructs failing in convergent and discriminant validity criteria and therefore removed from further analysis of the study.

In this study there are two formative measurement constructs: Effective project management and Operational flexibility potential that are evaluated for VIF. Assessment of the structural model was performed for the tests of hypotheses. PLS was used to estimate the path coefficients (β) between the paths of the exogenous and endogenous constructs within the combined data set. Based on the (β) and t values the model presents twenty nine significant paths in the process supports some hypothesis. Mediation analysis was conducted, followed by moderated mediation. In this study q^2, H^2, F^2 were computed using 'blindfolding' procedure. The predictive relevance for the significant path towards LE and CS also reflected the medium predictive relevance impact. Results show that all the blocks presented an acceptable CV-redundancy index and CV-communality index. The GoF for the proposed model was 0.6973 (69%) and can be accepted at a substantial level (Chin, 1998).

The theoretical implication of this study is that it contributes to knowledge in construction project management by developing and successfully testing the theoretical framework of operational flexibility that emphasizes the collective efforts of firms' resources, capabilities and strategies towards achieving operational flexibility, in a business environment fuelled by macro and micro forces. The study empirically demonstrates the influence of organizational resources, capabilities and

strategies towards achieving different operational flexibility types and thereby effectiveness of projects. The limitations of this study can be attributed to geographical area under consideration. The practical implications of this study are many, providing reasons why there must be conscious efforts and commitment on the part of management towards learning, information sharing and more transparency with customers and suppliers alike. Monitoring and reviewing of cost control measures and efforts towards relationship and reputation management are also to be given consideration, regardless of whether times are good or bad. This study thus lays the groundwork for future research concerning operational flexibility management in construction.

Conclusion

This study provides a framework on the functioning of operational flexibility, offering guidance to researchers and practitioners for discovering means to gain operational flexibility in construction firms. The findings provide an empirical understanding on kinds of resources and capabilities a construction firm must accumulate to respond flexibly to the changing project environment offering practitioners insights into practices that build firms operational flexibility potential.

Firms are dealing with complex, continuous changing and uncertain environments due trends of globalization, technical changes and innovations and changes in the customers' needs and expectations. To cope with the increasingly uncertain and quickly changing environment firms strive for flexibility. To achieve the level of flexibility that adds value to the customers, firms should look to flexibility from a day to day operational perspective. Each dimension of operational flexibility is derived from competences and capabilities. In this thesis only the influence on customer satisfaction and learning exploitation of flexibility dimensions which directly add value in the customers eyes are studied to answer the following

research questions: "What is the impact of operational flexibility on customer satisfaction?." What are the predictors of operational flexibility in construction industry? .These questions can only be answered after answering the questions like "Why do firms need operational flexibility?" and "how can firms achieve operational flexibility?" in the context of the construction industry.

The need for construction firms to be flexible, via the effective utilization of organizational resources and capabilities for improved responsiveness, is important because of the increasing rate of changes in the business environment within which they operate. Achieving operational flexibility is also important because it has a significant correlation with a project effectiveness and hence a firm's turnover. It is essential for academics and practitioners to recognize that the attainment of operational flexibility involves different types namely: (i) Modification (ii) new product development and (iii) demand management requires different configurations of predictors (i.e., resources, capabilities and strategies). Construction firms should consider these relationships and implement appropriate management practices for developing and configuring the right kind of resources, capabilities and strategies towards achieving different operational flexibility types.

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APPENDIX

SURVEY ON OPERATIONAL FLEXIBILITY & EFFECTIVE PROJECT MANAGEMENT

PART 1: GENERAL INFORMATION ABOUT YOUR FIRM

1. Type of your firm

Public listed	
Private Limited firm : Sole Proprietorship	
Partnership	
Family Business	

2. Name of your Firm.....

3. Age of your firm in years.....

4. Number of employees in the firm.....

5. Number of Housing and other projects completed by your firm so far.....

6.	**Your firms business focuses**	**Please tick**
1	Private Residential Construction	
2	Public Residential Construction	
3	Office and Shopping Construction	
4	Hotel Construction	
5	Factory Construction	
6	Educational institution Construction	
7	Renovation and alteration	
8	Property development	
9	Others.....Please Specify	

Part 2: learning Culture

1. During planning we review past plans	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
2. During planning we review past lessons learned	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
3. During planning we involve the people who have completed similar work in the past	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
4. We share what we learn with each other	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
5. We produce a detailed project plan discussing cost, schedule, and performance for each project.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
6. When a ``mistake' ' or failure to meet expectations occurs, we admit the mistake.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
7. During project execution we collect the data about the actual set of steps used to complete the project	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
8. During project execution we collect the data about the set of problems encountered in completing the project	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
9. We believe as project is an opportunity for learning	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
10. We are willing to share learning about project successes	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
11. We are willing to share learning about project failures	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

Part 3: Supply chain capabilities

Strategic supplier partnership (SSP)

1. We consider quality as our number one criterion in selecting suppliers.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
2. We regularly solve problems jointly with our suppliers.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
3. We have continuous improvement programs that include our key suppliers.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
4. We include our key suppliers in our planning and goal-setting activities.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
5. We actively involve our key suppliers in new product development processes.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

Customer relationship (CR)

6. We frequently interact with customers to set reliability, responsiveness, and other standards for us.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
7 We frequently measure and evaluate customer satisfaction.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
8. We frequently determine future customer expectations.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
9. We facilitate customers' ability to seek assistance from us..	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

Level of information sharing (IS)

10. We inform suppliers' & contractors in advance of changing needs.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
11. Our suppliers, contractors keep us fully in-formed about issues that affect our business.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
12. We and our suppliers, contractors exchange information that helps establishment of business planning.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

Level of information quality (IQ)

13. Information exchange between our suppliers, contractors and us is timely.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
14. Information exchange between our suppliers, contractors and us is adequate.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
15. Information exchange between our suppliers, contractors and us is reliable.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

Postponement (POS)

16. We try to incorporate a modular concept in our projects	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
17. We delay final constru ction activities until customer orders have actually been received	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

Part 4-Technological Capabilities

IT capabilities

1 .Our firm has the ability to communicate and share real time information among supply chain parties regardless of geographic dispersion	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
2. Our firm has the ability to communicate and share real time information among all decision makers and employees regardless of geographic dispersion	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
3. Our firm has the ability to retrieve information ie existing/past projects, from company data base in a timely manner regardless of geographic dispersion	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

Construction Process capabilities

4.Our firm has the ability to apply different process technology software (eg: estimating and purchasing software) to improve firms operational process	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
5.Our firm has the ability to lead in process technology innovation	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

Part 5-HRM practices

Competence development

How often does your firm provide the following for its employee's annually

1.Organizing training on latest issues(e.g. change in regulations and safety requirements) that have direct impact on firms operational processes	Never						Always
	1	2	3	4	5	6	7
2. Organizing training to upgrade knowledge and skills in using software (e.g. MS project, AutoCAD and accounting software).	Never						Always
	1	2	3	4	5	6	7
3. Organizing training to upgrade knowledge and skills on application of different construction methods and technologies	Never						Always
	1	2	3	4	5	6	7
4.Offering on the job training	Never						Always
	1	2	3	4	5	6	7

5.Offering job enrichment programme	Never						Always
	1	2	3	4	5	6	7
6. Subsidizing tuition fees of self upgrading courses and seminars attended by employees	Never						Always
	1	2	3	4	5	6	7

Stress Management

7.Organizing stress coping and management courses	Never						Always
	1	2	3	4	5	6	7
8. Implementing personal counselling program	Never						Always
	1	2	3	4	5	6	7

Performance management

9. Organizing informal gatherings, trips to recognize employees' achievements and to foster team building.	Never						Always
	1	2	3	4	5	6	7
10. Providing flexible compensation plans (e.g.: performance bonus)	Never						Always
	1	2	3	4	5	6	7
11.Conducting staff performance appraisal exercise as a formal means of discussing, identifying and recording their training need	Never						Always
	1	2	3	4	5	6	7
12. Offering career develop ment and promotion oppor tunities	Never						Always
	1	2	3	4	5	6	7

Relationship management

13.Encouraging regular face to face communication among employees.	Never						Always
	1	2	3	4	5	6	7
14.Implementing survey feedback programme to track the well being of employees.	Never						Always
	1	2	3	4	5	6	7
15. Providing subcontractors/suppliers the flexibility to plan their delivery schedule.	Never						Always
	1	2	3	4	5	6	7
16.Offering incentive scheme to suppliers and subcon tractors (eg: early payment).	Never						Always
	1	2	3	4	5	6	7
17.Organizing informal gatherings among other parties in the supply chain.	Never						Always
	1	2	3	4	5	6	7

Part 6-Employee Behaviour and skills

1 .Our employees have the ability to adopt an open mindset to all alternatives	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
2. Our employees have the ability to work in a team environment	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
3. Our employees have the ability to learn and adapt to different business conditions	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
4. Our employees have the ability to perform a diverse range of tasks and responsibilities.	Strongly Disagree						Strongly Agree

	1	2	3	4	5	6	7
5. Our employees have the ability to gain customer satisfaction.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
6. Our employees have the ability to perform highly sophisticated tasks.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
7. Our employees have the ability to work independently.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

Part 7-Operational Flexibility

1.We can effectively respond to multiple customer requirements in terms of repair, construction and maintenance	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
2.We can effectively negotiate with customers suppliers and contractors in terms of prices, delivery time through long term relationships	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
3.We involve customers to improve our services effectively.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
4.We quickly respond to feedback from consumers & marketing dept. effectively.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

5. We can successfully respond to multiple Project delivery requirements.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
6. We can quickly modify internal design in response to customer requests before construction as long as the elevations are minimally affected.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
7. We even do minimal modification according to customer needs even during construction.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
8.We can better meet customer needs by modifying existing projects	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
9.We can better meet customer needs modifying existing projects.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
10. We can quickly introduce a new product into the market.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
11.We take the lead in new product introduction	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
12..We can launch new projects inexpensively	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

13. We can operate efficiently irrespective of number of projects handled simultaneously.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
14.We can operate profitably at various levels of output	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
15.We can control the number of our projects reaching finish in advance	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
16. We can vary aggregate output from one period to the next to aid resource levelling.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
17. We offer a variety of projects in our portfolio.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
18. We can changeover quickly after finishing one project to next.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
19. We have systems to easily and accurately label & track individual units from planning till hand over and after.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
20. We keep accurate records of quantities & types of materials used in each units.	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

Part 8-Micro environmental Conditions

How often do you have encountered the following situations in your project operations and performance in the past?

1.Failure to meet the delivery date promises leading to customer complaints or dissatisfaction	Never				Always
	1	2	3	4	5
2.Delay in commencement of projects	Never				Always
	1	2	3	4	5
3.Lack of adequate cash flow affecting the pace of work	Never				Always
	1	2	3	4	5
4.Projects exceeded budgets beyond satisfactory limits due to cost escalations	Never				Always
	1	2	3	4	5
5.Scope or Design changes leading to reworks	Never				Always
	1	2	3	4	5
6.Reworks due to poor workmanship	Never				Always
	1	2	3	4	5
7.Poor waste management practices	Never				Always
	1	2	3	4	5
8.Unsafe work practices	Never				Always
	1	2	3	4	5
9.Reportable accidents	Never				Always
	1	2	3	4	5
10.Litigation with customers	Never				Always
	1	2	3	4	5

11.Litigation with Neighbours	Never				Always
	1	2	3	4	5
12.Litigations with Govt.	Never				Always
	1	2	3	4	5
13.Lack of management support	Never				Always
	1	2	3	4	5
14.Lack of commitment of project participants	Never				Always
	1	2	3	4	5

Part 9-Macro environmental Conditions

To what extent have the following conditions affected your project operations and performance in the past?

1. Fluctuations in demand for constructed facilities.	Never						Always
	1	2	3	4	5	6	7
2.Actions of competitors	Never						Always
	1	2	3	4	5	6	7
3. Price competition in the construction market.	Never						Always
	1	2	3	4	5	6	7
4.Non price competition in the construction market.	Never						Always
	1	2	3	4	5	6	7
5.Supply of raw materials	Never						Always
	1	2	3	4	5	6	7
6.Supply of labour	Never						Always
	1	2	3	4	5	6	7

7.Rising costs Materials	Never						Always
	1	2	3	4	5	6	7
8.Rising cost of Labour	Never						Always
	1	2	3	4	5	6	7
9.Rising cost of Finance	Never						Always
	1	2	3	4	5	6	7

Part 10-Effective Project Management

How much do you feel your projects have had the characteristics given below?

1..Develop new knowledge and expertise	Never				Always
	1	2	3	4	5
2.Increase level of professional development	Never				Always
	1	2	3	4	5
3.Generate positive reputation	Never				Always
	1	2	3	4	5
4.New market penetration	Never				Always
	1	2	3	4	5
5.Develop new business relationship	Never				Always
	1	2	3	4	5
6.Value for money (Value Engineering)	Never				Always
	1	2	3	4	5
7.Exploitation of technology	Never				Always
	1	2	3	4	5

8.Usable life expectancy	Never				Always
	1	2	3	4	5
9.Project functionality	Never				Always
	1	2	3	4	5
10.Aesthetic value	Never				Always
	1	2	3	4	5
11..Meets client(our) satisfaction	Never				Always
	1	2	3	4	5
12.Meets end-user satisfaction	Never				Always
	1	2	3	4	5
13.Pleasant environment	Never				Always
	1	2	3	4	5
14.Easy to maintain	Never				Always
	1	2	3	4	5
15. Meets stakeholders' needs & expectations.	Never				Always
	1	2	3	4	5
16.Meets corporate missions	Never				Always
	1	2	3	4	5
17.High profit margin	Never				Always
	1	2	3	4	5
18.Meeting pre-stated objectives of projects	Never				Always
	1	2	3	4	5

19.Supported by warranty programme	Never						Always
	1	2	3	4	5		
20.Excellent testing and commissioning programmes	Never						Always
	1	2	3	4	5		
21.Close-out process run smoothly & efficiently	Never						Always
	1	2	3	4	5		
22.Fitness for purpose	Never						Always
	1	2	3	4	5	6	7
23.Fast rectification of defects	Never						Always
	1	2	3	4	5	6	7
24.Early occupation	Never						Always
	1	2	3	4	5	6	7
25.Minimum cost of ownership	Never						Always
	1	2	3	4	5	6	7
26.High Customer retention rate	Never						Always
	1	2	3	4	5	6	7

Part 11-Demographic characteristics

1. Your designation and job title
2. Number of years you have participated in construction industry
3. Number of years in the present firm
4. Number of projects handled by you in the present firm

Thank You Very Much for the participation!

APPENDIX-2

WAVES-TVM-2013-01

PMI TRIVANDRUM, KERALA CHAPTER

BEST TECHNICAL PAPER

Presented to

GEORGE JOSEPH

for his paper

UNCERTAINTY MANAGEMENT USING FLEXIBILITY IN CONSTRUCTION PROJECTS

Presented at

WAVES 2013-A MONSOON PROJECT MANAGEMENT CONFERENCE

Conducted on 08 JUN 2013 at

UDAYA SAMUDRA, KOVALAM, TRIVANDRUM

08 JUN 2013

PRESIDENT,
PMI TRIVANDRUM, KERALA CHAPTER

VICE PRESIDENT,
PMI TRIVANDRUM, KERALA CHAPTER

DATE

Indian Institute of Management Kozhikode

HR SUMMIT 2014

Let's Learn

March 14 - 16, 2014

Certificate of Participation

This is to certify that **Prof. / Dr. / Mr. /Ms. /Mrs. George Joseph** has presented a paper titled **Assessing Learning practices, maturity and skill gap in Indian Construction Industry,** co-authored with **Dr. Zakkariya K.A,** in the IIMK HR Summit 2014, held during March 14-16, 2014 at IIMK Kochi Campus.

Convener
Prof. Debashis Chatterjee
Director, IIMK

Co-Convener
Prof. Manoranjan Dhal

Co-Convener
Prof. Surya Prakash Pati

RAJAGIRI CENTRE FOR BUSINESS STUDIES
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CERTIFICATE

Mr. George Joseph

has presented the paper titled

ROLE OF HR FLEXIBILITY IN PROJECT MANAGEMENT EFFECTIVENESS

at the International Conference on
Innovative Practices for Business Excellence (IPBE 2013)
organised by Rajagiri Centre for Business Studies,
Kakkanad,Kochi,Kerala on 14th January 2013

Joseph I Injodey Ph.D.
Hon.Dean

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Dr. Jay Kandampully (IRSSM Chair)

Dr. P.V. Mathew IRSSM (Co-Chair)

Uncertainty Management using Flexibility in construction projects-Towards a conceptual model for effective Project management

Mr. George Joseph, Research Scholar, School of Management Studies, CUSAT
Dr Zakkariya K.A, Asst. Professor, School of Management Studies, CUSAT
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Abstract

Purpose- This conceptual paper tries to present flexibility as a tool for uncertainty management contributing to effective project management.

Design/ methodology/ approach-A literature review on efficiency, effectiveness, uncertainty management and flexibility is done to arrive at a conceptual model.

Findings –The concept of flexibility which originated in manufacturing industry in various forms is yet to be introduced in project management body of knowledge as way to manage uncertainty and exploit opportunities to bring effectiveness in project management.

Research limitations/implications- This paper is conceptual in nature trying to highlight the significance of flexibility in managing uncertainty in construction projects, but lack empirical research to prove the same.

Originality/value –The value of this study comes from the fact that project based industries are yet to embrace newer concepts in other industries to manage uncertainty and therefore requests the experts behind PMBOK to study and add flexibility based concepts in project management after testing the same empirically.

Keywords - Uncertainty management, effectiveness, project management, risk, flexibility.

ROLE OF HR FLEXIBILITY IN PROJECT MANAGEMENT EFFECTIVENESS

George Joseph & Zakkariya K.A.

Abstract

Purpose- This empirical study sought to investigate whether flexibility of HR can have a positive influence on Project management Effectiveness. Specifically, it aimed to focus on the influences of Skill flexibility, behavioural flexibility and HR practices flexibility on various measures of project management effectiveness.

Design/methodology/approach- Questionnaire was developed based on the scale developed previously. Then through a survey we successfully obtain data from 37 Project managers and HR managers.

Findings- Components of HR flexibility holds significant and positive relationships with components of Project management effectiveness Research limitations/implications- First, this study is confined only to Construction industry hence generalizing the results across domains is questionable. Second, sub constructs of HR flexibility comprises of three main components, which the author feels needs further literature works to add to the exhaustiveness of the construct.

Originality/value -The value of this study comes from the fact that although various studies on flexibility and its influence on firm performance had been made in the past, a study on HR flexibility and its influence on project management effectiveness seems to be new and holds relevance as the findings of this study points out.

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Assessing Learning Practices, Maturity and Skill Gap in Indian Construction Industry

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Abstract

This is a three pronged research which was embarked upon to assess the state of learning in Indian construction industry. In order to achieve the objectives, data were collected using adapted instruments and also by interviews with construction project manager located mainly in Kerala, India. The Population consisted of *project managers of real estate developers who are members of CREDAI (Confederation of Real Estate Developers 'Associations oflndia. Forty seven completed questionnaires were analysed to understand the learning practices. The collected data for the first objective was subjected to descriptive statistical analyses. The findings indicate that "Information collection" was ranked highest while "Analysis" was ranked least. Through a series of interviews made and by using a developed maturity model that focuses on learning organization characteristics* of.- *1. Leadership, 2. Processes, 3. Infrastructure, 4. Communication, S. Education, 6. Culture at organization, community, and individual levels the level of learning maturity was found out. The results of the second objective suggest that, out of the forty interviews made at various organizations, twelve organizations were found to be at level zero, twenty one organizations* fits *to level 1 of the maturity model and only seven organization fit into level two. The third objective of this research was to identify the skill gap and barriers to learning in construction industry. This paper provides definitive and decisive insights in the course of achieving its objective to gain a better understanding of learning in construction industry.*

Keywords: Organizational learning, Learning processes, Learning maturity model, Skill gap, Construction industry.ISBN 978-93-84052-22-5