1.0 Introduction

This thesis is written to establish the thoughts and the premises to bring a new perspective of looking at strategic management of business and organizations. Organizations manage business strategically, irrespective of size and the revenue of the business. Identifying competencies and inability will help organizations to evolve their strategies for better growth and attain a gain in competitive advantage. Ability to look for insights from experiences from business activities is identified as Intelligence. Organizations learn, develop insights, wisely decide and execute meticulously the plans. If organizations knew their ‘selves’ better through introspection, they probably performed better.

This Research thesis revolves around the two prongs of the objective. Each chapter is presented with two parts. Part I deals with the need for the identification of the factors that might drive Intelligence of the organizations. Part II addresses the other need for establishing the linkage between Intelligence and Performance. This statement in short reveals the Objective of this work.

Section 1.1 of this chapter discusses the premises and the reasons for this research. Section 1.2 discusses the research gaps and the potential in this research topic. Section 1.3 discusses the research objectives. Section 1.4 discusses structure of thesis and section 1.5 concludes this introduction chapter.
1.1 Premises and Reasons for this Research Study

Most organizations orient their Strategic Management towards business results and are result oriented. There are organizations such as ‘Kanchi Mutt’ from Kanchivaram, Tamilnadu, India, founded by Adi Shankaracharya around a hundred decades back, exist so long successfully in India. These are socially oriented and non-profitable organizations thriving on set of values. Many organizations are a combination of both profitability and social responsibility. All these growing organizations are always at the juncture of introspecting internally to face the challenges and uncertainties of the future. Taking stock, developing insight from the past and planning for future is already being followed by good and great business organizations. However, the rapid changes in the business environments and technology of the future would demand organizations to take a stock of their innate intelligence that drives the competencies and capabilities for better business performance. Identifying the key ingredients behind intelligence can possibly support organizations to fine tune their business performances and competitive strategies immensely.

As humankind ventures deeper into the intelligence era, a totally re-defined mindset is essential to ensure its continuity. With the emerging new environment, organizations must behave as intelligent beings, in the same manner as biological entities are competing for survival in an ecological system. They must learn, self-organize, adapt, compete and evolve. Thus, organizational systems can no longer be like machine. Consequently, the structures and characteristics of the industrial era will have to be dismantled. This shift in paradigm requires all organizations to re-design their structure and operations around intelligence and become human organizations.
The basic reason for research begins from looking at the humanistic quality and capabilities of organizations. If organizations have abilities and behavior as those human beings, they also must be having intelligence to carry out actions and sustain, survive, adapt and grow like human beings. These human systems adopt an important initiative to establish an intelligent structure, and to nurture its collective intelligence inside themselves. A significant component of the mind of an organization is an intelligence enhancer comprising three entities, namely, intelligence, knowledge structure and theory (Thow Yick Liang, 2002).

This discussion by Thow Yick, A Physicist, and Technology Management Professor at Singapore Management University clearly defines a set of axioms in his research article on ‘Intelligent Human Organizations’ that clearly defines the Presence of Intelligence similar to that of Human Intelligence such as the ability to adopt with the changing environments, grow, perform and compete. There is an axiom which states that, there exists an intangible entity known as intelligence in all intelligent systems that provides the fundamental driving force for all their functions and activities.

There are four levels of Organizational Intelligence explained by Professor Thow: The First level of Intelligence: Slavery An organizational system operating at this level is only capable of economic production. It has literally no intelligence capability and has no environment scanning and responding component. It is a non-thinking, purely mechanistic system. It behaves like a slave whose intelligence is suppressed. As far as the intelligence domain is concerned, the system is dumb. A mechanical machine exists in this state. The next level is, Instinctive: Besides economic production, a system in this case is capable of sensing simple changes in the environment, such as changes in demand, and responds by varying the quantity of its output. The behavior of such a system is instinctive. Its level of intelligence is low. Many business organizations, at the moment, exist in this state, similar to plants in an ecological system. There is not much ‘mobility’ in this state.

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The third level is, Survival Seeking: A system can be classified in this category if an attempt has been made to improve its environment scanning and responding component. Such a system is also aware of the significance of having a well-established intelligence web. It is increasingly reactive to changes, and has assimilated learning and adaptive capabilities. It is a mobile intelligent being.

There is a next level of Intelligence: Highly Intelligent: A system in this category has a sophisticated intelligent network. It is highly reactive, as well as proactive to the environment. It is intelligent enough to influence the environment to enhance its existence. Whenever possible and necessary, this option is exercised. Such a system can diversify, ‘migrate’ and have ‘offspring’. Thus, existing in this state, the system possesses its own mind and collective intelligence, and behaves as a highly intelligent biological being.”

The next Axiom says “There exist one or more internalized knowledge structures in all intelligent systems that are the reference sources for intelligent activities and actions” which forms the basis for this entire research. The most basic concepts of the intelligent organization theory (Thow Yick Liang, 2002)² are, (i) Human organizations are intelligent beings; (ii) They are corporate beings with a mind and Collective intelligence. (iii) Their level of intelligence can be elevated through proper design. (iv) The more intelligent the organization, the more adaptive and competitive it is. (v) Such a competitive advantage is an intelligence advantage. Therefore, the conclusion by Professor Thow is, “there exists a critical relationship between intelligence and human organizations, similar to a relationship between intelligence and biological organisms”.

This conclusion is the basis and platform for the research objectives to explore the same and measure it if possible in the business organizations in India.

There are also interesting basic requirements for all these propositions in this research article by Professor Thow. They are; (i) The presence of an intense intelligence source is vital; otherwise, the activities of organizational systems will have no proper co-ordination and direction. (ii) The existence of a sophisticated

environment scanning and responding component is essential because such a component not only enables organizations to interact with their environment, but also enables organizations to nurture their collective intelligence (iii) The spread and integration of the intelligence web with the economic production functions connecting the components specified in (i) and (ii), are necessities as the absence of the web indicates that the organization is paralyzed (iv) The flexible physical structure must be supported by an intelligent deep process structure. An intelligent and coherent mind is the fundamental intelligent stratum of all intelligent organizations.

These aspects are the basis of studying the presence of intelligence in the organizations and hence the humanistic abilities are studied through the questionnaire designed. In addition, it is important to realize that the collective intelligence in human organizations can be elevated with proper design. The key concepts related to organizing around intelligence are as follows (Thow Yick Liang, 2002): (i) The intelligence strategy that focuses on an intelligence-based design helps to elevate the collective intelligence level of human organizations so that they can compete better as intelligent beings in the new economy. (ii) This new designing approach allows organizations to settle into a competitive state that is closer to an inherent intelligent structure of nature more spontaneously. (iii) Human organizations with an intelligent structure possess a mind, deep intangible structure and surface structure. Such intelligent systems are more coherent with information and knowledge-related functions.

The Humanistic Intelligence that is present in the organizations in the form of collective intelligence is measured in the form of capabilities Tata Groups which is known as Tata Business Excellence Model. There are larger business organizations in India applying Malcolm Baldrige Model for Total Quality Management in the Business Processes. There are organizations applying these kinds of models prepared in house for improvising business performance largely. Most of the large business houses use these kinds of business capability models designed based on the humanistic quality of organizations.
In Strategic Management, the Resource Based View (RBV) says that, a firm can attain a sustainable competitive advantage can be obtained by improvising the resource management capabilities. The Knowledge Based View (KBV) says that a firm can obtain the advantage over competitors by deploying knowledge that lies within itself. Capabilities of the organization evolve from two components. The explicit aspects of business based on resources and other physical components. The tacit aspect such as knowledge and information play equally a major role in determining the performance. There is a driving force behind these two aspects which is the intelligence of organizations. The driving force behind business entities might have different components based on perspectives. Various models from the literature are studied and perspectives are collected and compared. Every model of the past had a view to include the business realities which are based on business results, and softer aspects such as learning abilities to improve on the capabilities. These driving forces mentioned here are similar to organizational Intelligence theory proposed by Professor Thow.

1.2 Identifying Research Potential

Professor Thow’s theory of Organizational Intelligence forms the platform for this research study. If organizations behave like human beings in cognitive learning, responsiveness to environments and competitions, grow with abilities to plan, execute holding intellectual, rational and logical capabilities to think, the obvious question arises from that is, can this be proven to be present and if so, can we measure such an intelligence? The second question that arises from measuring Organizational Intelligence is to know the benefit of measuring such Intelligence. Measuring Intelligence can prove the presence of Intelligence and paves way to enhance their intelligence to improvise capabilities. Improvising capabilities lead to better performances and therefore, the obvious benefit of doing this research is to help business organizations to know their innate abilities better in addition to defining avenues for further research in Management Academics.
Thus the research objectives are identified. We understand from the capability models used by India’s large Corporate Houses that business leaders look for business performance improvement by improvising the capabilities of the organizations. So it is imperative to explore the intelligence of organizations particularly the small and medium business enterprises so that they can be suggested a scale for measuring the intelligence of the organization and fine tune those fines specific capabilities that add to intelligence for better business performance. Twenty four different large corporate houses responded very similarly in the pilot study. So we decided to take responses from small and medium business enterprises whose responses were not similar. This research study would provide a path to identify the unique aspects that are the stronger components of Organizational Intelligence that would help improvise performance.

1.3   Research Objectives

To study the key driver “intelligence” behind organizational growth and business growth in Indian business organizations is defined as the research task. The immediate need was to understand what research arena talks about this consciousness called intelligence of organizations. Literature survey enabled me to understand of the background and context of this ‘intelligence’ with respect to Western and Indian researchers. Most of the researchers looked at organizational intelligence as a driver for innovation, creativity, leadership, culture and many more. A few discussed about the innate ability of cognitive learning as ‘intelligence’ or organizations. Similar parameters are found to drive organizational learning. There are researches on intelligent organizations and learning organizations. So there definitely arose a need to find the boundaries, commonalities between intelligence and learning. There were common terms that drove intelligence as well learning by different researchers of different origin. There are various conceptual models proposed, different types of humanistic capabilities of the organizations representing intelligence of organizations. So we decided to identify the demarcation between organizational intelligence and organizational intelligence. This demands study of literature on
Organizational Intelligence and Organizational Learning and to differentiate them clearly.

Future organizations are in a position today re-look at their value systems, introspect thoroughly on the strategic management of business and leaders are in a crossroad to redefine the way they had been building their organizations. Futurologists have indicated the changes in technological breakthroughs, future market dynamics, cultural changes which would be very rapid and Indian organizations have to change and equip themselves to address such sudden changes. Future Organizations in the small and medium sector need to look at their capabilities and intelligence for business performance. This demands us to explore the presence of intelligence in the organizations, design an instrument to measure the intelligence so that intelligence can be developed by these organizations to perform better in future.

This research would provide an avenue to look at exploring the collective intelligence that drives business organizations to management academia. The research is based on the theory of intelligent organizations (Thow, 2002) which finds similarities between organizations and Bio Organisms. The Organizations behave like Human systems and in both cases intelligence and capabilities drive them to be what they are. Thus, it would make the research comprehensive, if the literature on organizational intelligence and learning are studied and the demarcations are defined. It would make this research work interesting if the capabilities that drive organizational Intelligence are identified and explored. If we can develop an instrument to measure organizational intelligence, that can help us study the relationship between organizational intelligence and business performance, thereby enabling organizations to improvise upon their performance, processes and systems and grow.

Thus the defined objectives are;

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(i) To study and compare the management literature on Organizational Intelligence (OI) and identify the variables that are used for the measurement of Organizational Intelligence.

(ii) The first part of the Objective is to study the presence of Organizational Intelligence (OI) and to explore the factors that construct intelligence of organizations so that an instrument to measure intelligence can be developed.

(iii) The second part is to study whether there is a relationship between Organizational Intelligence (OI) and Organizational Performance (OP) so that the intelligence scale can be utilized by organizations to improve performance and therefore enhance their competitive advantages in future.

Through the first objective, the variables for measuring OI would be chosen. Then the instrument for measuring OI can be developed and then the relationship between OI and OP can be explored.

1.4 Structure of Thesis

This thesis has seven chapters.

Chapter 1 is the introduction. This chapter discusses the basic premises of this research. It discusses the research gaps present and the reason why the research is undertaken. It also describes how the research objectives are set and roadmap is drawn for doing this research. This chapter emphasizes the need for the study and the sorting of literature that focuses on the constructs of organizational intelligence from the harder and softer aspects of business. This defines the objective with two different parts. One is to define the scale for measuring organizational intelligence and the other is to establish linkage between intelligence and performance to improve competitive advantage.

Chapter 2 discusses the entire literature studied and the key findings from them. The variables that construct organizational learning, organizational intelligence and organizational performances are compared. The premises for the research objectives and research study, gap and the need for doing this research work are
established. This chapter mainly focuses on the choice of variables from literature for the design of the instrument that can measure Organizational Intelligence. This chapter is also presented as two parts. Part I discusses the key aspects from OI literature. Part II discusses the attributes that affect OP. The section on key findings section compares the variables captured from literature and summarizes.

Chapter 3 discusses the research methods followed for doing this research study. The research problem identification, choice of research technique with respect to the objective, experimental design sample selection, data collection, and data analysis are discussed. The challenges faced and the techniques adapted are discussed. All these come under part I. Exploratory factor analysis to identify the key variables that impact organizational intelligence is discussed under part I of this chapter. Part II comprises of Multiple Regression Analysis to determine the causal relationship between OI and OP. Questionnaire design based on literature and the establishment of variables for measurement is discussed in part II as the variables chosen are connected with organizational performance. Thus the rationale behind the design of the questionnaire and variable selection is established.

Chapter 4 is an extension of the literature survey. It discusses various conceptual frameworks and definitions of OI given in literature. The findings and the inferences from these models are discussed at the end. These inferences can help in determining the variables chosen from the literature as given in the earlier chapter. The insights from this chapter can help us interpret the results of factor analysis where we determine the factors that influence OI.

Chapter 5 discusses the analytical strategy for the research processes and techniques chosen. This chapter is also divided in two parts. Part I discusses the concepts thumb rules for interpretation and the analytical framework for exploratory factor analysis. This part addresses the first part of the research objective and part II discusses the analytical framework behind regression analysis, hypotheses formulation and validity of the causal relationship model.
Chapter 6 discusses the analysis and the findings. This chapter is also divided into two parts. Part I discusses the results obtained from factor analysis and the formulation equations to measure OI. Part II discusses the key findings from the analysis and the impact of the variables that represent OI and influence OP – the causes of OP. The regression outputs are presented and hypothesis formulation and testing are done. This discussion is followed with the summary of key findings and development of OI instrument and the conceptual model of the linkage between OI-OP are presented at the end.

Chapter 7 lists the conclusions from this research work. It discusses the interpretations of results from the findings obtained from the data analysis. This chapter also presented in two parts. Part I discusses the interpretations from the findings of factor analysis. This results in the calculation of OI of organizations in the form of OIQ – organizational Intelligence quotient. Part II discusses the interpretations from multiple regression analysis. This leads to the OI-OP relationship model ready for application. The applications of the research work done, the issues in the model and how can they be overcome are also discussed. Recommendations are made to improvise the current work done now.

1.5 Conclusion

In this chapter we discussed the background and context of the research and the formation of research objectives. Structure of the Thesis and the organization of the main chapters of this thesis are explained. In the nest chapter we will present the literature survey done for doing this research work.
2.0 Introduction

This chapter has three major sections; Review of the literature on Organizational Intelligence (OI), Organizational Learning (OL) and Organizational Performance (OP). The literature review brings out the models that had been used to measure OI, OL and OP, various constructs that are common and uncommon between the three topics of research. This literature also will list down different types of definitions of OL, OI and OP. There are tables displayed that discuss different constructs of definitions and their implications. The similarities and differences between OL and OI are listed which indicate the absence of definite demarcation between these two variables of organizations. This also enables us to have the clarity in differentiating OL and OI as there are many common variables that describe OI and OL. Section 2.1 discusses the literature about OL, section 2.2 about OI and section 2.3 about OP respectively. Section 2.4 discusses the findings and inferences from literature. Section 2.5 concludes the chapter.

This chapter presented in two parts. First part discusses the Literature Study enabling the understanding of the first part of the research Objective of identifying different components of Organizational Intelligence. The second part
lists the literature that is required to explore the linkage between organizational intelligence and organizational performance.

Part I

2.1 Organizational Learning (OL)

This survey Research studies show that OL is constructed by many factors that are also the constructs of OI. It is appropriate to study what is OL. This will enable one to clarify the demarcation between OL and OI before exploring OI and OP and the relationship between them.

(Peter Senge, 1990)\(^4\) in his Book “The fifth Discipline” discusses about the learning organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together. He explains the five key disciplines of learning organizations are systems thinking, personal mastery, mental models, shared vision and team learning. In this book he sets a direction for defining what organizational learning through these models as attributes exhibited by learning organizations.

Learning organizations open up boundaries and stimulate the exchange of ideas amongst employees and business functions (Garvin, 1993)\(^5\). As the first emanate of OL as a separate subject of study in India, Dr. Madhukar Shukla of XLRI Business School states that the ability to generate and acquire new knowledge is becoming an essential prerequisite for success of organizations. He integrates both these approaches and focuses not only on how organizations learn, but also on how they can (and do) use knowledge and learning as strategic weapons to

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transform their operating paradigms through a framework called ‘competing through knowledge’ (Madhukar Shukla, 1997).6

Communities of practice can drive strategy, generate new lines of business, develop people’s skills, and help companies recruit and retain talent. Group of people who work together can create learning for an organization (Etienne. C. Wegner, WilliAm M Snyder, 2001).7 Organizations with people who talk smart as an effect of knowing more may not act on the know-how. This gap makes organizations perform poorly. True learning in an organization does not happen when People articulate effectively on what they know than acting on applying the learning for better performance. Know How - Knowledge and action gap affects organizations (Jeffrey Pfeffer, Robert Sutton, 2001).8 Knowing too much on business processes and stringently systematizing might lead to lose the knowledge that may be obtained from the system and its design. Key Learnings of an organization is lost when knowing and systematizing than grasping the tacit knowledge in those business processes (John Seely Brown, Paul Duguid, 2001).9

Codification strategy, Personalization strategy and Competitive strategy must drive Knowledge Management Strategy for Learning Organizations. Requirement of stable IT infrastructure for managing knowledge is addressed as a key need for a learning Organization (Morten Hansen, Nitin Nohria, Thomas Tierney, 2001).10 Organizations learn in many different ways. Double loop learning - a process of asking questions not only about the facts but also about the reasons and motives behind the facts - encourages organizational learning through introspection, taking responsibility for one's behavior and enables

organization to learn. Single loop learning blocks communication in a learning organization (Chris Angris, 2001)\(^\text{11}\).

Coevolving is a synergic way for learning (Kathleen Eisenhardt, Charles Galunic, 2001)\(^\text{12}\). Graphical depiction of organizational actions and functions will reveal the gap in competitive forces and plans in an organization. Graphical Documentation and Learning of business functions and actions lead to OL. Identifying key objects that enable OL through Organigraph is an efficient mode of learning (Henry Mintzberg, Ludo van der Heyden, 2001)\(^\text{13}\). Firefighting amongst employees spoils organizational productivity and learning. Employee relationship matters much for a conducive environment for learning (Roger Bohn, 2001)\(^\text{14}\).

There is an interesting perspective on organizational learning by Martin et al, which says that ‘Work Process Knowledge’ brings a fact that New forms of work demanding workers' knowledge and skill. The findings, based on a new set of investigations in a wide range of manufacturing and service industries, identify the kinds of knowledge acquired through learning is the key driver for innovative methods of functioning in an industrial organization (Martin Fischer, Nicholas Boreham and Renan Samurcay, 2002)\(^\text{15}\).

The Author of the book ‘Unlearning the Fifth Discipline’ states that the basic characteristics of a learning organization lie in the emphasis on a continuous learning strategy and culture, flexible rewards and structures, participative decision-making and open communications. This image is distinctly different from the conventional notion of an organization. The author mentions various


\(^{15}\) Martin Fischer, Nicholas Boreham and Renan Samurcay; “Work Process Knowledge”, Illustrated Ed, Routledge Pb; 2002
factors and forces that contribute to the changing profile of the organization-turbulent and unpredictable business environment, stringent customers and demanding share holders. In short the drivers of learning in an organization are, organization-turbulent and unpredictable business environment, stringent customers and demanding share holders largely (Devi akella, 2003)\(^\text{16}\).

Henrich Greve offers an intriguing analysis of how firms evolve in response to feedback about their own performance. Based on ideas from organizational theory and social psychology and research from many industries, it demonstrates that high-performing organizations quickly lower their rates of market entry, innovations and asset growth, but low-performing organizations only slowly increase those rates. The analysis outlines the consequences of this behavior for organizational survival and performance, and suggests ways to improve organizations with performance feedback. Organizations learn from performance feedback systems. Learning Organizations are high-performing organizations which can quicken the process of lowering their speeds of market entry, fasten innovations and asset growth (Henrich Greve, 2003)\(^\text{17}\).

Learning Transfer in Organizations is a novel concept introduced by a group of authors who address transfer of learning at individual and organizational levels. This book by Elwood F. Holton, Timothy T. Baldwin shows how to diagnose learning transfer systems, create a transfer-ready profile, and assess and place employees to maximize transfer. The book includes information on how to determine what process should be followed to design an organization-specific learning transfer system intervention. The authors focus on the actual learning process and show how to use front-end analysis to avoid transfer problems. Issues associated with such popular work-based learning initiatives as action learning and communities of practice are discussed along with the presentations of how to apply learning transfer practically in e-learning pedagogy while

\(16\) Devi Akella, “Unlearning the Fifth Discipline: Power, Politics and Control in Organizations”, Response Books Pb; 2003

\(17\) Henrich Greve, “Organizational Learning from Performance Feedback: A Behavioral Perspective on Innovation and Change”, Illustrated Ed; Cambridge University Press Pb; 2003

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training teams in effective organizations (Elwood et al, 2003). Presence is a book that takes an intimate look at the development of a new theory about change and learning; It’s about looking at and acting on things differently to achieve by transferring the learning for changing organizations and the way it functions (Peter Senge et al, 2004).

Leadership promotes OL and innovations (Gueldenberg, Konrath, 2004). OL is enhanced by the inter-relationships between customers by efficient utilization of resources (White et al, 2004). Recently, cross border effectiveness of the organizational model has become a fundamental management challenge amongst multinational operations. This interesting book by Vipin Gupta, broadly explains the nature and meaning of organizations in different regions of the world. It highlights how dynamic leaders can and do bring meaningful value to the world by creating and transforming organizations through OL. Knowledge Management, Innovation, Networking, Branding are the elements of strength with learning organizations (Vipin Gupta, 2004).

Various characteristics of OL had been studied by Sohal indicate the presence of variables that affect OL (Sohal et al, 2004). Knowledge management is an integral part of OL (Campos et al, 2004). OL is constructed by global responsibility and support process efficiency (Antal et al, 2004). A sociocultural model is proposed which identifies communication as the key trigger of

22 Vipin Gupta; “Transformative organizations - A Global Perspective”, Illustrated Ed; Sage Pb; 2004
sociocultural dynamics and organizational learning. Three learning practices are analyzed in detail; opening space for the creation of shared meaning, reconstituting power relationships and providing cultural tools to mediate organizational learning (Boreham et al, 2004)²⁶.

Creating knowledge and continuous learning are the key aspects of developing people and processes in a learning organization that holds a competitive advantage (Sharma et al, 2005)²⁷. The relationship between Leadership and OL is revealed in this study that connects transformational leadership with the ability of the firm to combine and exchange information.

This paper says that transformational leadership enhances learning capability of the firm. Organizational setting and attitude affect OL along with transformational leadership making OL as competitive advantage (Farrell et al, 2005)²⁸. The strategic practices and action patterns of a firm are based on learning and applying the knowledge internal and external to an organization while doing strategic planning. There are two different approaches such as adaptation and evaluation that support designing structured processes that incorporate organizational learning and knowledge application in strategic planning (Chengbo et al, 2005)²⁹.

Knowledge management, product and service quality standards enhance OL, which becomes competitive advantage of the firm (Chen et al, 2005)³⁰. Knowledge and Information management are the constructs of OL (Lehman et al, 2005)³¹. Learning organizations are based on complexity theory, autopsies,

and evolutionary epistemology; these kinds of organic organizations found to learn and evolve; they also have high level of ability of adaptations (Willium Hall, 2005).32

There are "best practices" in an organization that help organizations deploy developmental coaching on a large scale to drive leadership and employee effectiveness. Such organizations are also termed as Coaching Organizations. A Coaching Organization provides a guide for the strategic management of coaching initiatives, including executive coaching, internal coaching, coaching by managers and peer coaching, so as to maximize their impact and value (James et al, 2006).33

Knowledge management and OL are the triggers of OP (Ruiz et al, 2006).34 Personal learning effectiveness affects organizational learning (Grieves et al, 2006).35 The factors that affect OL and learning transfer are, lack of time to practice new learning and fragmented organizational support (Meyer et al, 2006).36

Specht’s study reveals that ‘cultural processes in an organization get affected by cultural processes that are constructed by social representations, groups’ interactions, organizational learning and team working (Specht et al, 2006).37 Learning of organization is affected by implementation of information systems, owner centered culture and resource constraints to a larger extent. (Kelliher et al, 2006).

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A study by Hyvonen reveals that innovation skills, good customer relationships and commitment affect performance impact organizational learning (Hyvnen et al, 2006).  

Juan analyses the impacts of OL by Organizational Learning (OL), by knowledge creation, and Information Technological Distinctive Competencies (TDCs) and entrepreneurial orientation (EO) (Juan et al, 2006). An individual’s trait such as 'curiosity' in conjunction with mindfulness and differences in learning styles, affect organizational learning process. (Leonard et al, 2007) OL gets enhanced by acquiring, disseminating and utilizing market knowledge of customers and competitors (Siu Loon Hoe, 2006).

A solid, research-based conceptual framework that demystifies organizational learning bridges the gap between theory and practice. Using an integrative approach, the authors provide practitioners and researchers with tools for understanding organizational learning under real-world conditions. This book established OL theory is different from practice (Raanan et al, 2007).

### 2.2 Organizational Intelligence (OI)

Past researchers had established some knowledge base to derive relationship between organizational knowledge and competitive advantage of a firm. Attempts towards measuring organizational intelligence are found to be very limited. A comprehensive study encompassing varied perspectives of managing

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43 Raanan Lipshitz, Victor Friedman, Micha Popper, “Demystifying Organizational Learning”, sage Pb, 2007
an organization and multitude of factors affecting the level of intelligence of both tangible and intangible aspects comprising of an organization is not available for normative and prescriptive guidelines to the contemporary academia as well as corporate executives. It had been decided to explore various facets of organizational intelligence (OI) and organizational performance (OP) and establish linkages between them in this research work. OI aims at creating a learning organization, a market driven organization, and an innovative organization. ‘Whether, the basic aims and tenets of OI lead to improving OP or not’ has been explored. Therefore, suitable models, constructs, propositions and instruments are required to measure OI and OP and relate them to real life organizational settings for validation. Literature reveals that, researchers have defined OI differently but not established the relationship between OI and the overall performance of organizations.

Presence of intelligence in organizations in terms of the knowledge and policies of industries and Government across the globe and OI is defined as processed information for strategic planning process (Etzioni et al, 1968)\textsuperscript{44}. A review of the book "Organizational Intelligence: Knowledge & Policy in Government & Industry", indicates, utilization of organizational intelligence for decision-making where in OI is defined as the ability to process and utilize information and knowledge for strategic planning of Government and Industrial Policies (Bill Goode, 1968)\textsuperscript{45}.

The relationship between Knowledge Management and OI of public and governmental organizations and Effective Policy Decisions triggers high quality organizational intelligence in private organizations. Comparison of review of the two books, "Organizational Intelligence: Knowledge and Policy in Government and Industry," by Harold L. Wilensky; and "Hidden Hierarchies: The Professions and Government," by Corinne Lathrop Gilb, reveals that there are obvious different orientations towards organizational intelligence. The former book indicates the relationship between an effective knowledge management and its

impact on policy decisions, wherein the later one focuses on how professionalism and hierarchical decisions get affected by policy decisions, which in turn trigger high quality intelligence in organizations. (Lakoff et al, 1968).

Organizational intelligence technology is usage of intelligent information systems (King et al, 1973). OI is a resource of high performing organizations (March, 1979). Intelligence is concerned with found in the product innovation (Cooper 1979). OI is enhanced by the ability of the organization to scan the business environment effectively (Hambrick, 1981). (Daft et al, 1984) focuses on organizations themselves as interpretation systems consisting of collecting data, giving meaning to data and learning. Resource management affects performance variations of organizations (Wernerfelt, 1984), (Barney, 1986). OI is closely related to with market knowledge and market proficiency (Cooper and Kleinschmidt, 1987).

Incremental experiential learning can be a form of OI, less demanding cognitively yet capable of considerable power. It says learning mechanism can improve organizational performance. It also reveals some of the possible heuristics to overcome learning liabilities in organizations. It also suggests effectiveness of incremental learning can be improved by slowing the rate of

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learning and adapting to behavioral changes that happen in organizations (Lounamaa, 1987).

OI enables an organization to meet contingencies of survival under such relatively novel unexpected crises (Curtis et al, 1989). Market orientation drives OI (Kohli et al, 1990). OI can lead to meaningful HR management policies and practices in corporate sector (Kraut et al, 1990). Huber (1991) summarizes the literature about knowledge acquisition, information distribution, information interpretation and organizational memory and links these constructs to organizational learning. There is a need for competitiveness, which arises from the counterintelligence for competitiveness leading to organizational intelligence (Sulc et al, 1992).


Knowledge base of an organization is a key resource (Hedlund, 1994). The “capabilities” approach in the strategic marketing literature proposes a theoretical basis for analyzing the relationship between knowledge management

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and product innovation (Day, 1994)\textsuperscript{64}. The Research article (Day et al, 1994)\textsuperscript{65} sorts capabilities into three categories: the inside out, the outside in, and spanning capabilities. It says that market driven organizations have a distinctive capability on outside-in processes consisting of market sensing, customer linking, channel bonding and technology monitoring activities and spanning processes including product innovation.

Knowledge creation is a resourceful activity in performing organizations (Nonaka, 1995)\textsuperscript{66}. Highly Intelligent Organizations outperform. The core concept of OI uses theories of organizational learning (Choo 1995)\textsuperscript{67}.

Firms possessing unique and inimitable resources are believed to survive or have better performance in the competitive market place (Connor, 1996)\textsuperscript{68}. OI is a resource of high performing organizations (McMaster 1996)\textsuperscript{69}. The organizational intelligence literature reveals three basic features of an intelligent organization; An intelligent organization is considered as a learning organization, a market-driven organization, and an innovative organization (Glynn 1996)\textsuperscript{70}. Individual intelligence forms the platforms for providing insight into how organizations can acquire information, disseminate information, utilize information, respond to information to facilitate and create competitive advantages (Glynn, 1996)\textsuperscript{71}.

The seven essentials of organizational intelligence include widespread truth and rights; freedom of enterprise, liberated teams, equality and diversity, voluntary learning networks, democratic self-rule, and limited corporate government -

form the basic drivers of OI (Thomas Gerald, 1996). OI is developed by innovations in the organizations; individual intelligence and organizational intelligence are functionally similar; OI is a social outcome due to the factors like mechanisms of aggregation, cross-level transference, and distribution in operations that affect organizational innovation process: initiation and implementation (Glynn et al, 1996). Information storing and management can enhance intelligence in organizations for decision making (Blackman et al, 1996).

OI is measured through market information processing skills of an organization (Moorman, 1995) and (Ottum et al, 1997). Organizational learning takes place only when the organization effectively acquires, organizes, stores, and, most importantly, transforms information into knowledge products that are useful to its purposes (Robert Williams, 1997). Intelligent organizations are in a continuous cycle of learning and adaptation; artificial intelligence constructs intelligent organizations (Krovi et al, 1997). There are parameters such as process efficiency and systemic efficacy that determine the learning abilities of an organization which is regarded as the intelligence of organizations; knowledge structures in the organization can improve process efficiency; In intelligent organizations have a standard architecture to scale production efficiency, utility, and effectiveness (Dan Zhu et al, 1997).

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According to Day (Day et al, 1997)\textsuperscript{80}, a modern school of thought emphasizes, the essence of acquisition, dissemination, and utilization of information in the organization lead to OI. These activities are considered critically important because of their roles in stimulating learning. OI is directly related to market knowledge competence (Li and Calantone, 1998)\textsuperscript{81}. OI is a key driver of High performance in organizations (Morgan 1998)\textsuperscript{82}. Organizations fail to learn from their experience in systems development because of limits of organizational intelligence, disincentives for learning, organizational designs and educational barriers; poor systems efficiency leads to poor performances (Lyytinen et al, 1999)\textsuperscript{83}.

Learning quality and OL is an outcome of OI (Clegg et al, 1999)\textsuperscript{84}. Cultural differences affect information system utilization and OI (Leidner et al, 1999)\textsuperscript{85}. Managing information and creating knowledge for strategic planning create intelligent organizations (Malinowski et al, 1999)\textsuperscript{86}. Competitive Intelligence and market intelligence add to OI of an organization (Calantone et al, 1988)\textsuperscript{87}, (Song and Parry, 1997)\textsuperscript{88} and (Harmsen, et al, 2000)\textsuperscript{89}.

Organizations that have effective knowledge management systems providing knowledge based competitive advantages over the competitors are considered to


be intelligent organizations (Liebowitz, 2000). OI is managed with varieties of strategic processes, which are offensive and defensive (Cronin et al, 2000). Organizations balancing power, knowledge and learning, gain a competitive advantage; intelligent organizations promote innovation and exploit new ideas to their advantage through strategic planning processes (Vickers et al, 2000). These concepts explain the relationship between organizational knowledge and competitive advantage (Thomas, et al., 2001). OI gets affected by environmental indicators of Business (Howell et al, 2001). Organizational cybernetics framed with virtuous, self-controlled and self-transforming qualities lead to specific organizational identity and OI (Schwaninger et al, 2001). External information awareness, effective decision architecture, internal knowledge dissemination, organizational focus, and business networks in banking sector impact OI drastically (Altinkemer et al, 2001). Inspiring and transforming leadership can enhance organizational intelligence (Hagenow et al, 2001).

Best practices of strategic process planning and decision-making enhances OI (Matheson et al, 2001). The value of goods and services would be based primarily on the development of knowledge-based intangibles including technical know-how, product design, marketing presentations, understanding

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customers, personal creativity, and innovation in an intelligent organization (Jones et al, 2001). Technology can affect knowledge management and information usage and in turn the intelligence of organizations (Schoech et al, 2002). Motivation, intelligence, thinking and knowledge creation, creating and managing intellectual capital along with systems and processes result in the creation of intelligent organizations (Richards et al, 2002). OI is driven by 1) being adaptable to changes, 2) being rapid in action and reaction, 3) being flexible comfortable, 4) being sensitive 5) being open-minded, 6) being able to use imagination, 7) being able to renew, 8) effective management and usage of human resources, 9) effective usage of technology, 10) effective usage of knowledge, and 10) organizational learning ability (Erçetin et al, 2002). The empirically derived factors such as awareness, communication, performance assessment, intellectual cultivation, environmental adaptability, social learning, intellectual capital management, and organization grafting; these factors gauge OL that impacts OI (Templeton et al, 2002).

Organizations can be reoriented towards organizational structure based on organizational mind with collective intelligence (Liang et al, 2002). Risk taking ability in organizations, ability of exploring and exploiting opportunity, ability of learning, ability for making a decision and executing it successfully, having knowledge consciousness and managing continuity, being conscious of changes in organizational actions are the parameters that affect OI (Miner et al, 2002).

Leadership drives OI (Kerfoot et al, 2003)\textsuperscript{106}. OI, firm specificity of technology, and causal ambiguity are identified as three drivers of technological learning and OP (Lin et al, 2003)\textsuperscript{107}.

OI is defined as "the capacity of an organization to mobilize all of its brain power, and focus that brain power on achieving the mission"; strategic vision, appetite for change, alignment and congruence, performance pressure, knowledge deployment, heart, and shared fate are the components of OI (sessa et al, 2004)\textsuperscript{108}. Learning behavior of an organization that implemented balanced scorecard method of performance management in different departments enhances OI (Askim et al, 2004)\textsuperscript{109}. Competition between human beings enhances the evolution of intelligence in organizations (Lawton et al, 2004)\textsuperscript{110}. Knowledge management processes, collaborative and competitive environment enhances the learning and adaptability of organizations leading to organizational intelligence in humanistic organizations (Liang, 2004)\textsuperscript{111}.

The relationship between OI and systemic cultural intelligence indicates the evolution of culture triggering intelligence of organizations, which impacts organizational development (Stalinski et al, 2004)\textsuperscript{112}. Rapid action and reaction; quickly adapting to changes; flexible in function; sensittiveness and being predictable; open-mindedness; the use of imagination; being innovative are the prime factors that are retained by intelligent organizations (Erçetin et al, 2004)\textsuperscript{113}.

\textsuperscript{106} Kerfoot, Karlene, (2003), “Organizational Intelligence/Organizational Stupidity: The Leader's Challenge”, Nursing Economics, Vol.21(2), p91-93
Ability of the organization to gather information, to innovate, to generate knowledge, and to act effectively basing on the knowledge it has generated are different components that construct OI. (Staškevičiūtė et al, 2006)\textsuperscript{114}. Inter-organizational networks, hierarchy, and organizational interaction construct OI (Seidl et al, 2007)\textsuperscript{115}. Spirituality is found in the organization that may exist in terms of the concerns and care of employees in workplace and at structural level add to OI (Moss et al, 2007)\textsuperscript{116}. There is an absence of dichotomy in terms of organizational intelligence and individual intelligence; a structuration view of OI integrates the fragmented studies on the epistemology of intelligence, which are measured with cognitive, behavioral and social/emotional abilities of learning (Akgün et al, 2007)\textsuperscript{117}. The relationship between OI and information management is positive (Cruz et al, 2008)\textsuperscript{118}.

**PART II**

### 2.3 Organizational Performance (OP)

Research studies show various parameters that affect OP positively. Pressure on quality improves OP (Hall et al, 1970)\textsuperscript{119}. Leadership affects OP positively (Pfeffer, Jeffrey, 1977)\textsuperscript{120}. Productivity and efficiency dominate quality and service, which are the primary metrics of organizational performance (Hackman et al, 1978)\textsuperscript{121}. Good organizational performance requires both good decision

\textsuperscript{118} Cruz et al. (2008), “Intelligence and Information Management: Integration in Organizational Contexts”, ACIMED, Vol.17(5), p51-60
making processes and efficient operations by the use of adaptive processes in a competitive environment (Neave et al, 1980).

Organizational culture affects OP (Wilkins et al, 1983). Job retention and expansion, healthy labor relations, individual and collective motivation, and wealth creation affect OP (Woodworth et al, 1986). Service production efficiency and marketing opportunities are to be balanced to obtain organizational performance (Tansik et al, 1990). Service quality and customer satisfaction, leadership and management practices influence organizational effectiveness and in turn their performance.


Total Quality Management (TQM) and Socio-technical Systems theory (STS) as 2 distinctive methods to achieve organizational stability and flexibility; The model

designed fosters efficiency, stability, innovation flexibility, psychological ownership, quality of work-life, continuous and discontinuous learning, and high organizational performance and customer satisfaction (Manz et al, 1999).  

Resource management processes are part of strategy formulation and deployment in high performing organizations (Tyson et al, 1997). Competitive edge increases due to improved productivity, product quality, organizational flexibility, and responsiveness to changes in the external environment increasing OP (Birecree et al, 1997). OP is improved by reengineering to efficient processes and systems to utilize resources efficiently leading to profitability (Cox et al, 1998). Process implementation initiatives affect OP (Noble et al, 1999). Market-driven business units developed higher levels of six vital marketing capabilities - market research, pricing, product development, channels, promotion, and market management against OP (Vorhies et al, 1999).  


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Knowledge management processes and organizational culture affect OP (Brockman et al, 2003). High performance work systems, information quality, and performance quality, employee knowledge, work design, and total quality management systems affect OP (Preuss et al, 2003). HRM practices such as training, job design, compensation and incentives directly affect the operational performance parameters, viz., employee retention, employee productivity, product quality, speed of delivery and operating cost (Paul et al, 2003).

Stakeholder relationships affect OP largely (Carmona et al, 2003). Quality management and process improvement affect OP (Yeung et al, 2004). Increased

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stakeholder participation in value creation and organizational governance can benefit both society and corporations through performing organizations (Harrison et al, 2004). High Performance Work Systems lead to financial performance through administrative efficiency and sustainable performance through flexibility arising from the coordination and exploitation of knowledge resources (Evans et al, 2005). Knowledge management (KM) processes affect organizational performance. (Sabherwal et al, 2005).

Performance Measurement Systems strategic initiatives enhance OP (Kit Fai et al, 2005). Process management frameworks affect Organizational Performance and organizational effectiveness (Baker et al, 2005). Sustained organizational performance depends on top management teams effectively exploring and exploiting. Leadership with abilities to articulate a paradoxical frame, to differentiate between the strategy, to innovate architecture for the existing and new products and those for innovation and to integrate between those strategies and architectures affect OP (Smith et al, 2005).

Healthy work environment improves OP (Anderzén et al, 2005). Downsizing affects employee's productivity, profitability and efficiency, which in turn measure OP (Gyu-Chang et al, 2006). Enterprise systems implementation

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impacts OP (Arnold et al, 2006)\textsuperscript{158}. OP affects organizational culture (Chehade et al, 2006)\textsuperscript{159}. Information systems implementation affects OP positively (Mehta et al, 2006)\textsuperscript{160}. Effective Business process management impacts OP (Richard et al, 2006)\textsuperscript{161}. Strategic Decision Making Process implementations affect OP positively (Snyman et al, 2006)\textsuperscript{162}. Total Quality Management is an integral part of OP (Chinho et al, 2006)\textsuperscript{163}. Service orientation and organizational culture affect OP (Lytle et al, 2006)\textsuperscript{164}. 

Return on total assets and profitability count OP (Szymanski et al, 2007)\textsuperscript{165}. (1) Financial, (2) customer satisfaction, (3) process innovation, (4) production process and (5) organizational learning and growth are the parameters that measure OP (Azadeh ET AL, 2007)\textsuperscript{166}. Business Process Reengineering and ERP implementation improve OP (Velcu et al, 2007)\textsuperscript{167}. 

Leadership impacts OP positively (Ashkenas et al, 2007)\textsuperscript{168}. Product and service quality, leadership, and effective KM implementations impact OP largely (Anantatmula et al, 2007)\textsuperscript{169}. Workflow systems, individual performance and


Labor productivity, competitive pay and customer satisfaction affect organizational performance (Subramony et al, 2008)\textsuperscript{181}. PMS usage improves OP (Gimžauskiène et al, 2008)\textsuperscript{182}. Implementation of quality management systems leads to high performance in organizations (Macinati, 2008)\textsuperscript{183}. Innovations in Organizational Governance improve OP (Moore et al, 2008)\textsuperscript{184}.

Identifying the variables that are repeatedly used by various management systems widely, are identified by this comprehensive exercise of tabulating the variables. This tabulation can also help researchers identify variables for study and while designing an instrument for measuring OI, it is important to choose right variables that would measure OI and that can be widely used by management systems for business applications and decision making.

2.4 Comparison of Variables of OL, OI, and OP from Literature

2.4.1 Variables of Organizational Learning (OL)

Leadership, innovation, Resource management, customer relationship management, knowledge management, global responsibility, support process efficiency, socio cultural dynamics, creating knowledge, continuous learning, strategic process planning, Product & service quality, information sharing, knowledge exchange, memory, learning ability, personal learning effectiveness, human resource practices, information system implementation, entrepreneurial orientation, learning styles, market knowledge and customer knowledge, are the key variables of OL.


From the list of variables of OL, we find that these variables are all found the set of variables that measure OI as discussed below.

### 2.4.2 Variables of Organizational Intelligence (OI)

Knowledge management, information management, Experiential learning, adapting to environmental changes for strategic planning process, disaster & crisis management planning, Human resource performance management, competitive intelligence, cognitive learning, artificial intelligence, attitudes and practices that get developed into processes, empowerment of lower level employees, decentralized decision making, innovation, adaptability to changing environments, process efficiency, systemic efficiency, learning quality, cultural dynamics, information utilization in strategic planning process, strategic planning and deployment, self controlled and self transforming abilities, transformational leadership, value creating culture, creating alternatives, continual learning, embracing uncertainty, outside in strategic perspective, systems thinking, disciplined decision making, alignment and empowerment, open information flow, employee rights and responsibilities, organizational knowledge management, technology management, intellectual capital, knowledge assets, being adaptable to changes, being rapid in action and reaction, being flexible comfortable, being sensitive, being open-minded, being able to use imagination, being able to renew, effective management and usage of human resources, effective usage of technology, effective usage of knowledge, and organizational learning ability, ORGANIZATIONAL LEARNING, risk taking ability, business continuity, learning ability, decision making, technology transfer, perception of employees by management, employee performance management system implementation, internal competitive environment, organizational culture, rapid action and reaction, quickly adapting to changes, flexible in function, sensitiveness and being predictable open mindedness, the use of imagination, being innovative, ability of the organization to gather information, to innovate, to generate knowledge, and to act effectively based on the knowledge it has generated, inter-organizational networks, hierarchy,
organizational interaction, spiritual intelligence, cognitive, behavioral and social/emotional abilities of learning – are the variables of OI.

We find that, the set of all the variables of OL are in the set of variables of OI as established by Erçetin et al in 2002. “OI is driven by 1) being adaptable to changes, 2) being rapid in action and reaction, 3) being flexible comfortable, 4) being sensitive 5) being open-minded, 6) being able to use imagination, 7) being able to renew, 8) effective management and usage of human resources, 9) effective usage of technology, 10) effective usage of knowledge, and 10) organizational learning ability (Erçetin et al, 2002). This clarifies and differentiates OL as a capability found with intelligent Organizations and may be considered as one of the variables for OI scale design.

2.4.3 Variables of Organizational Performance (OP)

Quality pressure, a professional concern, and financial responsibility pressure, an organizational concern, leadership, service quality, business process planning and management, organizational culture, employee relations, employee benefit schemes and employee health care, ergonomic conditions, service production efficiency, marketing opportunities, service quality and customer satisfaction, Leadership and management practices, Customer satisfaction, employee satisfaction, employee service quality, Human resource practices and systems, customer satisfaction, total quality management practices, Socio technical systems theory practices, resource management practices, productivity, product quality, organizational flexibility, responsiveness to changes in the external environment, systemic efficiency, process efficiency, Process implementation initiatives, Market-driven business units, ORGANIZATIONAL LEARNING, management systems, information technology initiatives, innovation in products, services and processes, financial performance, compensation and resource management, Enterprise Resource Planning implementation, high performance work systems, information quality, and performance quality, employee

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knowledge, work design, employee retention, employee productivity, product quality, speed of delivery and operating cost, performance metrics, stakeholder relationships, quality management, process management, employee involvement, corporate responsibility to society and stakeholder commitment, administrative efficiency, managing knowledge resources, usage of performance management systems, customer service innovation through process management, organizational architecture, psychosocial interventions to employees, profitability, firm’s efficiency, employee productivity, business process management, strategic decision making processes, service orientation, return on total assets, continuous financial performances, customer satisfaction, process innovation, production process, organizational learning, growth, high existing competition on the market, strict economic conditions, budgetary restrictions, requirements of governmental entities for a major efficiency in the assignment of the resources, needs for national and international accreditations, the emergence of rankings for universities, work flow systems, individual performance and attitudes towards the systems, organizational change, cycle time improvement, efficient resource utilization, Market growth and strategic Human Resource practices, Human capital, knowledge sharing practices, top management's knowledge sharing values, market & societal orientation, attitude, behavior, operational and financial aspects along with team work, supply chain strategic processes, marketing, financial performance, knowledge transfer, knowledge creation, labor productivity, competitive pay and customer satisfaction affect organizational performance, innovations in governance – are the variables that measure Organizational performance.

We also find that Organizational Learning is a variable that triggers OP as established by Schiller in 2001 - Organizational learning and strategy efficiencies and management systems affect OP (Schiller et al, 2001)\textsuperscript{186}, which again is conformed from the research by Azadeh in 2007 - 1) Financial, (2) customer satisfaction affect organizational performance, innovations in governance – are the variables that measure Organizational performance.

satisfaction, (3) process innovation, (4) production process and (5) organizational learning and growth are the parameters that measure OP (Azadeh et al, 2007).\(^\text{187}\)

Thus we find from the literature that OL is regarded as the learning ability of the organizations and intelligent and performing organizations possess that ability. Also we find that entire list of the variables of OL form a part of the set of all variables that form OI. Thus scrutinizing these variables as against the suggestions by senior executives of corporations that design measurement systems and develop organizational capabilities and the conceptual models designed by management research academia is essential to decide on the variables. This is discussed in chapter 3 under section “relevance of questionnaire” and chapter 4 “conceptual models from literature” confirms the choice of variables.

### 2.5 Findings from and Benefits of Literature

**Survey**

The research objectives for this research work evolved from the gap that is found from the OI literature.

There are also different types of definitions and models of OI (Anuradha et al, 2009)\(^\text{188}\) found in the literature as listed in Table 2.1.

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\(^{188}\) Anuradha et al, (2009), “Choice of Variables to Design an Instrument for Measuring Organizational Intelligence” Industrial Engineering Journal, IIIE Pb. (Accepted)
Table 2.1 - Definitions and Variables of OI from Literature

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Definitions of OI from Literature</th>
<th>Identification of Variables from Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Systematic processing of information and knowledge invokes OI</td>
<td>Ability to systematize the processes of information and knowledge Management assets</td>
</tr>
<tr>
<td>2</td>
<td>Innovation, Creativity, Imagination to understand processes and systems foster OI.</td>
<td>Ability to be innovative and creative</td>
</tr>
<tr>
<td>3</td>
<td>Creativity, organizational design, systems efficiency and intellectual capital are four prime forces that drive OI. Knowledge creation, motivation, intelligence and thinking create intelligent organizations</td>
<td>Ability to have Creativity, Systems Efficiency, And Knowledge Creation and management</td>
</tr>
<tr>
<td>4</td>
<td>Efficient information management leads to the birth of intelligent organizations</td>
<td>Ability to manage information</td>
</tr>
<tr>
<td>5</td>
<td>The need for information processing models and techniques for understanding business trends and decision making drives OI.</td>
<td>Ability to process information efficiently</td>
</tr>
<tr>
<td></td>
<td>Creativity and Innovation Processes and Implementation of creative ideas are cognitive in nature. OI and Individual’s Intelligence are similar and behave in a similar fashion</td>
<td>Being creative in getting and practically Implementing them</td>
</tr>
<tr>
<td></td>
<td>Fundamentally there are 3 factors</td>
<td>Ability to achieve purpose</td>
</tr>
</tbody>
</table>
|   | that group these 9 aspects of OI are, Achieving the purpose Understanding the environment Mobilizing the resources. | Ability to understand Environment Ability to mobilize Resource
|   | Ability to achieve the target is defined as OI | Ability to achieve targets
|   | OI is defined as the ability of organization to decide, learn from decisions made, take risk and share knowledge effectively | Ability to Learn, ability to Manage Knowledge
|   | OI is defined as the capability of automating database systems and processes effectively. OI is purely a technical parameter measuring the degree of effectiveness in the automation of database systems | Ability to implement Information Technology effectively
|   | OI is the measure of utilizing information effectively to learn about customers and competitors. | Ability to use customer, market and competitor information effectively
|   | Intelligent people, when assembled into an organization will tend toward collective stupidity which can be measured with 4 key aspects such as leadership, communities, knowledge platform and adhocracies of problem solving | The need for collective intelligence of people. (i.e)Ability of people to perform collectively
|   | OL is a component of OI. OL comprises of organizational memory, knowledge, learning, communication and conclusion | Organizational learning abilities
|   | OI is defined as the capacity of an Information systems, Structure | Information systems, Structure
|   | OI is defined as the ability of organization to decide, learn from decisions made, take risk and share knowledge effectively | Ability to Learn, ability to Manage Knowledge
|   | OI is defined as the ability of organization to decide, learn from decisions made, take risk and share knowledge effectively | Ability to Learn, ability to Manage Knowledge
|   | OI is the measure of utilizing information effectively to learn about customers and competitors. | Ability to use customer, market and competitor information effectively
|   | Intelligent people, when assembled into an organization will tend toward collective stupidity which can be measured with 4 key aspects such as leadership, communities, knowledge platform and adhocracies of problem solving | The need for collective intelligence of people. (i.e)Ability of people to perform collectively
|   | OL is a component of OI. OL comprises of organizational memory, knowledge, learning, communication and conclusion | Organizational learning abilities
|   | OI is defined as the capacity of an Information systems, Structure | Information systems, Structure
The conceptual models of OI proposed by various authors and compared and contrasted in chapter 4 - Conceptual Frameworks from Literature. Although all these models and definitions try to explain OI and OP individually, none of the past research had made an attempt to explore the relationship between OI and OP explicitly. These models that explain the reasons for the presence of Intelligence in Organizations defined with various contexts, however do not measure OI. These specific gaps in the literature pave way to define the research objectives, such as measuring OI and exploring the relationship between OI and OP, and the need for doing this research work.

Considering the first part of the objective of interest – ‘Instrument design for measuring OI’, it becomes necessary to identify the variables that are being used at various capacities to define OI by researchers and management systems. The commonly used variables that define OI largely should be explored for formulating a mathematical linear equation that might possibly define and
measure OI once the weightages of these variables in such an equation is established. Thus we found variables such as, Leadership and Culture, Rigor in Strategic process Planning and deployment, Health of Stakeholder Relationships, Knowledge and Information Management capabilities, Financial Performance, Systems efficiency, Business Process Efficiency, Product Quality and Service Quality are loftily used by researchers for exploring the presence of intelligence in the organizations.

This comprehensive literature study establishes the fact that, OL is an aspect of intelligent and performing organizations is confirmed by the theory of Clegg in 1999 - ‘Learning quality and OL is an outcome of OI’ (Clegg et al, 1999). Comparison of variables of OL and OI also reveals that all the variables of OL are also the variables that define OI. OL is an ability of an organization to learn. This is an outcome of a capability possessed by an organization called Intelligence, which differentiates OL from OI.

Study of Intelligence of an organization is essential to develop certain capabilities to enhance Performance and position itself competitively in market place. This benefit is attained by studying the relationship between OI and OP. If the relationship is established, it would enable management systems to fine-tune and interlink the performance with the variables that possibly create intelligence in the organizations. This benefit is expected from the fact established by Professor Thow that organizations behave like human systems and possess intelligence (Thow, 2002). According to Professor Thow, ‘Human like organizations’ are those organizations that possess capabilities such as human beings and behave, act and react like them, thus making this research objectives logical and research work scientific and beneficial to organizations to enhance their capabilities and improvise performances.

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2.6 Conclusion

This chapter accumulates and sorts out hundreds of concepts, variables and definitions used by researchers from 1968 to 2008 on OL, OI and OP. This literature study primarily established that OL and OI are same and OL is treated as a capability of intelligent and performing organizations and OL is not same as that of OI. It also establishes the logic behind the objectives and the research study, the benefits to management systems in studying their OI and OP and the underlying linkage between them. This study necessitates the importance of choosing the variables acceptable to both organizations and research academia while designing an OI instrument, which is discussed in detail in next chapter.

This comprehensive survey draws a scientific reason and premise that an instrument to measure OI can be constructed and by fine tuning certain variables that construct OI can help organizations to control their performances. This study brought out few key points. (i) Having many researchers defining OI as a specific humanistic capability of organization (Table 2.1) through various variables re-establishes Professor Thow’s proposal to look at organizations as human systems possessing Intelligence. (ii) Organizational Learning is a capability possessed by organizations that are Intelligent. (iii) Measuring OI is important to control the performance of organizations and that is the true benefit of doing this research study. (iv) The mathematical equation that evolves at the end would define OI and its linkage with OP.

In the next chapter, we will discuss about the Research Methods deployed for this research work such as selection of suitable variables to measure OI, designing and developing an OI instrument, sample selection, the issues and challenges in the research processes followed are described.
3.0   Introduction

In the earlier chapter we presented the literature on Organizational Intelligence (OI), Organizational Performance (OP) and Organizational Learning (OL) and various organizational variables that construct them as discovered by researchers. The literature survey revealed a few interesting observations. OI, OL, and OP are affected by several variables (Appendix - 4). OL is the trigger for OI and OP. The literature captures nineteen different models of OI. The literature also provides a wide opportunity of studying the relationship between these key constructs of OI.

We decided to cover the research design and process, population and sample selection, Instrumentation planning (i.e., questionnaire preparation, scaling techniques, data collection methods), and Instrument design (i.e., model variables, model design, data analysis methods and model description).

We start this chapter with Introduction as given in Section 3.0 above. Section 3.1 explains the research design of the study. Section 3.1.1 explains how the research problems had been identified and research objectives are set. Section 3.1.2 explains the focus group discussions conducted to arrive at decisions on research methods. Section 3.1.3 explains the research objectives that evolved through focus group discussions. Section 3.2 explains research processes followed in the form of a flow chart. Section 3.3 explains the experimental design and
observational methods used for this research study. Section 3.4 explains sampling techniques. Section 3.4.1 explains sampling techniques and describes the sample population, 3.4.2 sample frame, 3.4.3 sampling procedures respectively. Section 3.4.5 explains scale selection and section 3.4.6 explains the reasoning behind sample size. Section 3.5 explains data collection methods followed for this research study. Section 3.5.1 explains respondent’s profile. Section 3.5.2 explains the reasoning behind why a specific method of data collection is used and why other methods failed in this particular study. Section 3.5.3 explains the how the data was finally collected successfully. Section 3.6 explains questionnaire design and section 3.7 discusses the relevance of the questionnaire. It also discusses the reasoning and the literature evidences. Lastly, section 3.8 draws a conclusion by summing up the chapter.

The research design and the process are common for both the parts of the objective. However, entire research methodology is about deciding on variables and capturing them through questionnaire. As we are interested in capturing the variables that construct organizational intelligence initial sections contribute to the first part of the objective. This logic is brought out in the Figure 3.1 – a block diagram that explains the research process flow.

3.1 Research Design

The research design explains various processes and activities that go into doing the entire research, such as problem definition, setting research goals, research process development, choice of research methods, experimental design, questionnaire design, sampling methods, data collection and analysis methods and the issues and how they had been solved to achieve the research objectives.
3.1.1 Research Problem

The origin of the research problem is through observation and experience. It started with identification of the problem from my 18 years of work experience as a techno-manager. We had been observing some organizations perform high where in some under-perform irrespective of supportive as well non conducive business environments. Organizations learn cognitively from the past experiences to strategize and better perform in the future. Organizations that learn must be having intelligence same as that of human beings. They learn to adapt, decide and get dynamic to grow like that of any bio organism. This intriguing feeling made me read literature to know about cognitive learning abilities of human beings, organizational intelligence, learning organizations and organizational performance continuously and recording observations from literature. The result of these readings is a set of questions. They are; (i) Do organizations have intelligence? (ii) If they have intelligence, can it be fine tuned by some parameters for better performance? (iii) If they do not have intelligence, then what is that which triggers high performing organizations? (iv) What are the variables that contribute to Intelligence, if it exists? (v) Can an organization achieve an edge over its competitors by fine-tuning these variables? If these questions can be answered by an exploratory research, we can fine tune some of the key parameters to enhance their competitive advantage of organizations as well improve performance levels. There definitely was a need to discuss about this interest with my colleagues who are professors of management education and research scholars of business management domain to understand the extent of the feasibility of this study.

3.1.2 Focus Group Discussions

Soon after, we conducted a Focus Group Discussion with twenty research scholars of Management who had an average experience of 20 years along with Professors of Management Education on the research problem thus identified. The following are key aspects taken for discussion. I presented the problem and
my interest for about 20 minutes which is followed by a group discussion and inputs from the members of the group. The key points were, Feasibility of exploring this problem, identifying the exploratory research Methods, Research objectives and sample selection possibilities.

The outcomes of the discussions indicated clearly that this could be an interesting and possible study to explore the intelligence of organizations; large multinational corporations with systems and processes well matured could be taken as samples, as most of these samples are perceived to be smart organizations in the group; research objectives could be defined to explore the presence of organizational intelligence in growing organizations; the research methods could be survey based observations from the top executives of the samples followed by factor analysis and multiple regression to explore the relationship between the variables that construct organizational Intelligence; the focus group agreed that this study can benefit organizations if I could measure the quotient levels of intelligence; the group discussed that by fine tuning some specific factors/variables an organization can identify and build an edge over its competitors - a competitive advantage in the market place.

These outcomes helped us immensely to define our research objectives and draw research road map with better clarity.

3.1.3 Research Objectives

Interestingly, Literature study reveals that there are sufficient amount of research done on Knowledge Management (KM) and OP, and on the parameters that drive OP. However, there are very limited attempts are made to measure OI. Literature says OI aims at creating a learning organization, a market driven organization, and an innovative organization. However, the relationship between the drivers of OI and OP are not explored. Literature survey, gave us more than seventy variables that represent OI with a specific context and background. However considering the suggestions of leaders of leading corporate entities, we can choose the variables that can be used for measuring OI
in our research work. And, identifying the parameters that drive OI and OP under any given business conditions and environment will enable us understand the linkage between OI and OP better. Thus, we decided to explore the variables to construct an instrument for measuring OI; to explore whether OI triggers OP; and to study the relationship between OI and OP. Thus the research problem is an exploratory study and the Research Objectives are defined to be; (i) To identify key variables that construct OI from the Literature; (ii) To develop an instrument to measure OI; (iii) To explore the linkage between OI and OP and design a relationship model

3.2 Research Process

The entire planning process of this research work is explained with the Flowchart (Figure 3.1) given ahead.
Figure 3.1 - Flow Diagram of Research Process

Problem Discovery
Do Organizations have Intelligence?

Choice of Research Technique
An Exploratory Study of the Linkage Between OI and OP.

Focus Group Discussion on the Topic and Research Technique

Research Objectives defined
i. To Explore Literature for the Drivers of OL, OI, OP and compare them
ii. To Design an Instrument to measure IO
iii. To Explore the relationship between OI and OP

Selection of Research Method
Survey method to record observations from respondents
i. Identify key constructs of OI, OP
ii. Identify variables from literature that drive key constructs
iii. Questionnaire design to collect Primary Data of these variables
Sample selection
Small and Medium Business in Rural and Urban India through Simple Probability Random Sampling Method

Data Collection
Personally Administered the Questionnaire in Large Group Meetings of Respondents at a Specific Location

Data Analysis
Data Editing & Data Processing

Explore Variables with Exploratory Factor Analysis to Choose Variables that Contribute to OI

Explore the Relationship between the Chosen Variables with Multiple Regression Analysis

Interpret Results
Develop an Instrument for Measuring OI

Build a Causal Relationship Model
Explain the Relationship between OI & OP

Conclusions & Suggestions
This exploratory study is a survey-based experimental research. The experiment here is to observe the behavior of organizations through 40 variables that reflect 8 different key aspects of organizations as seen from literature. These aspects are, Leadership and Culture, Rigor in Strategic Process Planning and Deployment, Health of Stakeholder Relationships, Knowledge and Information Management Capabilities, Financial performance, Systems efficiency, Business Process Efficiency and Product and Service Quality Imperatives. The relevance of the choice of the variables and the questionnaire design are discussed in section 3.7.

Primary data of all the 40 variables were collected from the respondents who are business owners of businesses having headquarters located in cities as well in rural India. A questionnaire for primary data collection was designed. This questionnaire (Appendix-3) was administered to the respondents when assembled for a business training program at SP Jain Institute of Management and Research, Mumbai. A brief introduction on the research was given and the questions were explained along with the objectives to a batch of 115 respondents. A list of variables, their meanings derived from literature (Appendix - 4) was given to respondents along with the questionnaire for reference. This survey took 20 minutes to complete for each respondent. I was physically present in the room where respondents assembled till the data collection process got completed.

It is important to mention a key issue in the data collection process from the beginning. It would be ideal to collect the financial data from the officially published financial statements of the businesses chosen as samples. Practically it was difficult to collect authentic financial data from small and medium family owned businesses located at rural and urban parts of the country. Many a small and medium sized businesses did not like to reveal financial statements for confidentiality reasons. However they did not mind discussing the perceptions and understanding of financial status of their businesses orally. So we decided to collect the perceptional data on financial performances through the same questionnaire. The five questions on dependent variables such as, Financial
Returns, Market share growth, Business Valuation, Profit Growth, Rate of Business Expansion are collected from business owners along with other variables. These variables indicate the financial performance of organizations and a mandatory data to judge organizational performance. In this research study, we are considering only organizational performance is studied through financial performance assuming no variability in non financial performance parameters.

3.4 Sampling Techniques

We decided to study OI and OP of small and medium business in India located in and around Mumbai and Pune cities. A few large enterprises in India have created and applied their own business capability models such as Tata Business Excellence Model and Malcolm Baldrige Model for total quality Management and manufacturing and business excellence. Large enterprises manage business processes and systems efficiently. While sorting the data collected from such 24 multinational enterprises, we observed that these organizations have responded similarly for 80% of the questions. While discussing with the statistical experts, we understood that similarity of data points can affect the distribution of the data due to the reduction in the variations of data. On one hand, there is a statistical need to exclude influencing data points; on the other hand, there is an issue of more than 95% of samples of a population responding similarly. Thus we decided to consider only small and medium business with varied business processes and systems with different styles of leaderships and culture. Thus, we decided to choose SME (Small and Medium Enterprises) in and around Mumbai and Pune as samples of study. 115 samples managed by Indian families were chosen and the questionnaire (Appendix-53) was administered.

3.4.1 Sampling Techniques and Sample Population

We chose the samples from SME that are managed by family members, known as Family managed Businesses. These young respondents are the business owners
who assembled for a training program at S.P.Jain Institute of Management and Research (SPJIMR) located at Mumbai. These respondents aspire to understand their businesses better and take them ahead and interested in identifying the key parameters of their organizations that drive high performances and fine tune them to better positions with respect to the competitors and be competitively advantageous in the market place. They were keen on understanding the objectives of the research and the questions. The objectives of this research work and the interests of the respondents matched. Responses for the questionnaire designed demands complete understanding and macro overview of various business aspects from the respondents, who would preferably be responsible for business expansion, investments and business strategy formulation largely. They are either chief executive officers or managing directors of medium sized business organizations or business owners in the case of small and medium businesses.

3.4.2 Sample Frame

The sampling frame is identified to be the Small and Medium Business enterprises with business value ranging from 0.5 Crores to 5000 Crores of Rupees in India. Consultancy Firms owned by a person, smaller firms without proper business processes and work systems and entrepreneurial start up firms are excluded from the population of SME for this specific research work as the results would not apply to such businesses. These business owners were practically unable to respond to the questions in the questionnaire finding the variables and the concepts not applying to their businesses in the pilot study of the questionnaire to a set of 60 respondents. This enabled us to define the sample frame.

3.4.3 Sampling Procedure

Sampling procedure involved probability sampling. And samples were selected at random. The reason for selecting samples at random is the large size of the
population of SME in Indian Rural and urban areas. The reason is, S.P.Jain Institute of Management and Research considers the profile and aptitude of small and medium sized business owners from Rural and Urban sector as the participant for its training programs. This criterion of selection of participant gives us a set of respondents who are randomly selected from the pool of business owners. The selection of the participant (respondents & business owners) of Family Managed Business Program is not influenced by the size of the business, performance of the business owned by the learner. The selection is purely based on the merit of the participant in the learner selection process. Thus ‘Simple Random Sampling’ happens to be the sample selection method. Personal Businesses such as consultancy firms and entrepreneurial organizations are excluded from the sample as key aspects of established businesses such as standardized processes and work systems, and information and knowledge asset management planning do not exist. For the similar reasons, businesses with turnover less than 50 Lakhs of Rupees are also not considered. The respondents from these types of businesses could not fill in the questionnaire completely as they did not see relevance of the questions with their businesses. Entrepreneurial firms, consultancy firms and very small businesses without proper business processes and work systems are not part of the population. Thus the results of this research study are not applicable to such firms. Benefit of this research work will only enable established and systematically functioning businesses that may have an answer to the questions asked to their owners - the respondents of the questionnaire. Very small business owners could not answer most of the questions as they currently are not intended to strategize the business processes and systems and equip the organization with competitive edge over competitors. Innovators and entrepreneurs having start up firms tend to focus on profits and business expansion having high market opportunities. Their businesses are not fully established. Senior executives and Managers of medium businesses are also respondents of the questionnaire. The data is a collection of data from small and medium businesses. In Pilot study of data collection, from large corporations such as top 24 revenue making firms answered the questionnaire very similarly proving to be similar. Thus we chose medium and small sized organizations with varied background and random.
We can thus conclude, for a population of SME in India which has established businesses and business processes, simple random sampling procedure is employed for sampling. Thus every sample is given an equal opportunity of selection.

3.4.4 Scale Selection

Since the perception of respondents is studied, we decided to use the attitudinal scale - Likert scale. Each question is made as a closed ended question with options given ranging from 1 to 3 or 1 to 5 depending on the data to be collected. We felt it will be helpful to fetch exact attitudes and perceptions of the respondents towards various aspects of their enterprise. So that item analysis would evoke a wide response. It may also reveal the discrimination between positive and negative responses. Items with mixed response patterns and fuzzy from the final statement list are eliminated by this scaling method. A Likert item is simply a statement which the respondent is asked to evaluate according to any kind of subjective or objective criteria; generally the level of agreement or disagreement is measured. Often five ordered response levels are used, although many psychometricians advocate using seven or nine levels; a recent empirical study by John, (2008) found that data from 5-level, 7-level and 10-level items showed very similar characteristics in terms of mean, variance, skewness and kurtosis after a simple transformation was applied (John Dewas, 2008). Any grey answering is eliminated by Likert scale giving a bounded definition of each level of positive and negative attitudes towards the proposed question. This enables the respondent to answer in black and white leaving the fuzzy logic behind. The A standard Likert item is designed to be with “Strongly Disagree, Disagree, Neither Agree or Disagree, Agree, Strongly Agree” options. However the same is modified to suit the questions and the variable to be captured through that question. Hence there are 3 point scales, 5 point scales and 2 point scales.

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scales which act as dummy variables. There are biases in this scale such as, Respondents may avoid using extreme response options; agree with statements as presented; or try to portray themselves or their organization in a more favorable light. Designing a scale with balanced keying (an equal number of positive and negative statements) can obviate the problem of acquiescence bias, since acquiescence on positively keyed items will balance acquiescence on negatively keyed items, but central tendency and social desirability are somewhat more problematic. Given the distortions in this scale, it is chosen to be the optimum choice for data capturing and analysis as it is proven scale for a fairly accurate measurement model for an effective capturing of perceptions and attitudes.

3.4.5 Sample Size

We decided to collect data from the population of SME located in Rural and Urban India. There were finally 40 variables. For an exploratory study, to understand the relationship between OI and OP, it is necessary to do exploratory factor analysis amongst these variables and a regression analysis on those factors. For a satisfactory data analysis it is required to have data points that are at least 5 times the total number of variables. However, we could collect only 115 data points. Fortunately after doing factor analysis, we found from the factor loadings and the grouping of variables reduced the total number of variables from 40 to 12. We the required a minimum of only 60 data points for further analysis. However we had 115 data points which is sufficient for analysis. Hence we decided to continue analysis with the existing number of data points without collecting data anymore. Hair et al, (1995) says that if a researcher plans to use factor analysis in a study, factor analysis should not be done with less than 100 observations. Also, an increase in sample size will decrease the level at which an item loading on a factor is significant. For example, assuming an alpha level of 0.05, a factor would have to load at a level of 0.75 or higher to be significant in a sample size of 50, while a factor would only have to load at a level of 0.30 to be
significant in a sample size of 350 (Hair et al., 1995)\(^{192}\), which triggers a decision on a sample size that is justifiable balancing the trade off in the statistical analysis. This justifies the sample size of 115 for this research work.

### 3.5 Data Collection

Respondents’ profile and data collection method in this research study is explained in this section.

#### 3.5.1 Profile of Respondents

The respondents are owners of those businesses who have enrolled for family managed business management training program at SPJIMR, Mumbai. Profiles of respondents have age ranging from 20 to 30 and graduates and in businesses at least 6 months to 12 years. Age and the total experience are chosen to be 2 more variables added to the 40 variables while doing analysis. We expected that parameters such as “age and total experience” might affect the way the response was given as the questionnaire studies the perception of business owners on their businesses. We felt, it will be appropriate to include these variables in analysis.

#### 3.5.2 Data Collection Methods

We tried many modes of data collection methods. The percentage of success was very low.

i) **Email survey**: The questionnaire sent as an email attachment reached spam folders of most of the respondents. This method did not fetch any response from the respondents as they could not look at the questionnaire. From those who went through the

questionnaire, there were many doubts and queries regarding variable definitions. The discussion through email and chat took place without yielding results. This was also very expensive in terms of time. We found that most rural business owners do not use email regularly.

ii) **Telephonic Survey:** In this method, it was very difficult to get the appointment of business owners personally on telephone and explain and record the responses. Telephonic conversations got disconnected often. Getting them again on telephone was tough. This method was very expensive in terms of time and money.

iii) **Personal interviews:** This method too demanded lot of time and energy. Traveling across to different industries taking appoints did not work out successfully as business owners moved out on emergency. Many an appointments did not fetch the data we planned to get. This method consumed a lot of time in spite of having all the materials ready and me being present physically to administer the questionnaire. Work schedules could not permit me to travel and collect data personally.

iv) **Internet survey:** Using an internet portal for surveying was not effective for this questionnaire, unless I design a website myself for the same which demanded skills and time. We explored the outsourcing options of web designing and collecting data. Also we found, business owners were not comfortable in revealing anything about their businesses through such websites and emails. Earning their trust for getting true data became essential aspect of data collection.

v) Response rates were poor at the cost of time by all of these methods. So, the learning from the above experiences, made us decide to meet all business owners in a specific location at the same time, explain about the research and questionnaire and collect data. We decided this method will help me earn the trust of the respondents to reveal about their business realities. We planned to meet them and collect the data. Administering the
questionnaire personally to the respondent group at a specified location seemed feasible.

3.5.3 Self Administration of the Questionnaire

Questionnaire was personally administered and I was physically present to explain and clarify doubts if any. About the research work and the variables that are being captured from the respondents are explained briefly to avoid ambiguity and create interest amongst the respondents to fill the questionnaire. Total time taken by the respondents was 30 minutes including the prelude discussion and the doubts the respondents had about the names of the variables and definitions. A copy of Appendix -4 is given as a reference to the respondents while responding.

Part II

3.6 Questionnaire Design

Continuous search of literature on various performance measurement and business excellence models reveal various parameters that construct the questionnaire. It is then decided to explore various parameters that affect organization and performance. The queries raised and discussed in those focus group discussions at different stages of this research work are listed in Table 3.1. Literature Survey reveals that there are a few key aspects that drive the performance and growth of organizations. It is worthwhile to explore the drivers of these aspects in detail. There are many large multinational corporate houses explore themselves often to accelerate their growth and performance. The Literature study of research articles and business excellence models of successful enterprises of India explore various factors that drive performance and growth. Discussion by focus group on the literature study on OP, OI and OL lead to discussions on ‘How organizations achieve performance and growth? What are the broad factors that drive performance and growth? The key points are listed below, under 11 different categories for better understanding for questionnaire
design. The exploratory questions against each of these aspects of organization are listed below.

(I) **Leadership Capability**: How do leaders set and deploy organizational values, short-and longer-term directions, and performance expectations? How do leaders communicate organizational values, directions, and expectations through your leadership system, to all employees, and to key suppliers and partners? How do leaders ensure two-way communication on these topics? How do leaders create an environment for empowerment, innovation and organizational agility? How do they create an environment for organizational and employee learning? How do they create an environment that fosters and requires legal and ethical behavior?

(II) **Growth of organizational Performance**: How do leaders review organizational performance and capabilities? How do they use these reviews to assess organizational needs? Are Competitive performance and progress related to short-and longer-term goals? How do leaders use these reviews to assess organizational ability to address changing organizational needs? What are the key performance measures regularly reviews by your senior Leaders? How do leaders translate organizational performance review findings into priorities for continuous and breakthrough improvement of key business results and into opportunities for innovation? How are these priorities and opportunities deployed throughout the organization? How does an organization evaluate the performance of senior leaders and board members? How are these performance review findings used to improve leadership effectiveness?

(III) **Development of Strategy**: What are the key steps and people in strategic planning process in any organization? What are short- and longer-term planning time lines in strategic planning process of the organization? How does strategic planning address the key factors listed below? How does the organization collect and analyze relevant data and information to address these factors; customer and market needs, expectations, and opportunities competitive environment, capabilities relative to competitors, Technological and other key innovations or
changes that might affect products and services and operations, strengths and weaknesses, including human and other resources, opportunities to redirect resources to higher priority products, services, financial, societal and ethical, regulatory, and other potential risks, Changes in the national or global economy, partner and supply chain needs. What are the key strategic objectives and timetable for accomplishing them? What are the most important goals for these strategic objectives? How do strategic objectives address the challenges identified in response to this parameter in your organizational profile? Do strategic objectives balance short- and longer-term challenges and opportunities and the needs of stakeholders?

(IV) **Deployment of Strategy:** How does an organization develop and deploy action plans to achieve key strategic objectives? How does it allocate resources to ensure accomplishment of action plans? How does it ensure that the key changes resulting from action plans can be sustained? How to determine the changes in products and services, customers and markets, and operations, short and long term strategic plans for human resources planning? What are the key performance measures or indicators for tracking progress on action plans? How does the organization get aligned with the planning? How does an organization ensure the coverage of all deployment areas and stakeholders with a specific measurement system? How do organizations determine key performance projections for both short and longer-term planning time horizons? How does it compare projected performance with competitors’ projected performance? How does it compare key benchmarks, goals, and past performance across competitors?

(V) **Customer Oriented Market Analysis:** How does an organization determine customers, customer groups, and market segments? How does it include customers of competitors and other potential customers and markets in this determination? How does it determine key customer requirements and expectations and their relative importance to customers’ purchasing decisions? How does it use relevant information from current and former customers, including marketing and sales information, customer loyalty and retention data,
win/loss analysis, and complaints? How does it use this information for purposes of product and service planning, marketing, process improvements, and other business development? How do managers keep up learning in tandem with business needs and directions? How do organizations build relationships to acquire customers, to meet and exceed their expectations, to increase loyalty and repeat business, and to gain positive referrals? What are the key access mechanisms for customers to seek information, conduct business, and make complaints? How do they determine key customer contact requirements for each mode of customer access? How do they ensure that these contact requirements are deployed to all people and processes involved in the customer response chain? What is the complaint management process? How do organizations ensure that complaints are resolved effectively and promptly? How are complaints aggregated and analyzed for use in improvement throughout organization, vendors and by business partners? How does an organization determine indicators and design its scale for studying trends of customer satisfaction levels? How does it compare such analyses with competitors’ customer orientation levels? How an organization decides on the indicators of customer-perceived value, customer loyalty & retention and positive referral, product and service performance that are important to customers? How does an organization compare these results with that of competitors? How do organizations determine customer satisfaction and dissatisfaction? How do these determination methods differ among customer groups? How does it ensure that measurements capture actionable information for use in exceeding customers’ expectations, securing its future business and gaining positive referrals? How do organizations use customer satisfaction and dissatisfaction information for improvement? How do organizations follow up with customers on products, services, and transaction quality to receive prompt and actionable feedback? How do organizations obtain and use information on customers’ satisfaction with respect to that of competitors and industry benchmarks? How do they develop approaches to determine customer satisfaction of business needs and directions?
(VI) **Information and Knowledge Management:** How do organizations collect information and make them accessible to stakeholders? How do they decide on Information Infrastructure reliable, secure, and user friendly? How do organizations orient information systems towards business needs and goals? How do organizations accomplish the process of information collection, transfer of employee knowledge, Customer, Partner and supplier knowledge? How do organizations identify and share best practices? How do organizations manage integrity, timeliness, reliability, security, accuracy and confidentiality of data?

(VII) **Systems planning and Efficiency:** How do organizations manage work and jobs to enhance cooperation, Initiative, empowerment, innovation and organizational culture? How do they achieve agility to keep pace with changing business needs? How do work systems capture and capitalize on the diverse ideas, cultures, and thinking employees and the communities such as customer communities and employee clubs? How do organizations achieve effective communication and skill sharing across work units, jobs, and locations? How do employees’ performance management systems and feedback mechanisms support high performance, customer and business focus? How does an organization systematize compensation, recognition and reward and other incentive practices to reinforce high-performance work with a customer and business focus? How do Human resource systems identify characteristics and skills needed by potential employees? How do they recruit and retain new employees? How do organizations accomplish effective succession planning for leadership and key management positions? How do they plan and manage effective career progression for all employees throughout the organization? How do employee education and training contribute directly to the achievement of action plans? How do organizations find out the relationship between employee education, training and development address the needs of organizational performance improvement and technological change? How do organizations balance between short and long term goals through employee training and development, learning and career progression? How do employee education, training, and development address the needs of employee orientation across
diversity, ethical business practices, and knowledge management practices? How do organizations seek and use inputs from workers, managers and on employee skill betterment needs? How does the organization go about employee education and training? How do the delivery mechanisms get designed? What parameters of an organization decide the delivery modalities of training? How do you reinforce the use of new knowledge and skills on the job? How does an organization evaluate the effectiveness of employee training? Does it take into account the performances of individual and the organization as a whole? How does an organization motivate employees to develop and utilize their full potential? What are the mechanisms of an organization to help employees develop careers in their organization?

(VII) **Human Resource Planning, Management and Maintenance:** How does an organization deploy the plans for employee wellness and care policies? How does it improve workplace health, safety, security, and ergonomics? How do employees take part in improving them? What are the key indicators of these employee care aspects in an organization? What are the significant differences in workplace factors and performance measures or targets if different employee groups and work units have different work environments? How does the workplace prepared for managing emergencies and disasters? What is the level of preparedness to ensure business continuity? How does an organization determine key factors that affect employee well-being, satisfaction, and motivation? How are these factors segmented for a diverse workforce and for different categories and types of employees? How does an organization plan for employee benefits? How does it plan for catering diverse workforce and different types of employees? How does factors such as employee retention, absenteeism, grievances, safety, and productivity, to assess and improve employee well-being, satisfaction, and motivation used for planning employee motivational? How does an organization relate assessment of the observations of these factors for better business results, better work environment and employee support climate?

(IX) **Process Planning Efficiency:** How does an organization determine its key value creation processes? How do these processes create value for the
organization, customers, and key stakeholders? How do these value creating processes contribute to profitability and business success? What are the key requirements from customers, suppliers, and partners to create value? How does an organization design these processes to meet all the key requirements? How does an organization decide on incorporating new technology and organizational knowledge into the design of these processes? Does an organization incorporate cycle time, productivity, cost control and other efficiency and effectiveness factors into the design of these processes? How do they implement these processes to ensure meeting process design requirements? What are the key performance indicators used for the control and improvement of these value creating processes? How do organizations manage between the day to day operations and meeting process requirements for value creations? How is in-process measures used in managing these processes? How do organizations effectively minimize overall costs associated with inspections, tests, and process or performance audits? How does an organization prevent defects, rework and warranty costs effectively? How does an organization improve value creation processes to achieve better operational performance, reduce variability and improve products and services? How effectively the process improvements are shared with other organizational units and processes? How does an organization determine its key support processes to value creating processes? How do organizations select, collect, align, and integrate data and information for tracking daily operations and for tracking overall organizational performance? How do they use this information to support organizational decision-making and innovation? How do they effectively use comparative information to support operational and strategic decision-making and innovation? How do they use sensitive performance measurement systems to manage unexpected changes in organizations? What kinds of analyses they perform to support performance reviews and strategic planning? How do the results get communicated to work group and functional level operations to enable effective decision making?

(X) **Business Results:** What kinds of indicators of financial performance of an organization? Are there measures of financial returns and economic value of an
organization, market share or position, business growth and new market entries? How does an organization measure performance of work systems and effectiveness of employee learning and skill development, satisfaction and well being and operational performance, organizational strategy and action plans?

(XI) **Organizational Governance and Social Sensitivity:** How does an organization determine on the indicators of ethical behavior of stakeholders and decide on scales for measuring fiscal accountability, compliance of regulatory policies effectively? How does an organization accounts for the actions of Management? How does an organization protect the interests of stakeholders and stockholders? How does an organization address the impacts on society from its products, services, and operations? What are the key compliance processes, measures, and goals for achieving and surpassing regulatory and legal requirements? What are the key processes, measures, and goals for addressing risks associated with products, services, and operations? How does an organization anticipate public concerns with current and future products, services, and operations? How does it get prepared for these concerns in a proactive manner? How does an organization ensure ethical behavior in all stakeholder transactions and interactions? What are the key processes and measures of indicators for monitoring ethical behavior throughout the organization, with key partners, and in governance structure? How does an organization actively support and strengthen communities? How do a senior leader and employees contribute to improving these communities?

**Evolution of the Questionnaire:** The questionnaire with 165 questions picked and chosen from the above reflected from literature were sent across to senior management executives of 12 different large corporate houses chosen from the list of top 50 large enterprises of India. This questionnaire is given as Appendix-1. Only 6 people responded with the comments that the questionnaire had similar and redundant queries. Then we decided to prioritize the questions and removed those redundant questions that lead to similar answers from respondents. Another 24 corporate houses were chosen from the population and the second list was administered. This questionnaire having 153 questions
(Appendix-2). Only 12 organizations responded this time. Respondents said, they could not respond at one stretch as it was time consuming. It was then decided to reduce the number of questions drastically to something around 50. We called for focus group discussions once again, with the experts from the domain of organizational theory and research methodology on the ‘priority of questions’. After ranking all the questions, first 40 questions were chosen. All these 165 questions emanate from various research articles of different journals of Social Science, Psychology, Economics, Information technology and Management Science. The rationale behind those final 40 questions (Appendix-3) thus chosen have a relevance from the Literature which is discussed in detail in the next section. These forty variables form the basis for the instrument design. These 40 variables are also supported by the literature as discussed in the next section.

The questionnaire thus designed is structured and undisguised. The questions are designed to test various aspects of business management such as - attitudes towards quality, intentions towards employees, awareness about competitors and consumers, characteristics of socioeconomic conditions of the market and behavior of leaders. They are designed to fetch direct responses; they are closed ended questions.

3.7 Relevance of the Questionnaire

Variable selection and exact question design evolved from the literature which is being discussed as relevance of questions. In the previous chapter it is mentioned, “There are common constructs of OL, OI and OP; they are, Leadership and Culture, Rigor in Strategic process Planning and deployment, Health of Stakeholder Relationships, Knowledge and Information Management capabilities, financial performance, Systems efficiency, Business Process Efficiency, Product and service Quality”. Literature study reveals that there are 8 key constructs being common and repeatedly discussed by most researchers and from the table that compare constructs of OL, OI and OP (Table 2.1).
Initially a questionnaire (Appendix-1) containing 165 questions were designed and further reduced to 153 questions (Appendix-2) by eliminating similar questions. From this question set, 40 questions were selected. The paragraphs below list all these 40 variables and their relevance from the literature. Final version of the questionnaire thus formulated is given in Appendix-3.

1) A multinational company can develop and sustain ethical capability through the related processes of transformational leadership, organizational learning, and human resource management (Buller et al, 1999). This clearly indicates how interest of leaders in encouraging accountability and responsibility for organizational learning as a whole and incorporate values in business processes. This aspect is studied through the question “How many times in the last 6 months you have taken decisions to change critical business processes, considering the learning from the past in the organization?”

2) Effectively balancing the needs of various stakeholders can lead to enhanced corporate reputation, increased solidarity, commitment, loyalty, and productivity of employees, and lower costs in maintaining complex networks of suppliers, customers, agents and geographically dispersed employees, particularly in globalization strategies along with an organization's ability to engage in ongoing, and constructive dialogue with its various stakeholders can be an important source of competitive advantage (Buller et al, 1999). This indicates highly performing organizations have capable leaders who assess stakeholder needs of business units periodically. This can be studied through the question “How often you calculate the needs of stakeholders and business markets in your business unit?”

3) Assessing performance with key structural elements of a typical performance measurement system enables higher performance of customer

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centered business processes (Hatten et al, 2001). This indicates it is worthwhile studying whether learning leaders are interested in incorporating the findings of the employee performance into practice? This can be studied through the question “Have you taken decisions of changing roles of employees and business processes based on their performance to improve business performance?”

4) Best firms possess a product innovation strategy that consists of the business' goals for product innovation and how the new product effort ties into its overall business goals. They have a portfolio management system that helps leadership teams allocate resources to the right areas and right projects. It is stated that there is a positive climate and culture for innovations in top-performing business (R.G.C et al, 2007). It is relevant to explore if business units can create & deploy opportunities for innovations in business practices to meet business goals. This is studied through the question “How many instances were there in last 3 months, where you had encouraged your employees to innovate business practices and activities to meet business goals?”

5) Emotional Intelligence affects leadership behavior of the project leaders in the organization. Emotional Intelligence of leaders generates delegating, open communication, and proactive behavior, which can bring positive outcomes to the organization (Sunindijo et al, 2007). This Article indicates clearly it is worth exploring the good leaders stay proactive in sensing the opinions and concerns of employees and society about the products and services through open communication. This is studied through the question “How early and quickly you are able to sense the concerns of employees and society about your products and services? (Select one) within 2 months? Within 1 month? Within 15 days? Within 1 week?”

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6) The aim of an organization is to go beyond the satisfaction of stakeholders by meeting their needs and expectations—this goal is limited to specific transactions or time periods. The challenge for organizations is to reach a new frontier of trust among its stakeholders, which makes it possible to endure the hard times, and continually to explore, with success, emerging opportunities (Dervitsiotis et al, 2003). This article indicates studying the Presence of processes and scales in an organization to measure and determine the satisfaction and dissatisfaction of customers and employees and the cordial relationship between them—may yield clues on performing organizations. This is studied through the question “How frequently you measure the stakeholder relationship satisfaction in your business unit?”

7) Rapid technical progress and frequently changing market conditions force employers to manage labor force flexibly “Flexicurity”, the combination of labour market flexibility and security for employees has become a much praised policy in Europe. Employee security is encouraged in manpower management and welfare (Bekker et al, 2008). This indicates its worthwhile studying Interest of organization to protect health, safety and security of its employees (such as, health schemes, checkups, safety measure trainings and good ergonomic arrangements for work) that may lead to OP. Thus us studied through the question, “Where will you rank your organization for its interest to protect health, safety and security of its employees (such as, health schemes, checkups, safety measure trainings and good ergonomic arrangements for work). (Rank between 1 to 7. Lowest rank is 7. Highest 1)”

8) Design of dashboard for business continuity management system (BCMS) can be constructed using resiliency capability levels. This customer centric dashboard ensures the ability to track and baseline the present capability level and focus on the activities that would help leapfrog into the higher capability

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levels; it also provides guidance for governance (Sheth et al, 2008). This paper motivates the interest to explore organizations that are customer centric and keen on business continuity in dire circumstances. This can be studied with the question, “How many times in last three months your business unit met crisis and managed it effectively to continue business?”

9) A study (Huang et al, 1997) investigates the impact of participative management on the behavior of employees and the financial effectiveness of the enterprise. Analysis reveals that the quality control circles (QCC) and profit sharing amongst employees have a positive impact on organizational effectiveness, which is seen in profit and revenue growth rates. Where in, employee stock-ownership plans and grievance-handling systems have negative effects on both performance indicators - employee behavior and organizational effectiveness. It is worthwhile studying the performance of such profit sharing organizations for this research to explore Capability and interest of organization to support and share profits with employees via services, benefits and policies. The question that is designed to explore this aspect is, “How many different types of profit sharing modalities are in operation for employee benefits”

10) A research study (Oxenfeldt et al, 1981) presents a model of competitor analysis that provides operating executives with an action-oriented framework for preparing long-term plans and developing business strategies with competitor orientation contrasted with customer orientation background and current competitive analysis practices. This study triggers the interest to explore Capacity of organization to compare itself with competitors’ levels of customer and stakeholder satisfaction; their best practices and incorporate them in strategy formulation. This is studied with the question “How often Competitor comparison & analysis is done, for the aspects of products, customer satisfaction and best practices?”

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11) This research study (Issam et al, 2006) discusses quality function deployment (QFD) technique is used in the formulation process to provide the basis for selection between options in each of the formulation stages. The model proposed consists of six stages starting from the business strategy formulation, functional strategy formulation, manufacturing priorities formulation, the generation of action plans and the suggestions of the detailed tasks of each action plan, and ending up with the evaluation of the developed strategy. QFD capture software is used to form the matrices needed for the proposed model. This study indicates that it is worth exploring the interests of an organization to formulate methodical strategic formulation and deployment for business results. At a micro level, it is worth studying the Ability of leaders to decide key roles and responsibilities for the execution of action plans along with resource, which will indicate the ability to plan the minute details for strategic planning in an organization. The question that explores this aspect can be, “What are the key factors you consider while making action plans for your SBU (Strategic Business Unit)?” With answers such as, Roles and responsibilities definitions, resource allocation planning, action plan execution duration, crisis anticipation ability, disaster management planning. Respondents can be asked to select all of those, which are considered.

12) A study on customer valuation in marketing and strategy formulation (Wyner, Gordon, 1996) offers guidelines on how to use the concept of customer valuation in formulating marketing strategies. The author defines customer valuation as a definite economic component of lifetime value and reveals the worth of integrating these components into planning. This study indicates it might be beneficial to study the Ability of an organization to collect complete details on customers, market, competitors and use them to deploy opportunities, as there can be a valuation done on these aspects and the results will yield insights for business decisions. The question designed to explore this aspect can

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be, “How frequently you collect data about markets and customers to use them in strategic planning processes?”

13) This study (Lee et al, 2007)\textsuperscript{205} explores the factors to be considered by customers while choosing telecommunication services, identifies strategic dimensions in formulating telecommunication service selection strategy, and classifies companies that provide services into strategic groups. Finally, the characteristics of telecommunication service strategy of each strategic group are examined. The purpose of this study is to analyze organizational strategy in the viewpoint of technology selection for strategy formulation and deployment. This study indicates it is worth exploring Capability of organization to incorporate technological changes and innovations in planning process. The question exploring this aspect can be, “when last your team included technological changes and innovations in planning process?”

14) A brief case study (Partridge, Amy Bock, 2006)\textsuperscript{206} on tracking the progress of action plans yielding better business results. Besides the intended outcome, there are by-product benefits to the clients in addition to better business performance for the firm that tracks progress of action plans periodically. It is worth studying the Competency of organization to track the progress of action plans. The question that explores this aspect can be, “How often you find the success or failure of the action plans, while the plan is getting executed?”

15) This study (Wu Zhong et al, 2008)\textsuperscript{207} says that pursuing the maximization of enterprise's value is the same as pursuing the maximization of stakeholders' benefits under the balanced circumstance. The maximization of enterprise's value and the maximization of stakeholders' benefits are consistent. They comprehend financial object from two aspects of financial essence. It is worth studying Ability of organization to strike a balance the trade off between the goals of organization.

and stakeholder benefits at any stage. This can be explored with the direct question, “What is the level of clash between the organizational goals and stakeholder benefits? Rank between 1-7. (Most clash -7, least clash -1)”

16) This article (Turner, Paul et al, 1991) focuses on how the different types of information from Environmental analysis, Market analysis, Competitive advantage and Strategic options, are managed when linked together. The quest for a winning business strategy will force a firm to match its internal capabilities to external market opportunities. Strategic decision making will involve firms moving from a broad span of options to a narrower scenario through a process based on iteration, specialist functional inputs and the relationship between corporate and business unit goals. The subsequent ability of the firm to compete will depend on, identification of competitive forces and competency of the firm to mobilize resources in any given span of time. Information analysis skills and knowledge deployment are the keys to grow competitive. Such a perspective induces interest in studying the competency of organization to communicate and incorporate results of organizational level information /data analyses to work group and functional level daily operations. This can be studied with the question, “How frequently you collect data about your organization for planning business functions and activities?”

17) Effective Information usage depends on how effectively stakeholders use the information from a stable information and communication infrastructure. Information and communication technology research on the tools available for data collection, processing for accurate and correct information for decision making affect stakeholders’ decisions at various times (Barbour, R. H, 2006). This study indicates, it may be interesting to study the Competency of organization to ensure the quality, availability and accessibility of information for stakeholders. This can be explored with the question, “How quickly, continuously and accurately information can be accessed in your department for

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decision-making?" This question was specifically tested by designing and implementing digitization of library in symbiosis university, Pune. Information systems architecture was designed and implemented. The implementation of this information system implementation for digitizing the library was not tested to find out whether there had been any significant change in the performance of the organization could not be tested as there was only one sample was being tested. However the feedbacks from library on the efficiency of locating articles and books improved incrementally. (Anuradha et al, 2009)

18) The article (Jackson, Patrice, 2007) suggests a model for knowledge asset management (KAM). In the knowledge economy people are the most valuable asset of an organization, however, a methodology that correlates their value to organizational performance is lacking. Knowledge from experience can be stored and managed which can link to organizational performance. This indicates, it is worth studying the Competency of organization to build and manage its knowledge assets. The question to study this quality of an organization can be, “Does your organization have knowledge management forum/methods for employees to refer?”

19) This study (Shi-ming Huang et al, 2006) uses balanced scorecard framework to set up performance index for information security management in organizations. This study combines the information security researches and organizational performance studies. The result helps organizations to assess values of information infrastructure management and link performance to business strategies. This study obviously indicates that it will be worthwhile if someone studies the competency of organization to ensure the knowledge and information infrastructure secured, stable and user friendly to the users. The question representing this motive is designed to be “How will you rank your

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organizations IT and knowledge network infrastructure for security and stability between 1 to 7? (Best -1 worst -7)"

Good and Great companies align their business around customers value because it' is a good indicator of profitable market share. They collect customer information regularly and change organizations based on the information obtained. These organizations integrate information from cross-functional and cross-organizational level to act on customer's perceptions of products and services. The resultant closed-loop model enables organizations deliver superior customer, shareholder, and employee loyalty (Goodwin et al, 1999). This indicates the interest of organizations to collect analyze and use the information for well-defined business results. The question designed to investigate this quality is, “Does your organization understand customer relationships and buying decisions through any systematic study?”

Over a decade, empirical studies on the organizational performance of IT investment are not conclusive and not completely competent in measuring values of investments in Information Technology. Traditional measures have primarily been financial: return on investment and return on sales. This study shows that time tag has positive impact on the performance measures of corporate strategies, which are significantly correlated with operational activities (Wu et al, 2006). This indicates it is important to look at Financial Returns while studying organizational Performance. Capacity of organization to identify specific indicators of trends of its financial performance, financial return and economic value can indicate its intelligence in market place. Thus, the question is designed this way to explore the same aspect in this research study too. It is, “How will you rate your organization between 1 and 7 for its capacity to identify the financial growth trends? 1 - Excellent ability; 7 – totally ignorant of sensing financial growth” It is proposed to collect data on financial returns which will be one of the dependent variables for the experiment.

The objective of this study (Carlos et al, 2006) is to investigate the differences between high and low-performing manufacturing organizations in relation to critical organizational performance dimensions. This study reveals that high-performing manufacturing organizations, relative to their low-performing counterparts, tend to emphasize more the performance aspects related to employees, customers and market share. As such, these organizations appear to consider employees and customers related performance aspects as critical elements of the overall organizational performance. This study indicates performance of organizations impact market share. It will be worth studying market share portfolio along with other aspects for analysis. The direct open-end question that captures this crucial variable is, “Growth of Market share prices in the last 2 years” Market share is another dependent variable of the experiment designed.

Economic Value Added - has immense potential for capturing social and economic contributions of performing organizations, instead of merely going by financial returns. EVA is applied in private enterprises to correct accounting distortions; in public enterprises it can be applied to correct earnings distortions. This study (Ramesh et al, 2007) captures the opportunity cost of key factors, which make significant difference to their performance. EVA variable gives a valuable framework for inter and intra-organizational performance evaluation across the chosen organization for study. This indicates it is worth studying EVA of the samples as EVA reveals more clarity on organizations. EVA calculates the business value. EVA can also be considered as a dependent variable for the experiment designed. The question that is designed to capture this data is direct; “Economic Value Analysis indicators show positive signs of growth in the last 2 years”

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24) This study (De Smet et al, 2007)\textsuperscript{217} finds out a relationship identified between organizational performance and profitability. Strong organizational performance reaps financial dividends weaker performance leads to dip in financial dividends. It is worth studying the bottom line for this research undertaken through a direct question, “Profit growth in the last 2 years ----”. Profit Growth again can be considered as a dependent variable in the experimental design.

25) The article (Rakshit, Arup, 2008)\textsuperscript{218} discusses the initiatives of the Indian government to boost the competitiveness of its textile sector. It put up a scheme for Job Assurances and training of workers; the strategy for market expansion, product diversification, greater value realization for products and better market access is designed in this study. This study indicates Market expansion and business diversification indicates growth and performance. This variable “Business expansion” is also considered as a dependent variable for the experimental design. This direct question materializes the intention behind the experiment; “How many New Business verticals had been started in the organization in the last 2 years --------”

26) This study (Dean Jr et al, 1992)\textsuperscript{219} concludes that managers should use new technologies to empower the workforce, leads to predictions that AMT will be associated with less differentiation, decentralized decision making, and limited formalization. This indicates employee empowerment through decentralized decision-making leads to better performance of organizations. It is worth studying this aspect for the research undertaken. The data for this variable ‘Interest of organization to promote decentralized decision making through cooperation, initiative and empowerment for efficient work systems amongst employees’ can be obtained from the question, “Are employees at a lower level, located at different places empowered to decide apart from corporate offices?”

\textsuperscript{217} De Smet et al, (2007), “The Link Between Profits and Organizational Performance “, McKinsey Quarterly Issue 3, p6-9,
27) The article (McClernon, Timothy et al, 2006) discusses 3 levels of operations; individual, workflow and organization. System approach to training includes evaluating approaches before, during and after training to ensure employees truly benefited from the training in terms of enhanced result to the organization. In short, it indicates that studying the Capacity of organization to maintain and manage sustainable workflow systems will be worth it. The question designed to capture this variable is, “How often you change the workflow systems that are being followed?”

28) This study (Yuk et al, 2003) discusses collective capabilities, such as - gaining the trust of customers - arriving at tailored solutions through cross-functional collaboration – display core competencies on the non-task performance providing sustained competitive advantage. This study says that, to achieve advantage, employee performance management systems should not focus on task performance alone; it should emphasize employee development. This study clearly indicates it would be fruitful to research on the Capacity of organization to maintain and manage an effective workable employee performance management system. The question that captures this aspect is, “How effectively your organization manages employee performance management system? (Rank between 1 and 7)(Very well managed –1 poor management -7)”

29) This study (Hassan et al, 2007) reveals that there is a strong relationship between human resource development (HRD) practices and organizational values. HRD practices like potential appraisal and promotion, learning, training, performance guidance and development were positively related to organizational values of collaboration, creativity, quality, delegation, and humane treatment. However, performance appraisal system, career planning,

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and contextual analysis variables were negatively associated with values such as trust and creativity. This exploratory study induced the motivation to know the Interest of organization having a career path planning for employees. The question that is designed to capture this variable is, “Do all your employees have a career path in your organization?”

30) This study (Ittner et al, 1999) constructs a simple conceptual model linking product development cycle time to organizational performance. This indicates the importance of studying the Competency of organization to identify productivity, cycle time, supplier, and partner performance for measuring organizational effectiveness. The question that can study this variable is, “Rate the level of competency (between 1 and 7) of your organization to identify productivity, cycle time, supplier, and partner performance for measuring organizational effectiveness (Highest 1; lowest 7)”

31) The article (Akiyama, M, 2007) discusses on risk management and measuring productivity with Point of Act System (POAS) in hospitals. The POAS targets common issues in hospital management by synchronizing each department and allowing information exchange that enables the management of the business process, medical materials and medicine, expenditure of purchase and receipt, and medical records. This Study reveals the linkage between business process efficiency and productivity with Point Of act Systems. This clearly puts forth the need for exploring the Capability of organization to locate value creating processes and improve business process efficiency that contribute to productivity. This is achieved by asking a question such as, “How many value creating business processes you have in your SBU (Strategic Business Unit) /Department that impact productivity and profitability directly?”

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32) This study (Radha Krishnan et al, 2008) examines the relationship between Information technology and business value from a process-oriented perspective, and also helps to identify the underlying links between Information technology and its differential business value to firms. It develops a process framework to assess the intermediate organizational process capabilities and overall performance of firms that effectively deploy and use Information Technology. This indicates it is interesting to study the Ability of organizations to incorporate new technology and tools with organizational knowledge into the design of these processes. The question that explores it can be, “how many new technologies and tools you had used to design such value creating business processes in your organization?”

33) This study (Drakšaitė et al, 2008) discusses that the prime factor, which drives towards supply costs saved, is the notion and imperative to achieve sustainability into every aspect of defining and modifying certain supply chain of company. Innovative supply chain strategies that couple physical goods movement with financial information sharing and financial underwriting can open the door to greater end-to-end supply chain cost savings, better balance sheet, lower total costs, higher margins, and a more stable supply chain with everyone sharing the savings. This paper triggers the interest to study the Capacity of an organization to minimize overall costs associated with inspections, tests and process performance audits. This can be studied with the question “How many different ways with which you had reduced the costs of audits, inspections and process performance tests in your department?”

34) This paper (Alegre et al, 2008) examines how organizational learning capability affects product innovation performance. This study defines organizational learning capability through five dimensions or mechanisms: experimentation, risk taking, interaction with the external environment, dialogue

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and participative decision-making. The impact of these mechanisms on product innovation performance is also analyzed. This indicates the benefits of exploring the Competency of organization to improve value creation processes periodically resulting in better performance, variability reduction, and product & service improvements. This can be studied with the question, “Do you measure product and service improvements that happen through these value-creating processes?”

35) This study (Lee et al, 2008) assesses process improvement from organizational change in the areas of resource utilization and allocation and cycle time and cost reduction. A case study method was followed to indicate that the assessment method was a promising approach for identifying alternative processes that leads to better organizational performance. This study motivates the interest to explore the Capacity of organization to prevent defects and rework process performances. The question design is, “How many procedures and methodologies are used in your organization to prevent defects and rework process performances”

36) This study (Lenka, Usha, et al, 2008) identifies several quality management practices or core concepts of TQM that can help organizations to achieve business excellence. These core concepts are; (a) transformational leadership, (b) customer orientation, (c) human resource management, (d) organizational culture, (e) continuous improvement, and (f) quality measurement. In order to sustain in a competitive environment, companies need to adopt the core concepts of TQM. This triggers the interest to study the Capacity of organization to identify accurate indicators of product and service performance that are important to customer. The question that can capture the suitable data is, “Do you have scales to identify and measure product and service quality in your organization?”

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37) This research study (Yeung, Andy, 2008) reveals that Strategic Supply Management improves on-time shipments, reduces operational costs, and leads to customer satisfaction and improved business performance. Developed based on contemporary premises in supply chain and Quality Management, this research refines our understanding of the relationships among quality initiatives, Strategic Supply Management and organizational performance. It is worth studying the Capacity of organization effectively managing quality improvement programs in business processes leading to services. The question that can study this aspect can be, “How often do you upgrade procedures for quality business processes in your organization?”

38) This paper (Richard et al, 2006) reviews and examines the key concepts of Business Process Management and its effects on organizational performance. Process Alignment and People Involvement are two key concepts for successful implementation of Business Process Management. The findings provide in-depth interpretation of previous studies regarding the relationship between the effects of alignment on organizational effectiveness. The results present evidence that Process Alignment and People Involvement are positively associated with organizational performance. This obviously inspires the study of the Capacity of organization to upgrade the quality improvement processes and implement them in various business processes periodically. This is studied with the query, “How many different procedures are used for quality improvement of the business processes in your organization?”

39) This study (Nadvi, Khalid, 2008) reveals that Developing country firms and farms are confronted by an array of distinct product and process standards that they must meet. This has heightened the competitive challenges they face. Non-compliance can result in exclusion from profitable markets and secondly, considers how global standards affect the governance of value chain ties. There is

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an obvious trigger from this article, to study the capacity of an organization to have scales for measuring product/service quality at every stage of the value chain. This is studied with the question, “Do you measure value additions at every stage of the value chain?”

40) In this study (Hong Qin et al, 2008), the authors develop an instrument to examine the relationships among service quality, food quality, price/value, customer satisfaction, and behavioral intentions. The findings are employee behaviors, reliability, responsiveness, and empathy—positively influence the perception of service quality. The results also support the contention that service quality and customer satisfaction are two important antecedents of customer intention. The indirect effect of service quality on behavioral intentions is not supported by this study because the authors did not find a significant relationship between service quality and customer satisfaction. This interesting study instigate that the Capacity of organizations having procedures to monitor quality continuously will help this research immensely. This variable can be captured with the question “Do you have scales to monitor continuously the quality of processes?”

Out of these 40 variables, 5 variables are chosen as dependent variables. They are; Financial Returns, Market share growth, Business Value, Profit Growth, Rate of Business Expansion. These are the key measures of financial performance of businesses (Jeffrey et al, 1997).

Thus, we decided to explore these 40 variables (Appendix 4) from the data points collected along with two more variables that represent maturity of respondents, as the experience of the respondents affect their perceptions on business realities. These variables are estimated with the technique EFA (Exploratory Factor Analysis). Then it is decided to use multiple regression analysis technique to

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study the relationship between these factors from EFA. Appendix-4 lists names of the variables and their meaning perceived from the literature.

3.8 Coding of Questionnaire

The Questionnaire (Appendix 3) has 40 questions fetching data for 40 different variables chosen (Appendix 4). These questions are selected by business leaders and management Academia from the earlier versions having questions four times that of the final version. Organizing, sorting and coding are taken care of by SPSS software used for factoring the data. Except Question Number 11 (Appendix 3) the rest of the questions would be entered with the multiple choice option numbers. For Question 11, if only one of the options is chosen then 1 would be entered in the spreadsheet; if two options are chosen 2 would be entered, and so on.

3.9 Conclusion

In this chapter the entire Research Design and Processes, sampling procedures, data collection methods adopted are described. The Relevance of the questions and the variables are established with literature support. The rationale behind the choice of variables based on business reality is discussed. In the next chapter Conceptual Models from Literature, we will discuss about various conceptual models found in the literature and confirm the chosen variables for further design of the instrument.
Chapter IV
Models of OI from Literature

4.0 Introduction

This chapter is an extension of Literature Survey to confirm the choice of variables suggested by senior executives of corporations and researchers. In the earlier chapter we discussed about Research design and methods in detail. The choice of variables and samples, questionnaire design are discussed and the reasoning behind those designs was explained. In this chapter we will discuss about various conceptual frameworks from OI Literature. These models are based on intuitive understanding of the organic entity called organizations that learn cognitively and grow. These models are experimentally verifiable with suitable instruments. There are also analytical models that suit my research such as exploratory factor analysis and Multiple Regression methods. Here we discuss the model variables and how are they similar and different from the variables chosen for our research work. Section 4.1 covers different conceptual models found in literature. Section 4.2 discusses the inferences from them and confirms the choice of the variables chosen to study Organizational Intelligence (OI). Section 4.3 concluded the chapter.

This entire chapter sets the platform for the construction of OI measurement model – primarily with the Part I of the objective. Part II deals with the exploration of the linkage between Organizational Intelligence and
Organizational Performance and that is independent of the models discussed in this chapter. Thus this chapter revolves around first part of the objective set.

Part I

4.1 Models from OI Literature

There are plenty of angles to looking at organizational Intelligence (OI). They are theoretical, descriptive and largely intuitive designs of OI. Each Model addresses on various aspects of organizations from learning ability to organizational structure and performances in the market place.

4.1.1 Environmental Scanning Model of OI

This model proposes ‘Intelligent Organizations can scan environments’ (Thomas Gerald, 1997). This model describes that, it is difficult to transform information into knowledge for decision-making. Intelligent organization, defined as one that learns and adapts to the environment in which it exists, with particular emphasis on the value of systematic scanning of the organization's external environment. Learning takes place only when the organization effectively acquires, organizes, stores, and, most importantly, transforms information into knowledge products that are useful to its purposes. This Model once again establishes the humanistic nature of organizations to scan and learn from environments and change themselves to adapt to environments.

4.1.2 Creative and Innovative Model of OI

This model proposes ‘Intelligent Organizations are creative and innovative’ (Vickers Margaret, 2000). It reveals that a rational balance of exploitative and exploratory learning depends on the distribution and relations of power and

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knowledge constituting that organization. The power relations that foster innovation and creativity characterize intelligent organizations. They are able to successfully strengthen and distinguish their place in the market by trading off the intelligence of their employees. Global technology enhances dissemination of knowledge gained from exploratory learning across geographically distant domains.

Competitive advantage gained when innovations developed by skilled employees are disseminated to less economically rich locations, in which wages and other overhead costs are significantly lower, may come at the cost of future viability for the organization, its employees, and its community. OL will be enhanced if current practice is not embedded in past memory and constraining rules. Practical OL always involves imagination and understanding of multiple designs, processes, ways of thinking and realities. According to this theory, Creativity and OL are the components of an intelligent organization.

### 4.1.3 Intellectual Capital Model of OI

This model says, ‘Intelligent Organizations have Sufficient Intellectual Capital’ (Richards Brett, 2002)\(^{237}\). This model proposes that, in a dynamic, global environment in which competition is service-based and knowledge-intensive, human creativity and individual initiative is a critical source of competitive advantage. Additionally, organizations need to be designed so that they are flexible enough to exploit the idiosyncratic knowledge and unique skills of each individual employee. A fundamental challenge for leaders is to create effective systems and an organizational climate that allows intellectual capital to flourish. Intellectual capital is the sum of an organization's intangible assets. It's the, know how, know who, and know what of everyone in the organization that can be leveraged to create wealth. Intellectual Capital is taken as the key variable that may determine OI.

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4.1.4 Information Managing Model of OI

This model proposes ‘Intelligent Organizations manage Information efficiently’ (Malinowski et al, 1999). Identification of information needs, Information acquisition, Information storage and organization, Information products and services, Information distribution and Information usage are the key aspects that determine OI.

4.1.5 Action based Model of OI

This model proposes that ‘Intelligent Organizations have the ability to achieve the targets set’ (Sessa Valerie, 2004). OI is defined as "the capacity of an organization to mobilize all of its brain power, and focus that brain power on achieving the mission." There are seven organizational components of OI. These are strategic vision, appetite for change, alignment and congruence, performance pressure, knowledge deployment, heart, and shared fate. This model also speaks of the softer aspects of humanistic organizations such as brain power. The scale to measure and assess these aspects such as heart, fate sharing capabilities is based on perceptions.

4.1.6 Decision based Model of OI

This model says, ‘OI is the ability of an organization to decide correctly’ (Miner Anne, 2002). There are four aspects that contribute to OI. They are, Decisions in Organization, Learning in Organization, Risk Taking in Organization and The Giving and Taking of Advice in organization. These variables such as giving and taking advices, risk taking abilities are based on softer aspects such as culture, interpersonal skills and the leadership abilities.

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4.1.7 Information Utilization Model of OI

This model says that ‘OI is the ability of an organization to innovate effectively’ (Lawson and Samson, 2001)\(^\text{241}\). This model proposes that Innovators create an awareness of internal and external customers. Employees are actively encouraged to search out customer needs and problems, both known and latent, in order to solve them in a value-adding manner. The process of generating, learning and applying knowledge about competitors’ products and strategies are developed and used effectively in some management systems leading to better learning thereby establishing the presence of Intelligence. This model proposes the ‘Competitor Learning’ significantly help in position diagnostic benchmarking and position advantage building. This model deals with the harder aspect such as stakeholder satisfaction and competition management based on the business reality that can be measured directly.

4.1.8 Neural Network Cognitive Learning Model of OI

Compared to human beings who have an ability to grasp complex information from the external environment; an ability to process, assimilate and respond to the information and an ability to learn from the entire activity done from the reception of the information and the response given. In contrast, organizations do display such cognitive abilities and similar behavior patterns of learning (Anuradha et al, 2008)\(^\text{242}\).

This model proposes the learning organizations exhibit intelligence which can be measured with these 6 prominent attributes of organizations, which can be used for measuring OI. (i) **Bounded Rationality of Learning** - Learning behavior of organizations is actually indeterminable and probabilistic. There are many


actions performed that may not account to a predefined framework of rational learning.  (ii) *Implicit and Explicit Knowledge Management* – There are two ways by which organizational learning takes place; Implicit and explicit Knowledge management. (iii) *Conceptualization through Clustering* – Organizations learn through categorization and clustering of information same as that of human beings. (iv) *Building and Managing Expectations* – organizations manage future expectations by compare and build concepts that can be applied for future expectations.  (v) *Logical and Reasoning Abilities* – A multiplayer perceptional ability of decision making are developed from the logical and rational algorithm followed to arrive at a plan that may yield an optimum result for an organization. This ability is innately present with organizations. (vi) *Intuitive Learning Capabilities* - A truly motivated organization gets the skill of intuitive decision making by experience. The more is the complexity of business processes and the product lines; more is the need for intuitive abilities to understand the linkage between them. This is a research publication by the student, a secondary research work from the literature review done.

### 4.1.9 Combined Human & System Model of OI

An organization is a socio-technical system and it might be composed of many interoperating systems, each containing some intelligence. Thus the human intelligence of many employees when combined with the artificial intelligence of machines might deliver high efficiency of output (John Searle, 1999)\(^243\). This paper says integrating human intelligence with interdependent system intelligences can improve performance of organizations. It is interesting to note from the theory proposed in the book by Ray Kurzweil, that intelligent human beings can stay de-motivated in stupid organizations in (Ray Kurzweil, 1999)\(^244\). Systems thinkers such as ray Kurzweil and John Searle call an emergent property - an attribute of the whole system, not of the individual parts. What matters most

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is how the parts of the organization are put together to get it dynamic to perform the best. The integrated intelligence of organizations can be a combination of techno-intelligence and human intelligence of the organization. From the arguments put forth by Ray Kurzweil, there are four types of intelligences proposed conceptually that govern the integrated intelligence of the organization; they are listed in Table 4.1

<table>
<thead>
<tr>
<th>Intelligence Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Intelligence</td>
<td>Collecting, interpreting, and using vast quantities of complex data by both human beings and organizations.</td>
</tr>
<tr>
<td>Organizational Intelligence</td>
<td>Collaboration between people and technical artifacts within and beyond complex enterprises.</td>
</tr>
<tr>
<td>Developmental Intelligence</td>
<td>Capacity to acquire and use knowledge effectively for personal and organizational learning.</td>
</tr>
<tr>
<td>Existential Intelligence</td>
<td>Flexible engagement of interactions with the demands of the environment from human beings and systems</td>
</tr>
</tbody>
</table>

4.1.10 Learning Abilities Model of OI

This model (Carley et al, 1998) proposes key attributes of learning organizations that are similar to human cognitive learning abilities, such as,

1. **Agent Cognition Aspects**
   1. **Cognitive Learning Ability** - How well does the organization process information about itself and its environment?
   2. **Memory of Learning** - How does the organization retain experience in a useful and accessible form?

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3. **Interest in improving Learning** - How does the organization develop and improve its knowledge, capabilities and processes?

4. **Communication Biases** - How do the members of the organization exchange information and knowledge?

5. **Logical Reasoning** - How effective are the processes of collective thinking and decision-making?

### II. Organizational Structure

6. **Organizational Design** - How conducive is the structure and the design of the organization for the performance of people.

7. **Organizational Resource Access Structure** - How productively people can use the resources in the organization?

These two key aspects decide on the percentage of correct decisions made for high performances in organizations. This model also establishes the humanistic quality and the presence of Intelligence in Organizations and their learning and reactive behaviors being similar to that of human beings.

#### 4.1.11 Organizational Capabilities Based Model of OI

Popular Business models such as Malcolm Baldrige Model and Tata Business Excellence Models proposes different types capabilities of the organization that can be tested to qualify the organization for its business performance. They can also be viewed as a capabilities based model of Organizational Intelligence. (i) **Effective Communication between Stakeholders** - How effectively an organization enhances communication across stakeholders? (ii) **Group Dynamics in the Organization** - How productive the group dynamics amongst employees? (iii) **Knowledge Management Levels of Organization** - How efficiently the knowledge within the organization is managed? (iv) **Coordination between Business Processes and Goals of the Organization** - how precise is the coordination organizational goals and business processes? (v) **Risk Management Ability** - How prepared is the organization for managing unexpected uncertainties (vi) **Technology Management** - how efficiently the technology is deployed by the organization for better productivity?
4.1.12 William Halal’s Model of OI

Professor of Harvard Business School, (William Halal, 1998) proposed the model that has some interesting key points to probe while designing the questionnaire for primary data collection. The highlights of this model are, (i) Definition of OI. Table 4.2, graphically lists the key aspects of William Halal’s Model of OI, which primarily defines “OI is the capacity of an organization to create knowledge and use it to strategically adapt to its environment”.

Table 4.2 - Key Aspects of Halal’s Model of OI

| 1- Organizational Intelligence offers a broad conceptual framework. It allows CKOs to better understand the intricate complexities of managing an intelligent system. | Organizational Intelligence is defined as the capacity of an organization to create knowledge and use it to strategically adapt to its environment. It’s similar to IQ but framed at an organizational level. The mean is normalized at 100, so that an OIQ above 100 indicates a more intelligent organization, whereas one below 100 indicates a less intelligent organization. A higher OIQ doesn’t necessarily improve performance, any more than a high IQ ensures success in life. Rather, it’s the fit between OIQ and environment that determines performance. |
| 2- “Internal markets” offer the same benefits as external markets: better decisions through price information; creative entrepreneurship; and accountability for results. | |
| 3- Cooperation is essential: it’s now clear that knowledge increases when shared, thereby making cooperation economically efficient. | |
| 4- All human action is the outcome of the battle between ego and id. In organizations a similar conflict occurs between the formal leaders and the informal employees. | |

Source: (Halal, 1998)

(ii) Human and Organizational intelligence are compared for their ability to learn cognitively. Table 4.3 depicts the functions and the human Organization comparison.

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Table 4.3 - Equivalence of Human and Organizational Intelligence

<table>
<thead>
<tr>
<th>Function</th>
<th>Humans</th>
<th>Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
<td>Intelligence Quotient (IQ)</td>
<td>Organizational IQ</td>
</tr>
<tr>
<td>Information Technology</td>
<td>Personal IT Systems</td>
<td>Organizational IT Systems</td>
</tr>
<tr>
<td>Structure</td>
<td>Network of Nerve Cells</td>
<td>Network of Business Units</td>
</tr>
<tr>
<td>Subjective Filter</td>
<td>Personal Values &amp; Beliefs</td>
<td>Organizational Culture</td>
</tr>
<tr>
<td>External Linkages</td>
<td>Social Relations</td>
<td>Stakeholder Relations</td>
</tr>
<tr>
<td>Knowledge Store</td>
<td>Memory</td>
<td>Knowledge Management</td>
</tr>
<tr>
<td>Strategy Formation</td>
<td>Problem-Solving</td>
<td>Strategic Processes</td>
</tr>
<tr>
<td>Direction</td>
<td>Ego</td>
<td>Leader</td>
</tr>
<tr>
<td>Guidance</td>
<td>Vision</td>
<td>Mission</td>
</tr>
<tr>
<td>Decision – Making</td>
<td>Choice</td>
<td>Strategy</td>
</tr>
<tr>
<td>Covert Systems</td>
<td>Id</td>
<td>Information Organization</td>
</tr>
<tr>
<td>Routine Decisions</td>
<td>Autonomous Nervous System</td>
<td>Policies &amp; Procedures</td>
</tr>
<tr>
<td>Knowledge Gain (Single Loop Learning)</td>
<td>Education &amp; Action</td>
<td>Training &amp; Action</td>
</tr>
<tr>
<td>System Improvement</td>
<td>Personal Change</td>
<td>Organizational Change</td>
</tr>
</tbody>
</table>

(Source: (Halal, 1998)\textsuperscript{248})

(iii) This interesting aspect of Cognitive learning ability of organizations revolves around the intuitive Organizational Intelligence as depicted in figure 4.1 below.

Figure 4.1 – Cognitive Behavior of Organizations

Source: (Halal, 1998)\textsuperscript{249}


Figure 4.1 depicts graphically in a block diagram how organizations interact with environments and create knowledge from the intelligence within. This diagram also gives a few variables such as, Organizational Information Technology (IT) Systems, Stakeholder Relations, Knowledge Management, Strategic Processes and Leadership. Interestingly these are some of the variables being explored in this research study.

4.1.13 Innovation Capabilities Model of OI

This Model (Benn et al, 2001)\textsuperscript{250} defines OI as the capability to process, interpret, encode, manipulate and access information in a purposeful, goal-directed manner, so it can increase its adaptive potential in the environment in which it operates.

Since knowledge and ideas are primary imports into the innovation process, intelligent firms can use this information to reduce the inherent uncertainty and ambiguity of innovation. It allows them to identify new avenues for investigation and to more quickly eliminate unprofitable options.

This relies on being able to generate, communicate and act on the most relevant, up-to-date information available about their environment. Organizational intelligence is primarily about learning from customers and learning about competitors.

Understanding both competitors and markets to innovation management along with OI can lead to innovation. OI drives Innovation capability of an Organization. The capability Model (Benn et al, 2001)\textsuperscript{251} is given in Figure 4.2.


4.1.14 Karl Albrecht Model of OI

The management consultant (Karl Albrecht 2002)\textsuperscript{252} defines OI as "the capacity of an enterprise to mobilize all of its brainpower, and to focus that brainpower on accomplishing its mission." By that definition, the role of OI is simple; to make the enterprise more successful in its environment with aspects such as Strategic Vision, Shared Fate, Appetite for Change, Heart (or spirit), Alignment & Congruence (the structure, systems, and rules), Knowledge Deployment, and Performance Pressure. The organization that is moving in the direction of its highest potential must be continuously advancing in all seven of these key dimensions. Interestingly, his hypothesis says that Intelligent People in an organization leads to collective stupidity of organizations, which is proven.

4.1.15 Cross Cultural Model of OI

This Model (Dayan, 2004)\textsuperscript{253} discusses the information aspects from different cultures of an organization and their impacts on information usage and product innovation. Organizational Intelligence is measured with four constructs-


\textsuperscript{253} Mumin Dayan, “Cross Cultural Differences on Organizational Intelligence”, Proceedings of the 2004 International Research Conference on Innovations in Information Technology, College of Business Studies, Al Ghurair University, 2004
Acquisition, Dissemination, Utilization, and Responsiveness. However, in each discipline researches do not use all constructs simultaneously to measure it. In organizational learning literature, only acquisition, dissemination, and utilization constructs are used to measure organizational intelligence. In product innovation, mostly information acquisition and dissemination are used. In marketing strategy, only information acquisition, dissemination, and responsiveness are used. **Information Acquisition:** Information acquisition refers to the collection of primary or secondary information from customers, competitors, and other third parties. These processes are carried out through marketing surveys, competitive intelligence activities, and other formal and informal collection of information from salespeople and competitors. **Information Dissemination:** Information dissemination is explained as the degree to which information is diffused among relevant users within an organization. **Information Utilization:** Information utilization refers to the indirect use of information in strategy-related actions and direct applications of information to influence marketing strategy related actions. These processes include giving meaning to data, interpreting the data and categorizing the data. **Responsiveness:** In organizational intelligence literature, responsiveness refers to the actions taken in response to intelligence that is generated, transmitted, and utilized. The antecedents of Organizational Intelligence are, Formal Communication, Informal Communication, Declarative Knowledge, Procedural Knowledge, Clan Culture, Hierarchy Culture, Adhocracy Culture, and Market Culture. This model is oriented towards organizational structure, knowledge and communication largely.

### 4.1.16 OL - OI Linkage Model

This model (Ivana Simic, 2005)\(^ {254} \) depicts Organizational Learning (OL) as a component of Organizational Intelligence (OI). Organizational Intelligence is defined as two different forms. They are; (i) **OI as a Process:**

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intelligence as a process involves five basic components or parts: Organizational memory, Organizational knowledge, Organizational learning, Organizational communication, and Organizational conclusion. Organizational memory represents the ability to store (keep) events, situations, successful and unsuccessful behavior as well as the ability to recollect them if necessary. Organizational knowledge involves organizational ability of perception and understanding, which allows the organization to concentrate on the essence. Organizational learning represents the ability to promptly use the knowledge stored in the organizational memory and to learn on the basis of experience gained in the past. Learning is reflected in the behavior in non-standard situations and in examining new ways of action. Organizational communication includes the total exchange of data, information, and knowledge between and inside human and technical agents in the organization. Organizational conclusion involves avoiding, overcoming, and solving problems. (ii) OI as the Result of the Process: Organizational intelligence as the result of organizational intelligence as a process or corresponding state reflects the totality of structured, synthesized, aim-directed pieces of information. It is generated in the situations when there is the need for strengthening the abilities of informational systems used for solving appropriate organizational problems.

4.1.17 Smart Organization Model of OI

According to this model (David Matheson, 1998), there are nine components that define OI. They are; Continual Learning, Value creation culture, Creating Alternatives, Alignment and Empowerment, Disciplined Decision Making, Open Information flow, Outside - In Strategic Perspective, Embracing Uncertainty, Systems Thinking.

The conceptual boundaries of organizational intelligence are established according to the three working assumptions that Walsh and Ungson (Walsh et al, 1991)256 used to develop the construct of organizational memory: (a) organizations functionally resemble information-processing systems that process information from the environment; as such, organizations exhibit intelligence that is similar in function to that of individuals; (b) modeling organizations as information-processing systems implies that they also are interpretative systems that scan, interpret, and diagnose environmental events for their uncertainty and complexity, which supports the basic idea that adaptive capability underlies intelligent action; and (c) conceptualizing an organization as "a network of intersubjectively shared meanings that are sustained through the development and use of a common language and everyday social interactions" delineates intelligence as a concept that is invoked to explain a system but is itself not easily observed. The first assumption that of functional similarity between human and organizational intelligence, leads to the following definition of organizational intelligence:  

**Organizational Intelligence is an organization's capability to process, interpret, encode, manipulate, and access information in a purposeful, goal-directed manner, so it can increase its adaptive potential in the environment in which it operates.**

This definition embodies the second boundary condition (i.e., that organizational intelligence is adaptive); like individual intelligence, organizational intelligence is related to solving problems, meeting objectives, and making effective responses to environmental challenges. Regarding the third boundary condition, organizational intelligence offers an explanation for experiential learning processes that underscore organizational successes and failures (Glynn et al., 1994)257. Learning intelligently implies that an organization has learned correctly, accurately, and appropriately from experience; armed with good and valid information, the organization has the potential to perform more effectively.

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At an aggregate level, Intelligence of individual organizational members aggregates as organizational intelligence. Organizational intelligence varies as a function of its members, implying that organizations with more intelligent members will be more intelligent. And this is predicated on the measurement of the intelligence of individuals, typically with standardized instruments such as IQ. Organizational intelligence may be assessed as the aggregated total, the average, or the maximum of individual intelligence. This is measured with psychometric Instruments.

At a cross level, individual intelligence is transferred and encoded in organizational systems to become organizational intelligence. Organizations with more and better diffusion and institutionalization mechanisms will be more intelligent. Measurement of the effectiveness of mechanisms that transfer and institutionalize intelligence, including structural (e.g., roles, communication systems); technical (e.g., MIS and expert computer supports); social and / or political influence (e.g., social interactions, networks, power, and authority factors) mechanisms is found to be tough.

At a distributed level, Organizational intelligence is embedded in the organization's systems, routines, standard operating procedures, symbols, culture, and language. Organizational intelligence is increased to the extent that these systems encode declarative and procedural knowledge that is complex, information rich, and isomorphic with environmental demands. Assessment of the richness and ecological validity of an organization's systemic interaction patterns, (e.g., anthropological analysis of cultural, interpretive, and linguistic systems); assessment of reliability of systems; and assessment of an organization's behavioral interactions through qualitative studies is difficult. This inability of the model is overcome in the model constructed in this thesis which is explained in the forthcoming chapters.
4.1.19 Complexity Model of OI

According to the Complexity Theory (Encyclopedia of Life Support Systems, 2003)\textsuperscript{258}, Organizational intelligence and knowledge management refers to the capacity of an organization to gather information, to innovate, to generate knowledge, and to act effectively based on the knowledge that it has generated. Organizational intelligence refers to the knowledge-based capacity inherent in the organization. This capacity forms the basis of success in the rapidly changing or highly competitive environment of the knowledge organization. This development and leveraging of organizational knowledge is sometimes called knowledge management. Organizational learning has been described as occurring when an organization is able to engage in the process of detection, diagnosis, and correction of errors such as to potentially change its behavior in a favorable direction and reduce errors. In a similar way, a learning organization may be defined as one in which the members of the organization continually enhance their personal capacity to create what it is that they wish to create. Adaptive learning, or single loop learning, is the ability to resolve issues using established standard operating practices, but without examining the process through which this error reduction or fundamental assumptions about the way of doing work. Generative or double loop, learning results when the organization is able to examine, and potentially reengineer, the processes that organizations use in detecting, diagnosing, and correcting for errors. These are sometimes also called complex evolving systems. Thus, the process of learning is as important as what the organization knows, and improvements in both should be sought.

A learning organization is capable of generative learning and proactively seeks to master change processes. Five core disciplines are said to be necessary in order to build a learning organization: personal mastery, shared mental models, team learning, shared vision, and system thinking. For a learning organization, organizational intelligence is greater than the sum of the knowledge of each

\textsuperscript{258} Encyclopedia of Life Support Systems. Theme Section – Knowledge Management, Organizational Intelligence and Learning and Complexity, UNESCO, 2003.
individual in that organization. Organizational intelligence includes historical knowledge inherent in the organization and generative intelligence that results from collaboration between organizational members. Organizational intelligence is a major competitive advantage of a knowledge organization. Thus this theory speaks of the complexities in the cognitive learning processes of organizations. Organizational Intelligence is referred as the inherent ability of the organizations to learn cognitively however complex the learning may be.

4.2 Inferences from the study of the Models

These 19 different models obviously establish the fact that, there are plenty of avenues in which OI had been thought about by the researchers; cultural, communicational, planning, adaptation, responsiveness, ability to manage and use information, creative levels form the basic triggers or the variables that can measure the presence of OI. These Descriptive Models from Literature are intuitively designed. All these models have interestingly common aspects of the definition of Organizational Intelligence. These models can be verified by designing and capturing relevant variables from suitable samples.

To be very precise, we find some of these common aspects in all of the above models are Cognitive Learning Abilities, Communication, Organizational Culture & Design and Group Dynamics of people in the organization – which can be termed as the Softer Aspects of OI. Similarly the Harder Aspects may include, Leadership & Organizational Learning, Stakeholder Relationships, Strategic Processes, Knowledge and Information management, Systems Efficiency, Business Process Efficiency, Products & Service Quality and Financial Performances. It is to be noted that, the questionnaire design for this research study focuses only on Harder Aspects of Organizational Intelligence.

For this research study, we deliberately chose to study the ‘harder aspects’ that are based on the data that is purely based on the numbers fetched from business analysis as seen by business owners. A questionnaire with specific 40 questions is designed to address this study as discussed in the earlier chapter. However, Studying
softer aspects can be a different research study in the future based on the emotional and cognitive aspects of the organization. Our research work is based on the propositions made by Professor William Halal’s in his conceptual theory on OI (William Halal, 1998)259 which is proposed based on Business Realities. The pilot study of the Questionnaire containing 163 questions (Annexure 1) confirmed that studying OI based on business analysis as perceived by business owners would be more precise compared to studying the same based on softer aspects.

4.3 Conclusion

OI Models from literature and their composition of elements are compared with that of the measuring variables in this research work. The reasoning behind the choice of variables based on Business Reality is also explained. The inferences from these models justify the research being designed on business realities and the specificity of selection of variables from literature. These models listed in this chapter look at Organizational Intelligence with different perspectives. However there had not been an attempt to measure Organizational Intelligence Quotient for the self assessment of organizations.

In this chapter we listed concisely the key aspects of various important conceptual models from the literature, that triggered our thinking on variables that affect OI practically and different aspects that might affect those variables in turn. The softer and harder aspects of organizations and their linkage to OI also became obvious.

The variables found that define OI in the models discussed above are mostly based on the softer aspects of perceptible humanistic qualities of organizations. Wherein for questionnaire design the variables chosen are based on harder

aspects business realities seen by respondents, thus making our model distinctively different from other models discussed in this chapter.

In the next chapter on Analytical Framework, we will discuss about the theory behind the analytical techniques and software tools deployed for data analysis and the reasoning behind the selection of the techniques such as, exploratory factor analysis and multiple regression modeling. These methods help us to group the selected variables according to their behavior.
5.0      Introduction

In the last chapter we discussed the research methodology followed to conduct this research work. We also discussed the relevance of the variable selection and the questionnaire design. We discussed sample selection and how the experiment was conducted by administering the questionnaire personally. This chapter discusses those techniques and concepts that are applicable to this research study. In this chapter, analytical frameworks of two multivariate statistical techniques that are applied to analyze the data of the study and related hypotheses are discussed. In section 5.1 detailed discussions on exploratory factor analysis are presented.

This is followed with discussions on multiple regression analysis in section 5.2. The theory and reasoning behind the hypotheses formulation between the relationships of organizational intelligence and causative factors are explained in the next chapter. Section 5.3 explains the conclusion of the analytical frameworks discussed in this chapter. The analytical frameworks of the above mentioned statistical techniques are discussed with their conceptual overviews and scientific context of the method. Interpretation of the findings and their significance are discussed in a theoretical perspective.

In the first level of data analysis, *Factor analysis*, a multivariate technique, is used to identify the structure of interrelationships between the variables and reveal functional units, thus forming the base of the change of variables. The Factor
Analysis model building is described in a sequential manner. The purpose of the study demands us to determine how Organizational Intelligence affects the financial performance of firms. There are various variables that account for Organizational Intelligence, as mentioned in Chapter 3. The groups of independent variables of Organizational Intelligence might be affecting the variables of Organizational Performance in multiple manners. Variables of similar behavior could be grouped by the Explanatory Factor Analysis method and the total number of variables can be reduced. This would also fulfill the requirement of adherence to one of the classical assumptions, namely Multicollinearity, for our next model, i.e., Multiple Regression. As we group the independent variables which are highly correlated, we can get rid of the multicollinearity problem, while applying Multiple Regression Analysis Technique.

In the next level, we shall estimate these grouped variables and certain unique variables (which could not be grouped under factors) as independent variables to predict Organizational Performance as captured by a single dependent variable. The equation will be a relationship model between OI (Organizational Intelligence) and OP (Organizational Performance). As mentioned earlier, Organizational Performance variables are represented by a single dependent variable and the factors of Organizational Intelligence are independent variables. Thus the second level of data analysis clearly demanded the application of Multiple Regression Analysis. Thus Organizational Performance factors are chosen to represent financial performance and other organic attributes of organizations are grouped suitably with factor analysis to represent organizational intelligence.

Part I

5.1 Exploratory Factor Analysis

As discussed earlier, we will first present the theoretical framework of Factor Analysis, which we have applied to reduce the problem of multicollinearity amongst the independent variables during the application of Multiple Regression. It also gives us a fair amount of justification into the process of
clubbing similar variables, or variables that behave identically. As Factor Analysis provides us with the necessary credence, the formation of the factors with proper rationale is in itself considered to be a good finding in the literature of OI and OP.

5.1.1 What is Factor analysis?

Social science often involves primary data collection using the questionnaire method. As this is a time consuming and costly affair, researchers often avoid taking the risk of having exactly the same number of questions that are required to address the variables considered in the study. Hence, it often leads to a pool of large number of variables, though the exact number of variables required for the study could be much less. Here comes the requirement of the application of Factor Analysis.

There are a large number of variables proposed, and hypotheses and theories are linked to each other to explain or describe the complex variety and interconnections of various relationships. Factor analysis can simultaneously manage more than a hundred variables, compensate for random error and invalidity, and disentangle complex interrelationships into their major and distinct regularities (Rummel, 1970)

It is a good way of resolving the confusion of data complexity and identifying latent or underlying factors from an array of seemingly important variables (Nargundkar, 2004).

Factor analysis techniques can achieve their objectives from either an exploratory or confirmatory perspective. *Exploratory Factor Analysis* (EFA) is useful in searching for structures among a set of variables or as a Data Reduction method. It is a widely utilized and broadly applied statistical technique in the social sciences (Osborne, 2005)

Hair et al (Hair et al, 2006) mention that Factor Analysis provides the tools for analyzing the structure of the interrelationships

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260 Rummel, R.J., Applied Factor Analysis, Evanston IL: Northwestern University Press; 1970
261 Nargundkar, R., Marketing Research: Text and Cases, 2nd Ed, Tata McGraw-Hill Pb; 2004
262 Osborne., By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
263 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
(correlations) among a large number of variables by defining sets of variables that are highly interrelated. Confirmatory factor analysis (Joreskog et al, 1993)\textsuperscript{264} is used for analyzing the validity and reliability of actual structure of the data based on theoretical, latent constructs or prior research. In this study, EFA is discussed and termed as Factor Analysis.

The essential purpose of factor analysis is to describe, if possible, the covariant relationships among many variables in terms of few underlying, but unobservable, random quantities called \textit{factors} (Johnson et al, 1992)\textsuperscript{265} interpreted through weights of the variable called factor loadings, organized in a matrix of factor loadings.

The factors, by definition, are highly inter-correlated and are assumed to represent dimensions within the data. By reducing the number of variables, the dimensions can guide in creating new composite measures (Hair et al, 2006)\textsuperscript{266}.

The Factor Analysis model is organized in such a way that all variables within a particular group are highly correlated among themselves, but have relatively small correlations with variables in another group. Typically, factors used for any further analysis should contain unique variables (Makhura et al., 1997)\textsuperscript{267}.

Flow chart depicting Exploratory Factor Analysis is given in Figure 5.1.

\textsuperscript{264} Jorescog et al, LISREL8: Structural Equation Modeling with the SIMPLIS Command Language, Mooresville, IN: Scientific Software International, 1993
\textsuperscript{265} Johnson et al, Applied Multivariate Analysis, 4\textsuperscript{th} Ed, Prentice Hall Pb, 1998
\textsuperscript{266} Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006
Figure 5.1 - Flow Diagram of Factor Analysis

Research Problem Definition

Is Analysis Confirmatory or Explanatory?

Structural Equation Modeling (Confirmatory) – Not Chosen for this research study

Exploratory Factor Analysis (Explanatory)

Select the Type of Factor Analysis: What is Being Grouped? Grouping of Variables or Cases

Q - Type Analysis or Cluster Analysis (Cases)

R – Type Factor Analysis (Variables)

Research Design: What Variables are included? How the Variables are measured? What is the Desired Sample Size?

Assumptions: Linearity, Normality, Homoscedasticity and Collinearity
Selecting a Factor Method:

Total Variance: Extract Factors with Component Analysis

Common Variance: Extract Factors with Common Factor Analysis

Specifying Factor Matrix:
Determining the Number of Factors to be Retained

Selecting a Rotational Method:
Should the Factors be Correlated or Uncorrelated?

Orthogonal Methods:
VARIMAX, EQUIMAX, QUARTIMAX

Oblique Methods:
Oblimin, Promax, Orthoblique

Interpreting the Rotated Factor Matrix:
Can Significant Loadings be found?
Can the Factors be named?
Are Communalities sufficient?

2

NO

YES
Validation of Factor Matrix:
Split / Multiple Samples
Separate Analysis of Sub-groups
Identify Influential Cases

Factor Model Respecification:
Were Any Variables deleted?
Should Number of Factors be changed?
Any other Type of Rotation required?

YES

NO

Validation of Factor Matrix:
Split / Multiple Samples
Separate Analysis of Sub-groups
Identify Influential Cases

Selection of Surrogate Variables
Computation of Factor Scores

Creation of Summated Scales
5.1.2 Why Using Exploratory Factor Analysis for this Research Study?

_Appropriateness of Exploratory Factor Analysis:_ Exploratory Factor Analysis can be a highly useful and powerful multivariate statistical technique for effectively extracting information from large bodies of interrelated data. When variables are correlated, the researcher needs to manage these variables, by grouping highly correlated variables together, labeling or naming the groups, and by creating a new composite measure that can represent each group of variables. The primary purpose of Exploratory Factor Analysis is to define the underlying structure among the variables in the analysis. As an interdependence technique, factor analysis attempts to identify grouping among variables, based on the relationships represented in a correlation matrix. It is a powerful tool to understand the structure of the data better. It is used to simplify analyses of large set of variables by replacing them with composite variables. When it works well, it points to interesting relationships that might not have been possible from examination of the raw data alone, or even the correlation matrix. Factor analysis provides the basis for data reduction through either summed scales or factor scores. The researcher can combine the variables within each factor into a single score that can replace the original set of variables with four new composite variables.

_Difference between exploratory factor analysis and confirmatory factor analysis:_ Factor analysis used for this research work, which is primarily an exploratory technique, does not give enough control over the specification of the structure, such as number of factors and loadings on each variable etc. However an attempt to confirm the Factors will require Structural Equation Modeling.

_Seven stages of applying Factor Analysis_ include (i) Clarifying the objectives of factor analysis (ii) Designing a factor analysis, including selection of variables and sample size (iii) Assumptions of factor analysis (iv) Deriving factors and assessing overall fit, including which factor model to use and the number of factors (v) Rotating the interpreting factors (vi) Validation of factor analysis
Additional uses of factor analysis results, such as, selecting surrogate variables, creating summated scales or computing factor scores (Hair et al, 2006).

**Difference between R and Q Factor Analysis:** The principal use of factor analysis is to develop a structure among variables, referred to as R factor analysis. Factor analysis can also be used to group cases, which is referred as Q factor analysis. Q factor analysis is similar to cluster analysis. The primary difference is that Q Factor analysis uses correlation as the measure of similarity whereas cluster analysis is based on a more distant measure.

**Difference between component analysis and common factor analysis:** 3 types of variance are considered when applying factor analysis; Common Variance, Unique Variance and Error Variance. They sum up to give the Total Variance. Component Analysis (principal component analysis), considers the Total Variance and derives the factors that contain small proportions of Unique Variance and in some instances Error Variance. Component analysis is preferred when data reduction is the primary goal. Common Factor Analysis is based only on Common Variance (Shared Variance) and assumes no importance to Unique and Error Variances in defining the structure of variables. It is more useful in identifying latent constructs and there is little information about Error and Unique variances. The 2 methods achieve essentially the same results in many situations.

**Determining the number of factors to extract:** The total number of factors extracted from Factor Analysis is retained for interpretation and further analysis. This decision on the number of factors depends on the questions such as, how many factors to extract, how many factors to retain in the structure?, and how many factors can be reasonably supported with empirical evidence? The research begins with some predetermined criteria such as the general number of factors and some general thresholds of practical relevance. These criteria are combined.

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268 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
with empirical measures of factor structure. An exact quantitative basis for deciding the number of factors to extract has not been developed. Stopping criteria for the number of factors to extract include latent root or eigen value, a priori, percentage of variance and scree test. These empirical criteria must be balanced against any theoretical bases for establishing the number of factors (Hair et al, 2006).

**Explaining the concept of rotation of factor:** The most important tool in interpreting factors is Factor Rotation. The term rotation indicates the turning of the reference axes of factors about the origin until some other position has been reached. There are 2 types of rotation – orthogonal and oblique. Unrotated factor solutions extract factors in the order of their importance, with the first factor being general factor with almost every variable loading significantly and accounting for the largest amount of variance. The second and the subsequent factors are based on the residual amount of variance, with each accounting for successively smaller portions of variance. The ultimate effect of rotating the factor matrix is to redistribute the variance from earlier factors to later ones to achieve a simpler, theoretically more meaningful factor pattern. Factor Rotation assists in the interpretation of factors by simplifying the structure through maximizing the significant loadings of a variable on a single factor. In this manner, the variables most useful in defining the character of each factor can be easily identified (Hair et al, 2006).

**Naming the factor:** Factors represent composite of many variables. When an acceptable factor solution had been obtained, all variables have a significant loading. The researcher attempts to find meaning out of the factor loadings. Variables with higher loadings are considered more important, for they have greater influence on the name or label selected to represent the factor. The significant variables for a particular factor are examined. Greater emphasis is on those variables with higher loadings. A name is assigned to a factor that reflects the variable loadings on that factor. The researcher identifies variables with the

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269 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pbl; 2006
270 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pbl; 2006
greatest contribution to a factor and assigns a name to represent the factor’s conceptual meaning (Hair et al, 2006).  

**Uses of Factor analysis:** The researcher can stop with the Factor Interpretation or further proceed to Data Reduction. If the objective is just to identify the logical grouping of variables through better understanding of the interrelationships among the variables, then the Factor Interpretation will suffice. If the objective is to identify appropriate variables for subsequent application of statistical techniques, then Data Reduction will be necessary. In the procedure of Data Reduction, the researcher would identify a single variable as the best representation of entire set of variables for further statistical analysis. Another option is to calculate the summation of the variables with highest factor loading. This is known as the summated scale. A single summated score represents a factor but only selected variables contribute to the composite score. A third option is to calculate the factor scores for each factor, where each factor contributes to the score based on its factor loading. This single measure is a composite variable that reflects the relative contributions of all the variables to the factor. If the summated scale is valid and reliable, it is probably the best of these 3 data reduction techniques.

**Limitations of factor analysis technique:** There are 3 most frequently cited limitations. (Hair et al, 2006) There are many techniques available for performing Factor Analysis, although controversy exists over which technique is the best. The subjective aspects of Factor Analysis such as number of factors to be extracted, technique to be used to rotate the factor axes, and significant factor loadings are all subjected to many differences in opinion. The problem of reliability is real, and like any other statistical procedure Factor Analysis starts with a set of imperfect data. Changes in sample, data gathering procedures, and measurement errors affect the results of the analysis. The results of a single analysis are therefore not completely dependable. Factor analysis technique is

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271 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006  
272 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
complex and plausible, though the fact that plausible solutions do not guarantee complete validity or stability remains unruffled.

5.1.3 Objectives of Factor Analysis

There are four key issues attached to the objectives of Factor Analysis: specifying the unit of analysis, Data Summarization and Reduction, variable selection, and using Factor Analysis results with other multivariate techniques. Each is briefly explained below.

There are several methods of factor analysis. However, the most commonly used are the R-Factor Analysis or Q-Factor Analysis (Thompson, 2000). These types refer to what is serving as variables and what is serving as the observations in the arrangement of data row and column wise. In R-Factor analysis, the variables are the columns of the data set and observations are the rows. In R-Factor analysis, we look for the latent factors that lie behind the variables, and the Q-Factor analysis condenses large number of people in distinctly different groups within a large population. There are other possible combinations of groups and variable types (Stewart et al, 1981, Thomson, 2000). The data analysis for the given study refers to R-Factor analysis.

There are 2 distinct, but interrelated outcomes of factor analysis: Data Summarization and Data Reduction. The concept of Data Summarization is to evolve the definition of structure, through the structures of the variables from most detailed levels to more generalized levels can be viewed. The goal is achieved by defining a small number of factors that adequately represent the original set of variables (Hair et al, 2006). The purpose of Data Reduction is to retain the nature and character of the original variables, but reduce their numbers to simplify subsequent Multivariate Analysis. The objective of applying

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275 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
Factor Analysis in the study was to condense or summarize the variables, the building blocks of relationships, into smaller sets of new, composite dimensions called factors, with a minimum loss of information. The factors then created in new composite measures were applied in further analysis.

Factor Analysis is most efficient when conceptually defined dimensions can be represented by the derived factors. The quality and meaning of the derived factors reflect the conceptual underpinnings of the variables included in the analysis and judgment of the researcher. Factor Analysis still maintains the flavor of an art, and no single strategy should yet be ‘chiseled into stone’. Factor Analysis should not be used in most practical situations (Chatfield et al, 1980). Heir et al (Hair et al, 2006) mention that Factor Analysis provides a clear understanding of, which variables may act in concert and how many variables may actually be expected to have impact in the analysis. It is an excellent starting point for many other multivariate techniques.

5.1.4 Research Design for Factor Analysis

The research design of the Factor Analysis involves 3 decisions: (i) Calculation of a correlation matrix (input data); (ii) Design of the study in terms of number of variables, measurement properties of variables, and types of allowable variables and (iii) The necessary sample size. These decisions are discussed below.

i) **Correlations among variables or respondents:** The first decision focuses on calculating the input data for the analysis. Earlier we discussed R-type and Q-Type factor analyses. Hair et al (Hair et al, 2006) posit in R-type factor analysis, the traditional correlation matrix specifying correlations among variables is used. In Q-Type factor analysis, the correlation matrix is derived from the correlations between the individual respondents. The resultant factor matrix identifies similar

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277 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
278 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
individuals. R-Type factor analysis is used widespread and the discussion in this chapter continues on R-Type factor analysis.

**ii) Variable Selection and Measurement:** In factor analysis, correlations among variables is the only means of determining appropriateness and therefore the observed patterns have to be conceptually valid and appropriate to study. The primary requirement of the Factor Analysis is that a correlation value can be calculated among all variables. If the metric variables are used in factor analysis, they can be measured by several types of correlations. But non-metric variables can not use the same type of correlation measures that of metric variables. Therefore to include a non-metric variable, an approach of dummy variable (coded 0-1) is taken. If all the variables are dummy variables, then specialized forms of Factor Analysis such as Boolean Factor Analysis can be used (Hair et al, 2006)\(^{279}\). A rule of thumb for substantial correlation value is \( > 0.30 \). To find patterns among groups of variables, each proposed factor should include several variables (five or more). It is of little use in identifying factors composed of only a single variable (Hair et al, 2006)\(^{280}\).

**iii) Sample Size:** The best method for standardizing sample size data is subject to item ratio. Anna Costello and Osborne conclude that a large percentage of Factor Analyses are done using relatively small sample sizes. Their research indicates that 14.7 percent studies were done with a subject to item ratio of 2:1 or less, 25.8 percent studies had a ratio of \( > 2:1 \), \( \leq 5:1 \); 22.7 percent studies had the ratio of \( >5:1 \), \( <10:1 \). About 37 percent studies had the subject to item ratio \( \geq 10:1 \). Past research has revealed that adequate sample size is partly determined by the nature of data. In general, the stronger the data in terms of uniformly high communalities without cross-holdings, plus several variables loading strongly on each factor, smaller is the sample. However, in practice these conditions can be rare (Osborne et al, 2005)\(^{281}\).

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\(^{279}\) Hair et al, Multivariate Data Analysis, 6\(^{th}\) Ed, Printice Hall Pb; 2006  
\(^{280}\) Hair et al, Multivariate Data Analysis, 6\(^{th}\) Ed, Printice Hall Pb; 2006  
\(^{281}\) Osborne., By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
As a thumb-rule, Factor Analysis requires minimum 50 observations as the sample size, and preferably 100 or larger sample. Another general rule is to have minimum ratio of observations to variable as 5:1. More acceptable ratio is 10:1. Stevens (Stevens et al, 2002)\textsuperscript{282} summarizes some specific results backed by simulations as follows. The number of observations required for factors to be reliable depends on the data, particularly how well the variables load on the different factors. A factor is reliable if it has:

- 3 or more variables with loadings of 0.8 and any $n^*$
- 4 or more variables with loadings of 0.6 and any $n$
- 10 or more variables with loadings of 0.4 and $n \geq 150$
- Factors with only a few loading require $n \geq 300$

$^*$ $n$ is the number of observations

5.1.5 Assumptions in Factor Analysis

The critical assumptions underlying Factor Analysis are more conceptual than statistical. The character and composition of the variables included in the analysis require a strong theoretical foundation before meeting the statistical requirement of the multivariate technique. Given below are the assumptions that have to be met with for conducting Factor Analysis.

5.1.5.1 Conceptual and Statistical Aspects

The basic assumption of Factor Analysis is that some underlying structure does exist in the set of selected variables (Hair et al, 2006)\textsuperscript{283}. The appropriateness of the technique is determined only by the correlations among variables, and therefore it is imperative that the observed patterns are conceptually valid and appropriate from the aspect of variables selection. Another assumption is that the sample is homogeneous with respect to the underlying factor structure. In case of 2 samples or sub-samples combined, the resulting correlations and factor

\textsuperscript{282} Stevens et al, Steven's Handbook of Experimental Psychology, 3\textsuperscript{rd} Ed, John Wiley and Sons Pb; 2002
\textsuperscript{283} Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006
structure gives a poor representation of the unique structure of each group. From statistical standpoint, some degree of multicollinearity is desirable, because the objective is to identify interrelated sets of variables.

5.1.5.2 Overall Measures of Intercorrelation

Hair et al posit data matrix of correlations should reveal substantial number of correlations greater than 0.30 to make factor analysis appropriate. If all of the correlations are low, or all correlations are equal, it implies that no structure exists to group variables and the application of factor analysis is questionable. The correlations among variables can also be analyzed by computing the partial correlations among variables. Partial correlation is the unexplained correlation when effects of other variables are taken into account. It should be small, i.e. less than .7, if the “true” factors exist in the data (Hair et al, 2006).284

Another method of determining the appropriateness of Factor Analysis is to examine the entire correlation matrix. The Bartlett test of Sphericity checks the null hypothesis that the original correlation matrix is an identity matrix (Andy Field, 2000).285 It provides the statistical significance that the correlation matrix has significant correlations among at least some of the variables. High significance (p < .001) of Bartlett’s test indicates appropriateness of Factor Analysis.

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy varies between 0 and 1. A value close to 1 indicates that patterns of correlations are relatively compact and so the factor analysis should yield distinct and reliable factors. Andy Field recommends acceptable values greater than .5. the values between .5 and .7 are mediocre, values between .7 and .8 are good, values between .8 and .9 are great, and values above .9 are superb (Andy Field, 2000).286 In Table 5.1, an

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284 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
example of a SPSS output of the given study is depicted for KMO and Bartlett’s test.

Table 5.1 - KMO and Bartlett's Test

<table>
<thead>
<tr>
<th>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</th>
<th>.906</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>1647.350</td>
</tr>
<tr>
<td>Df</td>
<td>351</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

KMO value is 0.906, slightly more than 0.9, and can be considered as a superb value, indicating that the patterns of correlations are compact and the factor analysis should yield distinct and reliable factors. Bartlett’s test shows significance P < 0.001, and therefore the Factor Analysis is appropriate. The Measure of Sampling Adequacy (MSA) is the third measure to quantify the degree of interrelations among the variables and appropriateness of Factor Analysis. The measure can be interpreted with the following guidelines: 0.80 or above, meritorious; 0.70 or above, middling; 0.60 or above, mediocre; 0.50 or above, miserable; and below 0.50, unacceptable (Hair et al, 2006).287

5.1.6 Deriving Factors and Assessing Overall Fit

There are 2 decisions in applying Factor Analysis are concerned with: (1) the method of extracting the factors, and (2) the number of factors selected to represent the underlying structure in the data.

5.1.6.1 Criteria for Extracting the Factors

Factors are produced by common Factor Analysis (FA), while components are produced by Principal Components Analysis (PCA). They both are essentially Data Reduction techniques, differing in the variance of the observed variables

287 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
that is analyzed. In PCA, all the variance in the observed variables is analyzed whereas in FA, only shared variance is analyzed. Statistical theorists have disagreement about the applicability of each method. Some researchers favor FA as a true analysis method and propose severely restricted use of PCA, whereas others disagree, and point out either that there is almost no difference between PCA and FA, or that PCA is preferable (Osborne et al, 2005).

The total variance of any variable consists of 3 types of variances: common, unique, and error. A variable’s communality is the estimate of its shared or common variance among the variables as represented by the derived factors (Hair et al, 2006). The communalities represent the proportion of the variance for each of the variables included in the analysis that is explained or accounted for by the components in the factor solution. The derived components should explain at least half of each original variable’s variance, so the communality value for each variable should be 0.50 or higher. If one or more variables have a value for communality that is less than 0.50, the variable with the lowest communality should be excluded and the Principal Component Analysis should be computed again.

Principal Components Analysis (PCA) considers the total variance and derives factors that contain small proportions of unique variance and, in some cases, error variance. The components are calculated using all of variance of the manifest variables, and all of that variance appears in the solution. As PCA does not discriminate between shared and unique variance, when the factors are uncorrelated and communalities are moderate, it can produce inflated values of variance accounted for by the components. However, researchers rarely collect and analyze data without an a priori idea about how the variables are related (Osborne et al, 2005).

In Factor Analysis, only common or shared variance is considered with the assumption that both the unique and error variance are not of interest in defining

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288 Osborne. By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
289 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
290 Osborne., By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
the structure of the variables. The aim of Factor Analysis is to reveal any latent variables that cause the manifest variables to co-vary. There are several factor extraction methods in Factor Analysis to choose from: unweighted least squares, generalized least squares, maximum likelihood, principal axis factoring, alpha factoring, and image factoring. However, information on their relative strengths and weaknesses is scare and often available in obscure references (Osborne et al, 2005). Probably because of this, Principal Component Analysis is the most preferred technique. PCA is the default method of extraction in many popular statistical software packages such as SPSS and SAS. The data for the study has been analyzed using PCA in SPSS.

5.1.6.2 Criteria for Selecting Number of Factors to be Retained

After extraction, the decision is to be made on how many factors to retain for rotation. (Mardia et al, 1980) point out that there is a limit to the number of factors that can actually end up with a simpler model than the raw data. The minimum number of variables required to select the number of factors is given in Table 5.2.

Table 5.2 - Minimum Variables required for Factors Selection

<table>
<thead>
<tr>
<th>Factors</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables Required</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>11</td>
</tr>
</tbody>
</table>

This is a guideline and factor loadings on each variable also have to be assessed before actually deciding the meaningfulness of the factor. The decision on the number of factors to be retained from the extraction process is based on the several stopping criteria for the number of factors to extract. Usually in practice, more than one criterion is used to select the factors. The criteria available in SPSS software are discussed below.

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291 Osborne., By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
The latent root criterion is used with the rationale that any individual factor should account for the variance of at least a single variable if it is to be retained for interpretation. With component analysis each variable contributes a value of 1 to the total eigenvalue. One of the least accurate methods is retaining the number of factors having eigen values greater than 1 (Osborne et al, 2005).

All the factors having eigen values > 1 can be retained for the correlation matrix. However, Hair et al., (Hair et al, 2006) reports that establishing a cutoff is most reliable when the number of variables is between 20 and 50. Stevens (Stevens et al, 2002) reports that if variables are greater than 40 and their communalities are around 0.40, they are considered to be too many.

A more accurate cutoff point is with 10-30 variables and their communalities are around 0.70. This criterion is also known as Kaiser’s recommendation, and appears in SPSS as an option under the Extract box. In the ‘a priory criterion’, the number of factors to extract is decided before undertaking the Factor Analysis. This approach is used in testing a theory or a hypothesis about the number of factors to be extracted, or in replicating another researcher’s work.

Percentage of variance is another criterion used to decide the number of factors to extract. This approach is based on achieving a specified cumulative percentage of total variance extracted by successive factors, by ensuring that they explain at least a specified amount of variance. In social sciences, where the information is less precise, it is common to consider a solution that accounts for 60 percent of the total variance, as there is no absolute threshold adopted for all application.

A variant of this criterion is to select the factors with communality of more than .50 for each of the variable. This approach is considered for not to neglect the degree of explanation for the individual variables (Hair et al, 2006).

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293 Osborne., By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
294 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
295 Stevens et al, Steven's Handbook of Experimental Psychology, 3rd Ed, John Wiley and Sons Pb; 2002
296 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006

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The scree test criterion is an alternate method for factor retention, and is available in most frequently used statistical software including SPSS. It is the method to identify the optimum number of factors that can be extracted before the amount of unique variance begins to dominate the common variance structure.

A graph is plotted for latent roots (eigen values) against the number of factors in their order of extraction. The graph is examined and at the point at which the curve first begins to straighten out or breaks from the natural bend, is considered the cutoff point. The number of data points above the “break” (not including the point at which the break occurs) is usually the number of factors to retain (Osborne et al, 2005). As a general rule, the scree test results in at least one or sometimes 2 or 3 more factors being considered for inclusion than does the latent root criterion (Hair et al, 2006).

5.1.7 Interpretation of Factors

A strong conceptual foundation for the anticipated factor structure and its rationale is important, as there are no specific processes or guidelines for interpreting factors. In the study, the theoretical concepts of conflict typology and causative factors were related with the analytical framework of factor analysis to interpret factors and the structure lying underneath.

5.1.7.1 Factor Rotation

Factor interpretation is circular in nature. First, the initial unrotated factor matrix is computed, containing the factor loadings for each variable on each factor. Hair et al (Hair et al, 2006) define factor loadings as the correlation of each variable and the factor. These are the means of interpreting the role each variable plays in defining each factor.

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297 Osborne., By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
298 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
299 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
The next decision is of selecting the rotation method. The goal of rotation is to simplify and clarify the data structure. It can not improve the basic aspects of the analysis such as the amount of variance extracted from the items (Osborne et al, 2005)\textsuperscript{300}.

The initial unrotated factor matrix does not provide enough information of the variables under observation. Ambiguities in the interpretation are found because the first factor tends to be a general factor with almost every variable loading significantly, accounting for the largest variance. Subsequent factors are based on the residual mount of variance. Therefore, factor rotation is used. Hair, et al (Hair et al, 2006) posit the ultimate effect of rotating the factor matrix is to redistribute the variance from earlier factors to later ones, to achieve a simpler, theoretically more meaningful factor pattern.

Two methods of rotation are used, orthogonal and oblique. Orthogonal rotations produce factors that are uncorrelated and oblique methods allow the factors to correlate. Varimax, quartimax, and equimax are commonly available orthogonal methods of rotation, while direct oblimin, quartimin, and promax are oblique methods (Osborne et al, 2005)\textsuperscript{301}.

Orthogonal rotation produces more easily interpretable results, and is commonly used method in research. The SPSS program gives five options for rotation (Ajai Gaur, 2006)\textsuperscript{302}. The rotated factor matrix output is interpreted after orthogonal rotation; pattern matrix is examined for factor/item loadings in oblique rotation, and factor correlation matrix reveals any correlation between the factors. The substantive interpretations are essentially the same (Osborne et al, 2005).

\textsuperscript{300} Osborne., By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
\textsuperscript{301} Osborne., By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
5.1.7.2 Significance of Factor Loadings

In interpretation, it is essential to make the decision regarding the factor loadings that are worth considering. Practical significance of making a preliminary examination of factor loadings is important, as larger the absolute size of the factor loading, the more important the loading is in interpreting the factor matrix. Tabachnick and Fidell (Osborne et al, 2005) suggest 0.32 as a good rule of thumb for the minimum loading of an item, which equates to approximately 10% overlapping variance with the other items in that factor.

Using practical significance as the criteria, factor loadings are assessed as follows (Hair et al, 2006):

- Factor loadings in the range of $+0.30$ to $+0.40$ are considered as the minimum level for interpretation of the structure.
- Loadings $+0.50$ or greater are considered practically significant.
- Loadings exceeding $+0.70$ are indicative of well-defined structure.

The significance level for the interpretation of loadings can be determined in the similar way of determining the statistical significance of correlation coefficients. However, researchers have demonstrated that factor loadings have substantially larger standard errors than typical correlations (Hair et al, 2006). Therefore factor loadings have to be evaluated at a considerably stricter level.

Anna Costello et al (Osborne et al, 2005) caution that Factor Analysis is a large-sample procedure in which generalizable or replicable results are unlikely if the sample is too small. Hair et al (Hair et al, 2006) present the guidelines for identifying significant factor loadings based on sample size, as follows in Table 5.3.
Table 5.3 - Guidelines for Identifying Significant Factor Loadings

Based on Sample Size

<table>
<thead>
<tr>
<th>Factor Loading</th>
<th>Sample Size Needed for Significance&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>.30</td>
<td>350</td>
</tr>
<tr>
<td>.35</td>
<td>250</td>
</tr>
<tr>
<td>.40</td>
<td>200</td>
</tr>
<tr>
<td>.45</td>
<td>150</td>
</tr>
<tr>
<td>.50</td>
<td>120</td>
</tr>
<tr>
<td>.55</td>
<td>100</td>
</tr>
<tr>
<td>.60</td>
<td>85</td>
</tr>
<tr>
<td>.65</td>
<td>70</td>
</tr>
<tr>
<td>.70</td>
<td>60</td>
</tr>
<tr>
<td>.75</td>
<td>50</td>
</tr>
</tbody>
</table>

<sup>a</sup>Significance is based on a .05 significance level (α), a power level of 80 percent, and standard errors assumed to be twice those of conventional correlation coefficients.


5.1.7.3 Factor Matrix

To identify the most indicative factors of the underlying structure, all the factor loadings are sorted and a five step process is applied. In the first step, the factor matrix of loadings is examined. It contains factor loading on each variable. In the rotated factor loading analysis, the factors are arranged as columns, and each column of numbers represents the loadings of a single factor. The factor pattern matrix had loadings that represent the unique combination of each variable to the factor. A factor with less than 3 variables is generally weak and unstable; five or more variables, with loadings >0.50 in a factor are desirable and indicate a
solid factor. It may be possible to reduce the number of variables and maintain a strong factor in large samples with further analysis (Osborne et al, 2005).308

The second step is of identifying the significant loading(s) for each variable. The interpretation starts with the first variable on the first factor, from left to right, looking at the highest loading for that variable on any factor. When the highest loading is identified and is significant as per the criteria discussed earlier, it is underlined. The process of selecting highest loading per variable continues till all the loadings are sorted. When a variable is found to have more than one significant loading, it is known as cross-loading. Different rotation methods can be used to eliminate cross-loadings and simplify the data.

Third step is to assess the communalities of the variables. In case of any variables that are not adequately accounted for by the factor solution, one approach is to identify any variable(s) lacking at least one significant loading. Another approach is to examine communality of each variable, which represents the amount of variance accounted for by the factor solution for each variable. Variable communalities are considered ‘high’ if they are .80 or greater.

However, it is unlikely to occur in real data. More common magnitudes in the social sciences are low to moderate communalities of 0.40 to 0.70. A variable having < 0.40 communality is either not related to other variables, or suggest an additional factor that should be explored (Osborne et al, 2005).309 As a general guideline, all the variables with communalities less than 0.50 are identified as variables not having sufficient explanation (Hair et al, 2006).310

The fourth step is to re-specify the factor model, if needed. In case of a variable having no significant loadings, or its communality is deemed too low, or a variable having cross-loading, several ways can be taken. These are either to ignore those problematic variables and interpret the solution as it is; or to

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308 Osborne., By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
309 Osborne., By Best Practices in Quantitative Methods, Sage Publications Inc Pb, 2005
310 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
employ alternative rotation methods; or to increase/decrease the number of factors retained, or modify the type of factor model used.

The fifth step is to label the factors. The labels have to be developed intuitively based on their appropriateness for representing the underlying dimensions of a particular factor. Each extracted factor is given a name or a label that represents each of the derived factors as accurately as possible.

5.1.8 Creation of Factor Scores

The objective of the study is not only Data Reduction, but also is to identify appropriate variables for subsequent application to other statistical techniques. Hair et al (Hair et al, 2006)\textsuperscript{311} elaborate 2 methods of data reduction and creation of new factors. In one method, the variable with the highest factor loading is selected as a surrogate representative for a particular factor dimension, and in another method the original set of variables are replaced with an entirely new, smaller sets of variables created from factor scores. Creation of factor scores is discussed in detail, as it is the technique used for the Factor Analysis of the data of the study.

Factor scores are used for diagnostic purposes and also as inputs to the subsequent analysis. They are smaller sets of variables that replace original set. Conceptually factor score represents the degree to which each case (individual) scores high on the group of items with high loadings on a factor. Thus, higher values on the variables with high loadings on a factor will result in a higher factor score (Hair et al, 2006)\textsuperscript{312}.

Factor score represents all variables loading on the factor, and is used for complete data reduction. By default, the factor scores are orthogonal and can avoid complications caused by multicollinearity. Factor scores are the scores of

\textsuperscript{311} Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006

\textsuperscript{312} Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006
each case (row) on each factor (column). To compute the factor score for a given case, for a given factor, the case’s standardized score is taken on each variable, is multiplied by the corresponding factor loading of the variable for the given factor, and these products are summed up.

The objectives of the study as mentioned earlier were: data reduction; identification of the variables that construct the factors; and replace the variables with the factors in the original data. This reduces number of independent variables in the statistical model and makes the process parsimonious. Of course, in the process of replacing the variables with factors a certain degree of explanatory power is lost, as the percentage of variance explained be the factors is generally not more than 70 percent.

5.1.8.1 Methodology of Calculating Factor Scores

The methodology of calculating factor scores which will replace the independent variables with new factors for further analysis is as follows.

The process starts with the rotated factor loadings of the variables. For example, \( n_1 \) variables construct factor 1. The rotated factor loadings of the variables have to be converted into relative loadings by dividing the factor loading of the variable by the sum of the factor loadings of all the \( n_1 \) variables. As a result, all \( n_1 \) variables that construct factor 1 lead to a sum-total of 1, when relative factor loadings are considered. These values are considered as the coefficient of the \( n_1 \) variables that construct factor 1. If the relative factor loadings are represented as \( \beta_1, \beta_2, \ldots, \beta_n \) and \( n_1 \) variables are denoted as \( X_1, X_2, \ldots X_n \), then factor 1 can be represented as, 

\[
\text{factor1} = \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n .
\]

Similarly, other factors are formed. In this context, it is crucial to check that that factors are not created mechanically just by observing at the rotated factor loadings. It is equally important to interpret and understand the relevance of the factor created. If the factor created does not make adequate sense, it is wise to drop it. Factor score for each factor calculated in the above manner is transferred to SPSS data sheet. For
each individual respondent (row), a new data file of seven factor scores (columns) is created. The factor scores now become the starting point for the second multivariate technique of multiple regression.

5.1.9 Software used for Factor Analysis Technique

The most widely used statistical software package SPSS is used in the Data Analysis for the study. Although SPSS incorporates statistical and mathematical processes for Factor Analysis as described above, it has a specific terminology and commands to be applied for conducting the Data Analysis. Data Analysis with SPSS software is discussed in chapter 6. SPSS 16.0 is selected for factor analysis for this research work as it incorporates Principal Component Analysis such as SAS. SPSS is preferred over SAS for the simplicity, usability and availability.

Part II

5.2 Multiple Regression Analysis

After the completion of Factor Analysis, we start our discussion on linear multiple regression. Multiple regression analysis is a statistical technique that can be used to analyze the relationship between a single metric dependent variable and several independent variables which could be either metric or dichotomous. It is a dependence technique. The objective of this technique is to form a regression variate – a linear combination of independent variables that predict the dependent variable the best. The regression variate is also known as regression equation or regression model. This technique is used when both dependent and independent variables are metric. Under special circumstances, it is possible to include non metric data either as independent variables (by transforming either ordinal or nominal data with dummy variable coding) or the dependent variable (by the use of a binary measure in logistic regression). To apply Multiple Regression Technique they must be transformed and before
formulating the regression equation, the dependent and independent variables have to be segregated.

Sometimes the independent variables exhibit a quality of multicollinearity (correlation among 3 or more independent variables amongst themselves). The impact of multicollinearity is to reduce any single independent variable’s predictive power to the extent to which it is associated with the other independent variables. As collinearity increases, the unique variance explained by each independent variable decreases and the shared prediction percentage rises. Because the shared prediction can account only once, the overall prediction increases much more slowly as independent variables high multicollinearity are added. To maximize the prediction power of the model, from the given set of independent variables, the researcher should look for independent variables that have low multicollinearity with the other independent variables and have high correlation with the dependent variable. In this case, as discussed before, factor analysis has taken care of the multicollinearity problem. The figure below diagrammatically explains the flow of research design of Multiple Regression Analysis.

Flow chart depicting Multiple Regression Analysis is given in Figure 5.2.
Research Problem:
Select Objectives, Prediction, Explanation
Select Dependent and Independent Variables

Research Design Issues:
Obtain an Adequate Sample Size to ensure Statistical Power and Generalizability

Creating Additional Variables:
Transformations to meet Assumptions
Dummy Variables for the use of Non-Metric Variables
Polynomials for Curvilinear Relationships

Assumptions in Multiple Regression:
Do the Individual Variables meet the Assumptions of Linearity, Normality, Homoscedasticity, Independence of Error Terms

Select an Estimation Technique:
(i) Specifying Regression Model
(ii) Specifying Procedure to Optimize Prediction

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2. Procedure Selects: Sequential Search Method / Combinatorial Approach

Does the Regression Variate Meet the Assumptions of Regression Analysis?

3. Examine Statistical and Practical Significance:
   Coefficient of Determination
   Adjusted Coefficient of Determination
   Standard Error of the Estimate
   Statistical Significance of Regression Coefficients

Identify Influential Observations:
Are any Observations determined to be Influential and require deletion from the Analysis?

4. Interpret the regression Variate: Evaluate the Prediction Equation with the Regression Coefficients, Evaluate the Relative Importance of the Independent Variables with Beta Coefficients, Assess Multicollinearity and its Effects
5.2.1 Why using Multiple Regression Analysis for this Research Study?

*Appropriateness of Multiple Regression Analysis:* We decided to use Multiple Regression Analysis to predict and explain Financial Performances of small and medium business organizations. Multiple Regression Analysis can describe the relationship among 2 or more intervally scaled variables and is much more powerful than simple regression with a single independent variable. Multiple Regression Analysis is used to analyze the relationship between a single dependent (criterion) variable and several independent (predictor) variables. The objective of Multiple Regression Analysis is to use several independent variables whose values are known to predict the single dependent variable. Multiple Regression Analysis is a dependence technique.

To use this technique effectively, both dependent and independent variables must be distinct from each other and they must be metric. Under certain circumstances, it is possible to include non-metric data either as independent variables (by transforming either ordinal or nominal data with dummy variable coding) or the dependent variable (by the use of binary measure in the specialized technique of logistic regression). Thus to apply Multiple Regression Analysis, the data must be metric and appropriately transformed as well the depending and independent variables from the groups have to be decided.

In this research work, the data collected is sorted and suitably transformed with 5-level Likert scale and those questions varying from this 5-level Likert scale are with seeking ordinal answers and 3-level answers are suitably transformed to yield uniformity for regression analysis purposes.

One of the objectives of the research is to establish the relationship between OP and OI. There are variables such as, Financial Returns, Market Share Growth, Business Valuation, Profit Growth and Rate of Business Expansion as the measures of Organizational Performance. They are variables capturing Financial Performance of the Firm. Financial Performance is a universally accepted
standard measure of high performing organizations (Jeffrey et al., 1997). 
‘Financial returns’ captures the perceptions of the Business owner on ‘Return on Equity, Return on Assets, Financial Growth’; Market share growth captures perceptions on ‘Growth rate of market share over a period of 1 year’; Economic Value Added captures ‘Business Value’; Profit Growth measures ‘Growth of profit before tax’; and Rate of Business expansion captures ‘Increase in business verticals and diversification’ (Jeffrey et al., 1997). These are variables that depend on other independent variables listed in Appendix 4 - Variable selection from the Literature. Each of these dependent variables can be predicted with a set of independent variables with the group of factors evolved from exploratory factor analysis and a few unique variables which could not be grouped.

**Ordinary Least Square Method and Accuracy:** Before estimating the regression equation, we must calculate the baseline against which we will compare the predictive ability of our regression models. The baseline should represent our best prediction without the use of any independent variables. In regression, the baseline prediction is the simple mean of dependent variable. Because the mean will not predict each value of the dependent variable, we must have a way to assess predictive accuracy that can be used with both the baseline prediction and the regression models we create. The customary way to assess the accuracy of any prediction is to examine the errors in predicting the dependent variable. Although we might expect to obtain a useful measure of prediction accuracy by simply adding the errors, this approach is not possible, because the errors from using a mean value always sum to zero. To avoid this problem, we can sum up the squares of all the errors - known as sum of squared errors - provides a measure of prediction accuracy that will vary according to the amount of prediction errors. The objective is to obtain the smallest possible sum of squared errors as our measure of prediction accuracy. Hence the concept of least squares

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helps us achieve highest accuracy possible. This method is also known as Ordinary Least Squares method (OLS) (Hair et al, 2006)\textsuperscript{315}.

**Interpreting Dummy Variable:** Usually researchers desire to utilize non-metric independent variables. Many multivariate techniques assume metric measurement of both independent and dependent variables. When dependent variable is measured as a dichotomous variable (0,1), either discriminant analysis or a specialized form of regression – logistic regression – is appropriate. The ‘Business Valuation’ variable captures dichotomous value and hence we have eliminated it from Multiple Regression Analysis. The other 4 variables are taken as dependent variables for the model equation. When the independent variables are non-metric, and have 2 or more categories, we can create dummy variables that act as replacement independent variables. Each dummy variable represents one category of non-metric independent variable, and any non-metric variable with \( k \) categories can be represented as \( k-1 \) dummy variables. Thus non-metric variables can be converted to a metric format for use in most multivariate techniques (Hair et al, 2006)\textsuperscript{316}.

**Assumptions in Multiple regression analysis:** Improvements in predicting the dependent variable are possible by adding independent variables and transforming them to represent non-linear relationships. To do so, we must make several assumptions about the relationships between the dependent and independent variables that affect the least square procedure used for multiple regressions. The basic issue is to know whether in the course of calculating the regression coefficients and predicting the dependent variable, the assumptions of regression analysis have been met. We must know whether the errors in predictions are the results of the absence of a relationship among the variables or caused by some characteristics of the data that are not accompanied by the regression model.

\textsuperscript{315} Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
\textsuperscript{316} Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
The assumptions to be examined include linearity of the phenomenon measured, constant variance of the error terms, and normality of the error term distribution. The assumptions underlying Multiple Regression Analysis apply both to the individual variables, (dependent and independent) and to the relationship as a whole. Once the variate has been derived, it acts collectively in predicting the dependent variable, which necessitates assessing the assumptions not only for individual variables but also for variate. The principal value of prediction error for the variate is the residual – the difference between the observed and predicted values for the dependent variable. Plotting the residuals versus the independent or predicted variables is a basic method of identifying assumption violations for the overall relationship (Hair et al, 2006)\textsuperscript{317}.

Usually, statistical inferences from classical linear regressions are based on several assumptions in addition to the above mentioned assumptions on interrelationships between independent variables error distributions of the predictors. These assumptions are listed below.

(i) The regression model is linear in parameters.
(ii) The values of regressors are fixed in repeated sampling.
(iii) For a given set of independent variables, the mean value of the disturbances is zero.
(iv) For a given set of independent variables, the variance is constant or homoscedastic.
(v) For a given set of variables there is no autocorrelation in the disturbances.
(vi) If the independent variables are stochastic, the disturbance term and the independent variables are uncorrelated.
(vii) The number of observations must be greater than the number of independent variables.
(viii) There must be sufficient variability in the values taken by the regressors.
(ix) The regression model is correctly specified.
(x) There is no exact linear relationship in the regressors. (presence of multicollinearity).
(xi) The stochastic disturbance term is normally distributed.

\textsuperscript{317} Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006
When a relationship between several independent variables and a dependent variable is turned into a multivariate model, it is known as a Multiple Regression Model. Most theoretical results developed for the simple regression model naturally extend to Multiple Regression. Such a model has the general form

\[ y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \ldots + \beta_k x_{ki} + e_i \]

In this model also the subscript \( t \) denotes sample number, there being \( i \) total number of samples available for parameter estimation and analysis. As is the case with simple regression, to make the Multiple Regression Models complete and acceptable for forecasting and other applications, certain assumptions must hold for the errors or residuals \( \{e_i\} \). They are:

- \( E[e_i] = 0 \), implying that each random error has a probability distribution with zero mean.
- \( \text{var}(e_i) = \sigma^2 \). Each random error has a variance equal to \( \sigma^2 \). Such errors that have equal variance are called homoscedastic.
- \( \text{cov}(e_i, e_j) = 0 \) for \( i \neq j \), implying that the covariance between two random errors corresponding to any two different observations marked by \( i \) and \( j \) is zero.
- Sometimes it is further assumed that errors \( \{e_i\} \) are normally distributed. That implies \( e_i \sim N(0, \sigma^2) \)

Since the general linear Multiple Regression Model is developed by following procedures similar to that for the simple regression model, the OLS parameter estimation procedure is again used here. This is valid provided the above assumptions are met by the random errors \( \{e_i\} \).

The goodness of fit of a regression model—simple or multiple—is given by a measure \( R^2 \), which expresses the fraction of the variability in the endogenous variable \( y \) that may be “explained” by the exogenous terms \( (X_1, X_2, X_3, \text{etc.}) \) of the regression model. The “significance test” of a regression model tests the relevance of all the explanatory variables included in the model. This test hypothesizes that all the model parameters \( \{\beta_i\} \) are zero, except the intercept \( \beta_0 \), and then checks the acceptability of this statistical hypothesis by performing an F test.
Regression models are built based on data collected in which each observation consists of the set values of the independent variables, and the corresponding observed value of the dependent variable y. Parameter estimation in multiple regression analysis procedurally requires matrix algebra to manipulate the several simultaneous equations derived from the least squares criteria.

When data are collected from uncontrolled experiments, many of the “independent” variables may move together in systematic ways. Such variables are called collinear and when several such variables are involved, the system is said to have the problem of multicollinearity. In this case even if several independent variables are involved, the data collected may not be “rich in information”. In such cases it is not possible to isolate the relationship between the dependent and the independent variables reliably. Such situations are handled by special analytical approaches. We note again, that a key assumption of Multiple Regression Model building based on the least squares or OLS criteria is that the values of the explanatory variables are not random and are not exact linear functions of the other explanatory variables.

Prediction problems with Multiple Regression Models are similar to the simple regression case: we first need to reliably estimate all model parameters (coefficients) $\beta_0, \beta_1, \beta_2, \beta_3, \text{etc.}$ and also establish an acceptable goodness of fit for the model. Then it is possible not only to estimate the dependent variable given certain specified values of the explanatory variables, but also the variance and the confidence interval of the prediction. Note that even categorical or discrete variables (white, male, graduate, etc.) can be incorporated into regression models. Also, nonlinear relationships can be modeled, with suitable mathematical transformations of the variables, such as taking log, to convert the relationships into linear relationships, so that the technique of regression may be applied to develop a model. Interactions between the independent variables also can be used as contributing terms in a multiple regression model. Furthermore, polynomial terms may be used in a regression model.
We briefly mention some other problems in successfully developing Multiple Regression Models. We have already mentioned the issue of collinearity. This is detected by observing the covariance matrix, especially the co-variances estimated between the different explanatory variables. The solution is to drop a few explanatory variables from the model in order for the OLS algorithm to work, which requires solving simultaneous and linearly independent equations to deliver the estimated model parameters $b_1$, $b_2$, $b_3$, etc. The other way to take care of the multicollinearity problem is applying factor analysis on the independent variables before going for Multiple Regression. This is what we are doing in this research.

The other critical issue is that of autocorrelation (among errors over different time periods) when one is developing a multiple regression model using time series data. As our data is cross-section data, free from any time series analysis, autocorrelation is absent. In this situation also the standard OLS procedure cannot be directly applied. The solution requires one to use an extended procedure known as the generalized least squares procedure (Hill et al, 2001)\(^\text{318}\). A similar problem that is faced by cross-section data is procedure is heteroscedasticity, which is applicable when error variances are not constant, i.e., is present among errors $\{e_i\}$. Hence, when we use Multiple Regression as a model we need to make sure that all the above classical assumptions regarding the behavior of the error term $\{e_i\}$ are met.

**Selection of an Estimation Technique:** In a Multiple Regression, a researcher may chose from a number of possible independent variables for inclusion the regression equation. Sometimes the set of independent variables are exactly specified and the regression model is essentially used in a confirmatory approach. This approach referred to as a simultaneous regression, includes all variables at the same time. In other instances the researcher may use the estimation technique to pick and chose among the set of independent variables with either sequential search methods or combinatorial processes. The most popular sequential search method is stepwise estimation which enables the

researcher to examine the contribution of each independent variable to the regression model. The combinatorial approach is a generalized search process across all possible combinations of independent variables. The best known procedure is all possible subsets regression which is exactly as the name suggests. All possible combinations of independent variables are examined and the best fitting set of variables are identified. Each estimation technique is designed to assist the researcher in finding the best regression model using different approaches. In this research study, there were initially 165 variables which reduced to 153 by eliminating similar types of variables and finally reduced to 40 variables as found from the literature. So the estimation techniques were not used, instead the entire set of independent variables are used against each of the dependent variable prediction (Hair et al, 2006).

**Interpreting the Results of Regression:** The regression variate must be interpreted by evaluating the estimated regression coefficients for their explanation of the dependent variable. The researcher must evaluate not only the regression model that was estimated but also the potential independent variables that were omitted if a sequential search or a combinatorial approach was employed. In those approaches, multicollinearity may substantially affect the variables ultimately included in the regression variate. Thus, in addition to assessing the estimated coefficients, the researcher must also evaluate the potential impact of omitted variables to ensure that the managerial significance is evaluated along with statistical significance. The estimated regression coefficients, or beta coefficients represent both the type of relationship (positive or negative) and the strength of the relationship between independent and dependent variables in the regression variate. The sign of the coefficient denotes whether the relationship is positive or negative, while the value of the coefficient indicates the change in the dependent value each time the independent variable changes by one unit.

Prediction is an integral element in regression analysis, both in the estimation process as well as forecasting situations. Regression involves the use of a variate

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319 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
to estimate a single value for the dependent variable. This process is used not only to calculate the predicted values in the estimation procedure, but also with additional samples for validation or forecasting purposes. The researcher often is interested not only in prediction, but also explanation. Independent variables with larger regression coefficients make a greater contribution to the predicted value. Insight into the relationship between independent and dependent variables is gained by examining the relative contributions of each independent variable. Thus for explanatory purposes, the regression coefficients become indicators of relative impact and importance of independent variables in their relationship with the dependent variable (Hair et al, 2006)\(^\text{320}\).

**Assessing Influential Observations:** Influential observations include all observations that have a disproportionate effect on the regression results. The three basic types of influential are,

(i) **Outliers:** Observations that have large residual values and can be identified only with respect to a specific regression model.

(ii) **Leverage Points:** Observations that are distinct from the remaining observations based on their independent variable values.

(iii) **Influential Observations:** all observations that have disproportionate effect on the regression results.

These 3 aspects depend on 4 conditions;

(a) **An error in observations or in data entry:** This can be corrected by correcting the data or deleting the data.

(b) **A valid but exceptional observation that is explainable by an extraordinary situation:** This can be corrected by deleting the case unless variables reflecting the extraordinary situation are included in the regression equation.

(c) **An exceptional observation with no likely explanation:** This is a special problem because the researcher has no reason for deleting the case, but its inclusion cannot justify either, suggesting analyses with and without observations to make a complete assessment.

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\(^{320}\) Hair et al, Multivariate Data Analysis, 6\(^{th}\) Ed, Printice Hall Pb; 2006
(d) An ordinary observation in its individual characteristics but exceptional in its combination of characteristics: This indicates modifications to the conceptual basis of regression model and should be retained.

The researcher should delete truly exceptional observations but avoid deleting observations that, although different, are representative of the population (Barnett et al, 1994)\(^{321}\).

### 5.2.2 Objective of Multiple Regression Analysis

The objective of Multiple Regression Analysis is to predict the dependent variable with the help of the independent variables. While doing so, the analysis fulfills couple of objectives which are discussed as below.

#### 5.2.2.1 Research Problems Appropriate for Multiple Regression

The first problem is due to those assumptions about the specification of the model and about the disturbances. The second issue is due to the assumptions about the data (Barrie et al, 1986)\(^{322}\).

Under these assumptions listed earlier in this chapter, the variables are selected to be,

\[
Y = C + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots + \beta_n X_n
\]

In this specified model, \(C\) represents the disturbance term, \(Y\) the dependent variable and \(X_i\) the independent variables and \(\beta\) - the regression coefficients.

Multiple Regression Technique is used for prediction and explanation. Prediction involves the extent to which the regressors can predict the dependent variable. Explanation examines the regression coefficients for each independent variable.

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\(^{322}\) Barrie Wetherill, Regression Analysis with Applications, Chapman and Hall, NewYork; 1986, p 14-15
Attempts are made to develop a theoretical reason to understand the behavior of the relationship between $X_i$ and $Y$.

Prediction with Multiple Regression has 2 key objectives. One is, to maximize the overall predictive power of the independent variables as represented in the variate. Predictive accuracy is always crucial to ensure the validity of the set of independent variables. Measures of predictive accuracy are developed and statistical tests are used to assess the significance of predictive power.

While considering the applications of prediction alone, the interpretations from beta coefficients are relatively less important. Predictive accuracy is improved at the cost of beta coefficient interpretations. Next objective is, to compare 2 or more sets of independent variables to ascertain the predictive power of each variate. The predictive power of more models are studied and compared to judge about the dependent variables.

Explanation with Multiple Regression provides a means of objectively assessing the degree and character of the relationship between dependent and independent variables by forming the variate of independent variables and then examining the magnitude and direction as well statistical significance of regression coefficient for each independent variable. The independent variables collectively as well individually predict dependent variable and their beta coefficients will explain their relationship with dependent variable individually.

Interpretation of the variate will rely on 3 perspectives; the importance of the independent variables, the types of relationships found, the types of interrelationships among the independent variables. (i) The most direct interpretation of the regression variate is a determination of relative importance of each independent variable in the prediction of dependent measure. (ii) In addition to assessing the importance of each variable, Multiple Regression Analysis also affords the researcher a means of assessing the nature of the relationships between the independent variables and the dependent variable. (iii) The multiple Regression Analysis also provides insight into the relationships
among the independent variables in their prediction of the dependent measure (Hair et al, 2006).  

These interrelationships are important for 2 reasons. First, the correlation among the independent variables may make some variables redundant in the predictive effort. In such instances, the independent variable having strong relationship with dependent variable which is diminished due to the presence of relationships of other independent variables with the dependent variable. Then the researcher must guard against determining the importance of independent variables based solely on the derived variate, because the relationships among the independent variables may mask or confound relationships that are not needed for predictive purposes but represent substantive findings nonetheless. 

The interrelationships among the variables can extend not only to their predictive power but also to the interrelationships among their estimated effects, which is best seen when the effect of one independent variable is contingent on another independent variable. Multiple Regression Analysis provides diagnostic analyses that can determine whether such effects exist based on empirical or theoretical rationale. Indications of high degree of interrelationships (multicollinearity) among the independent variables will suggest the use of summated scales (Hair et al, 2006).

5.2.2.2 Selecting Dependent and Independent Variables & Specifying the Model. 

Functional relationship calculates the exact value whereas a statistical relationship estimates an average value. In predicting the dependent variable accurately, it is important to define the assumptions made while formulating the relationship model. Predictive power of Multiple Regression Analysis depends on the assumptions made and the validation of interpretations of the independent variable. The success of a Multiple Regression Analysis depends on

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323 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006 
324 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
the selection of dependent and independent variables and the specification of the model. *Strong Theory* says that the selection of variables must be based on conceptual or theoretical grounds even when the objective is solely for prediction. The researcher must select variables indiscriminately or allow the selection of independent variables to be solely based on empirical bases.

The other aspect of variable selection is measurement error. *Measurement error* refers to the degree to which the variable is an accurate and consistent measure of the concept being studied. If the dependent variable has substantial measurement error, then the best set of independent variables will not be able to achieve higher levels of predictive accuracy.

Measurement error can be addressed by the usage of summated scales of independent variables or by structural equation modeling. Summated scales can be directly incorporated into Multiple Regression by replacing either dependent or independent variables with the summated scale values, while structural equation modeling requires the use of an entirely different technique generally regarded as a difficult analysis to implement.

Thus, summated scales are recommended as the first choice as a remedy for measurement error. Another error that occurs in variable selection is *Specification error*. *Specification error* is due to the inclusion of irrelevant variables or the omission of relevant variables from the set of independent variables. Inclusion of irrelevant variable impacts regression variate. It reduces model parsimony, which might be critical in the interpretation of results. It can mask and replace the effects of more important variables if some sequential form of model estimation is used. It can reduce the precision of the multiple regression models and reduce the significance of the entire analysis.

Similarly, the exclusion of relevant variables can bias the results and misdirect the interpretation considerably. If there is no correlation between the excluded and the included variables then the model accuracy will be reduced. If there is a correlation between them, then the prediction will be biased to the extent of the
correlation between the excluded and included variables. Model interpretation will suffer from precision and accuracy (Hair et al, 2006)\textsuperscript{325}.

5.2.3 Research Design of Multiple Regression Analysis

Research Design of Multiple Regression analysis primarily means the design of sample size as this technique maintains the necessary levels of statistical power and significance across broad range of sample sizes. The design includes the decision of unique elements of the dependence relationship. It is assumed that dependent variable and the independent variables share a linear relationship. Additional variables can be added to this relationship to represent special aspects of the relationship. Multiple Regression accommodates metric independent variables that are assumed to be fixed in nature as well as those with the random component. Nature of Independent Variables also decides the research design.

5.2.3.1 Sample Size

In multiple regression power refers to the probability of detecting a significant R-square. Sample size plays a role in assessing the power of current analysis as well proposed analysis (Mason et al, 1991)\textsuperscript{326}.

Table 5.4 illustrates the interplay among the sample size, the significance level (α) chosen, and the number of independent variables in detecting significant R-square (Hair et al, 2006)\textsuperscript{327}. The table values are minimum R-square that the specified sample size will detect as statistically significant at the specified alpha (α) level with the power (probability) of 0.80.

\textsuperscript{325} Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006
\textsuperscript{327} Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006
Table 5.4 - Minimum Significant R-Square

<table>
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<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

NA = Not applicable

(Minimum R-square that can be found statistically Significant with a Power of 0.80 for Varying Numbers of Independent Variables and Sample Sizes)

Source: (Hair, 2006)\(^{328}\)

The researcher must be aware of the anticipated power of any proposed Multiple Regression Analysis. The researcher can determine the sample size needed to detect effects for individual independent variables given the expected effect size (correlation), the \(\alpha\) level, and the power desired (Cohen et al, 2002)\(^{329}\). The general rule is, the ratio of independent variables and sample size should not fall below 1:5. The maximum can be 1:20. When this level of samples is obtained, the results are generalizable as the samples become representative of population. A stepwise procedure can be employed to increase the ratio to 1:50, however this

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\(^{328}\) Hair et al, Multivariate Data Analysis, 6\(^{th}\) Ed, Printice Hall Pb; 2006

ratio can lead to a tendency towards the results being sample specific (Wilkinson, 1975).

When the ratio falls below 1:5, there is a risk of over fitting the variate to the sample, making the results too specific to the sample and thus lacking generalizability. Each observation represents a separate and independent unit of information (i.e., one set of values for each independent variable). Ideally the researcher should dedicate a single variable to perfectly predicting only one observation, second variable to another observation and so forth. If the sample is relatively small, then predictive accuracy could be quite high and many of the observations could be perfectly predicted. The number of estimated parameters (regression coefficients and the constant) equals the sample size, perfect prediction will occur even if all the variable values are random numbers. This scenario is totally unacceptable and it is extreme over fitting as the estimated parameters relate only to the sample data and no generalizability is possible. Whenever a variable is added to the regression equation, R-square value will increase.

The degree of generalizability is represented by the degrees of freedom.

\[ \text{Degrees of Freedom (df)} = \text{sample size} - \text{Number of estimated Parameters} \]

Or

\[ \text{Degrees of freedom (df)} = N - (\text{Number of independent variables} + 1) \]

The larger the degree of freedom, the better is the generalizability. Degrees of freedom increases for a given sample if the number of independent variables reduces. The objective is to achieve highest predictive accuracy with large degrees of freedom. When there is perfect prediction, with the number of estimated parameters equaling the sample size, zero degrees of freedom appears. The researcher is advised to reduce the number of independent variables to improve predictive accuracy. Degrees of freedom indicate the generalizability of the results for a given size of samples. There thumb rules are, (i) Simple

regression can be effective with the sample size of 20, but maintaining power at 0.80 in Multiple Regression requires a minimum sample of 50 and preferably 100 for most of the research situations. (ii) The minimum ratio of observations to variables is 5:1. Preferred ratio is 15:1 or 20:1, which would increase further if stepwise estimation is used. (iii) Maximizing the degrees of freedom improves generalizability and addresses both model parsimony and sample size concerns.

5.2.3.2 Creating Additional Variables

Problems appear when a non-metric data such as gender or occupation had to be incorporated into a regression equation. Regression is meant for metric data. This introduction of non-metric data will lead to non-linear equations of regression. In such situations new variables are created by transformations. Variable transformation methods (Box et al, 1964) are used primarily to improve or modify relationship between dependent and independent variables and to enable the use of non-metric variables in the regression variate. Data transformations are achieved by trial and error, to make the analysis to best represent the actual data set. All these transformations are carried out by the statistical software used for regression analysis.

When dependent variable is measured as a dichotomous (0, 1) variable, either discriminant analysis or logistic regression is appropriate. When independent variables are non-metric, dummy variables are introduced. If there are non-metric variables in k categories, k-1 dummy variables are introduced in multiple regression analysis. The most common format of dummy variable coding is ‘indicator coding’, where each category of the non-metric variable is represented by either 1 or 0. The regression coefficients of dummy variables represent differences on the dependent variable for each group of respondents from the reference category (the omitted group that received all zeros). These group differences can be assessed directly because the coefficients are in the same units as the dependent variable. This form of coding is most appropriate when a

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logical reference group is present, as in the case of an experiment. An alternative method of dummy variable coding is termed as ‘effects coding’. It is the same as indicator coding except that the comparison or omitted group (the group that got all zeros) is given a value of -1 instead of zero for the dummy variables. The coefficients represent differences for any group from the mean of all the groups rather than from the omitted group. Both the forms of coding give same predictive results, coefficient of determination and regression coefficients for the continuous variables. Interpretation of results will depend on the coding of dummy variables. There are thumb rules for variable transformations. They are, (i) Non-metric can only be included in regression analysis by creating dummy variables. (ii) Dummy variables can only be interpreted in relation to their reference category (Hair et al, 2006)\(^{332}\).

The estimation procedures for models using both types of independent variables are the same except for the error terms. In the random effects models, a portion of the random error comes from the sampling of the independent variables. The statistical procedures based on the fixed model are quite robust. Using the statistical analysis as if a fixed model is being dealt with will be appropriate as a reasonable approximation.

### 5.2.4 Assumptions in Multiple Regression Analysis

To improve the predictive accuracy of the model, the researcher needs to lay down a few assumptions about the relationship between the dependent and independent variables that affect the least square procedure used for Multiple Regression. There are 4 types of assumptions made. (i) Linearity of the phenomenon measured. (ii) Constant variance of the error terms. (iii) Independence of error terms. (iv) Normality of the error term distribution.

In Multiple Regression once the variate is derived, it acts collectively in predicting the dependent variable, which necessitates assessing the assumptions

\(^{332}\) Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
not only for individual variables but also for the variate itself. Testing assumptions occur before as well after predicting the model. The principal measure of prediction error is the residual – the difference between the observed and the predicted values of the dependent variable. Some form of standardizations is recommended to make the residuals comparable while predicting dependent variable. Studentized residual – the most widely used values that correspond to t-values. Plotting residuals Vs Independent variables is a basic method of identifying assumption violations for the overall relationship. They are also plotted against predicted dependent values. These plots are compared with null plot where all the assumptions are completely met. The patterns are compared to understand the error of the variate (Hair et al, 2006) 333.

5.2.4.1 Linearity of the Phenomenon

The linearity of the relationship between dependent and independent variables represents the degree to which the change in the dependent variable is associated with the independent variable. The regression coefficient is constant across range of values for the independent variable. The concept of correlation is based on the linear relationship, thus making it a critical issue in regression analysis. Linearity of a bivariate relationship is examined through residual plots. Any consistent curvilinear pattern in the residuals indicates that the corrective action will increase both predictive accuracy of the model and the validity of the estimated coefficients. The corrective actions could be; transforming the data values (logarithm, square root etc.) of one or more independent variables to achieve linearity; Directly including non linear relationships in the regression model, such as creation of polynomial terms; Using specialized methods such as nonlinear regressions specifically designed to accommodate the curvilinear effects of independent variables or more complex nonlinear relationships (Hair et al, 2006) 334.

333 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
334 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
The residual plot reveals the combined effects of all independent variables. Determining the independent variable for a corrective action from the pattern seen from such a plot could not help. So, partial regression plots are prepared where, relationship of individual independent variables with dependent variable are plotted separately controlling the other variables. So, the unique relationship between a specific independent variable and the dependent variable can be come obvious. These plots when superimposed on a residual plot reveal whether the variable violates the linearity assumption or not.

5.2.4.2 Constant Variance of the Error Term

The presence of heteroscedasticity (unequal variances) is one of the most common assumption violations. Diagnosis is made with residual plots or simple statistical tests. Plotting the residuals against the predicted dependent values and comparing them to a null plot shows a consistent pattern if the variance is not constant. Many a times a number of violations occur simultaneously such as non linearity and heteroscedasticity. All statistical softwares provide tests for homogeneity of variance which measures the equality of variances. If heteroscedasticity is present, two remedies are available. One is, if the violation can be attributed to a single independent variable through analysis of residual plots, then the procedure of weighted least squares can be employed; the other is to execute variance stabilizing transformations that allow transformed variables t exhibit homoscedasticity(equality of variance) (Hair et al, 2006)335.

5.2.4.3 Independence of the Error Terms

In regression, researchers assume that each predicted value is independent, which means that the predicted value is not related to any other prediction (i.e., they are not sequenced by any variable). This occurrence can be identified by plotting the residuals against any possible sequencing variable. If the residuals are independent the pattern should appear random and similar to the null plot of

335 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
residuals. Violations will be identified by a consistent pattern in the residuals. They can be identified when there is a dependence of error term with time and when there is a dependence of error term with respect to the occurrence of events (Hair et al, 2006).³³⁶

5.2.4.4 Normality of the Error Term Distribution

The most frequently encountered assumption is the normality of the error term distribution or the violation of the non-normality of the dependent or independent variables or both (Seber, G.A, 2004).³³⁷ Simplest diagnosis is to plot the independent variables against dependent variables and obtain a histogram ideally. For smaller samples this method is ill formed while plotting. A better method is the use of normal probability plots. They differ from residual plots in that the standardized residuals are compared with the normal distribution. The normal distribution makes a straight diagonal line, and the plotted residuals are compared with the diagonal. If a distribution is normal, the residual line closely follows the diagonal. The same procedure can compare the dependent and or independent variables separately to the normal distribution (Daniel et al, 1999).³³⁸

The rules of Thumb for assessing statistical assumptions are,

(i) Testing assumptions must be done not only for each dependent and independent variable, but for the variate as well.

(ii) Graphical analyses (i.e., Partial regression plots, residual plots, normal probability plots) are the most widely used methods of assessing assumptions for the variate.

(iii) Remedies for problems found in the variate must be accomplished by modifying one or more independent variables.

³³⁶ Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
³³⁸ Daniel et al, Fitting Equations to Data, 2nd Ed, NewYork: Wiley-Interscience; 1999
5.2.5 Estimating the Regression Model and Assessing the Overall Model Fit

The researcher is expected to accomplish 3 basis tasks; To select a method for specifying the regression model to be estimated; To assess the statistical significance of the overall model in predicting the dependent variable; and To determine whether any observations exert any undue influence on the results. In ‘confirmatory specification’, the researcher chooses the exact set of independent variables. It should be noted that the selection should not be empirical but based on theoretical justification. The other approach is ‘sequential search’, which employs stepwise selection or forward addition and backward elimination techniques to select variables one after another to bargain for better predictive accuracy.

**Stepwise Estimation:** This method of estimation has a framework as given below (Hair et al, 2006)\(^{339}\).

(i) Start with simple regression model by selecting the one independent variable that is the most highly corrected with the dependent variable. The equation would be, \( Y = b_0 + b_1X_1 \).

(ii) Examine the partial correlation coefficients to find an additional independent variable that explains the largest statistically significant portion of the unexplained – error – variance remaining in the first regression equation.

(iii) Recomputed the regression equation using the two independent variables and examine the partial F value for the original variable in the model to see whether it still makes a significant contribution, given the presence of new independent variable. If it does not, eliminate the variable. This ability to eliminate variables already in the model distinguishes the stepwise model from the forward addition/backward elimination models. If the original variable still makes a significant contribution, the equation would be, \( Y = b_0 + b_1X_1 + b_2X_2 \).

(iv) Continue this procedure by examining all independent variables not in the model to determine whether one would make a statistically significant addition.

\(^{339}\) Hair et al, Multivariate Data Analysis, 6\(^{th}\) Ed, Printice Hall Pb; 2006
to the current equation and thus should be included in the revised equation. If a new independent variable is included, examine all the independent variables previously in the model to judge whether they should be kept.

(v) Continue adding independent variables until none of the remaining candidates for inclusion would contribute a statistically significant improvement in the predictive accuracy. This point occurs when all the remaining partial regression coefficients are non-significant.

A potential bias in the stepwise procedure results from considering only one variable for selection at a time. Multicollinearity among the independent variables can substantially affect all sequential estimation methods. Examining ten different factors stepwise with five different dependent variables is cumbersome. The factors are grouped from individual variables that may be collinear and due to multi collinearity issues this method does not suit our research purpose of finding the strongest fit to explore the linkage between the factors of Organizational Intelligence and five different variables of Organizational Performance.

**Forward Addition and Backward Elimination:** The procedures of forward addition and backward elimination procedures are largely trial and error processes for finding the best regression estimates. The forward addition model is similar to the stepwise procedure in that it builds the regression equation starting with the single independent variable. The backward elimination procedure starts with the regression equation including all the independent variables and then deletes independent variables that do not contribute significantly.

The primary distinction between stepwise procedure and the forward-addition and backward-elimination procedure is, in stepwise method, addition or deletion of a variable at each stage is possible where in, in forward-addition, backward elimination procedures addition of variables in a later stage is not possible. This flexibility makes stepwise procedure preferred method for researchers. The procedures of variables addition and elimination would not be suitable for our
analysis as we are interested in finding the strongest regression fit model to establish the linkage between Organizational Intelligence and Organizational Performance which is obtained by regressing the factors of Organizational Intelligence with the five dependent variables chosen to represent Organizational Performance.

**Caveats to the above Sequential Search Methods:** there are three key caveats to the sequential search methods of estimations discussed above.

(i) The multicollinearity among independent variables has substantial impact on model specification. Although the sequential search approaches will maximize the predictive ability of the regression model, the researcher must be careful in using these methods in establishing the impact of independent variables without considering multicollinearity among independent variables.

(ii) All sequential search methods create a loss of control for the researcher. Though the researcher specifies the variables to be considered for the regression variate, it is the estimation technique, interpreting the empirical data specifies the final regression model.

(iii) In stepwise procedure, multiple significance tests are carried out in the model estimation process. To ensure the overall error rate across all significance tests is reasonable, the researcher should employ more conservative thresholds (e.g., 0.01) in adding or deleting variables.

**Combinatorial Approach:** This approach suggests regression of all possible subsets of independent variables and the best fitting set of variables is chosen. This procedure is not preferred as it does not consider multicollinearity, identification of outliers and influentials and the interpretability of results in this research. The rules of the thumb of estimation techniques are; Irrespective of the estimation techniques, theory must be the guiding factor for evaluating the final regression model; Confirmatory specification method allows direct testing of pre-specified model. This is also the most complex from the perspective of specification error, model parsimony and predictive accuracy; Sequential search methods make the estimation fully automated leaving the researcher with out any control on the selection of variables; Combinatorial approach removes
control from the researcher, however gives an understanding of parallel models of predictive accuracy. Using more than one method in combination may provide a balanced perspective.

Thus we proposed to regress all the ten independent factors collected from exploratory factor analysis with the five different dependent variables of financial performance and study the stronger fit of the models from R-Square value and chose the strongest fit as the best explaining model of IO-OP relationship.

5.2.5.1 Testing the Regression Variate for Meeting the Regression Assumptions

With independent variables selected and regression coefficients estimated, the researcher must now assess the estimated model for meeting the assumptions underlying multiple regression. The individual variables as well the variate must meet the assumptions of linearity, constant variance, independence and normality. If substantial violations are found the researcher must take corrective actions on independent variables and re-estimate the regression model.

5.2.5.2 Examining the Statistical Significance of the Model

If Researchers take random samples of respondents and estimate regression equation for the sample, the regression coefficient values will differ for each set of sample and the sampling error will cause this situation. Researchers usually chose only one sample set and estimate the regression model. This approach demands the tests of the random variation explained – coefficient of determination – and regression coefficient.

**Testing the Coefficients of Determination:** To test the hypotheses that the amount of variation explained by the regression model is more than the baseline prediction (i.e., the R-square is significantly greater than zero). The $F$ Ratio is
calculated as the ratio of the ratios of the sum of squares per degree of freedom for regression and residuals respectively.

\[ F \text{ ratio} = \frac{E1}{E2}; \]

where,
\[ E1 = \text{Sum of squares } / \text{degrees of freedom: (from regression model)}; \]
\[ E2 = \text{sum of squares } / \text{degrees of freedom: (from unexplained variance - the residual)}. \]

Intuitively, if the ratio of the explained variance to the unexplained is high, the regression variate must be significant in explaining the dependent variable. Larger the R-square values, higher the F values. Statistical significance is the impact of sampling error. Statistically significant values are all practically significant. It is to be noted that for larger samples smaller R-square can be of high significance.

**Adjusting the Coefficients of Determination:** Addition of a variable in the regression model will increase R-square value. Generalizability of the model should be depending on R-square value as R-square value may increase even if a non-significant predictor variable is introduced. This demands an adjustment based on the number of independent variables and sample size combination. Adding non significant variables in the regression model will change R-square and this is adjusted R-square – adjusted coefficient of determination. The adjusted R-square is useful in comparing across the regression equations involving different numbers of independent variables or different sample sizes because it makes allowances for the degree of freedom for each model (Hair et al 2006)\(^{340}\).

**Significance Tests of Regression Coefficients:** Significance testing of a regression co-efficient is a statistically based probability estimate of whether the estimated

\(^{340}\) Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006
coefficients across a large number of samples of a certain size will be different from zero. To make this judgment, a confidence level must be established around the estimated coefficient. If the confidence interval does not include the value of zero, then it can be said that the coefficient’s difference from zero is statistically significant. To make this judgment, the researcher relies on 3 concepts. (i) Establishing significance level ($\alpha$) denotes the chance the researcher is willing to take of being wrong about whether the estimated coefficient is different from zero. A value typically used is 0.05. as the researcher desires a smaller chance of being wrong, and sets the significance level smaller (0.01 or 0.001), the statistical test becomes more demanding. Increasing the significance level to a higher value (0.1) allows for a larger chance of being wrong, but makes it easier to conclude that the coefficient is different from zero. (ii) The sampling error is being the cause for variation in the estimated regression coefficients for each sample drawn from a population. For small sample sizes, the sampling errors are larger and the estimated coefficients will most likely vary widely from sample to sample. As the size of the sample increases, the samples become more representative of the population (i.e., sampling error decreases), and the variation in the estimated coefficients for these large samples become smaller. This relationship holds true until the analysis is estimated using the population. Then the need for significance testing is eliminated as the sample size is equal to population and thus exact representative of the population (i.e., no sampling error). (iii) The standard error is the expected variation of the estimated coefficients (both the constant and regression coefficients) due to sampling error. The standard error acts like the standard deviation of a variable by representing the expected dispersion of the coefficients estimated from repeated samples of this size.

With the significance level selected and the standard error calculated, we can establish a confidence interval for a regression coefficient based on the standard error. There are 3 key angles to be looked at while checking the confidence interval. They are; (i) the researcher sets the significance level from which the confidence interval is derived (e.g., a significance level of 5% for a large sample establishes the confidence interval at $\pm 1.96 \times$ standard error). A coefficient is deemed statistically significant if the confidence interval does not include zero.
(ii) if the sample size is small, sampling error may cause the standard error to be so large that the confidence interval includes zero. However if the sample size is larger, the test has greater precision because the variation in the coefficients become less (i.e., the standard error is smaller). Larger samples do not guarantee that the coefficients will not equal zero, but instead make the test more precise. (iii) a coefficient being statistically significant does not guarantee the practical significance. Evaluating the sign of the coefficient is thus crucial (Hair et al, 2006)\textsuperscript{341}.

A simple regression model implies hypotheses about 2 estimated parameters; the constant and regression coefficient. To assess the significance level, the appropriate test is t-test which is available in all regression analysis programs. The t value of the coefficient is the coefficient divided by the standard error. T value represents the number of standard errors that the coefficient is from zero. For example, a regression coefficient of 2.5 with the standard error of 0.5 would have a t value of 5.0 (i.e., the regression coefficient is 5 standard errors from zero). To determine whether the coefficient is significantly different from zero the computed t value is compared with the table value for the sample size and the confidence interval selected. If our value is greater than the table value, we can be confident that the coefficient has a statistically significant effect in the regression variate for the selected confidence level.

Most computer programs calculate the significance level for each regression coefficient’s t value, showing the significance level at which the confidence interval would include zero. The researcher can then assess whether this level meets the desired level of significance. For example, if the statistical significance of the coefficient is 0.02, then we can say that it was significant at the 0.05 level because it is less than 0.05, but not significant at 0.01 level. It is to be noted that the estimated parameters would be different from zero within specified level of acceptable error (Hair et al, 2006)\textsuperscript{342}.

\textsuperscript{341} Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006
\textsuperscript{342} Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006
5.2.5.3 Identifying Influential Observations

There are generally sets of observations that influence the model by staying outside the data set. They have disproportionate effect on the model. Outliers are the observations that have large residual values and can be identified only with respect to a specific regression model.

Outliers were traditionally the only form of influential observation considered in regression models, and specialized regression methods (e.g., robust regression) were even developed to deal specifically with outlier’s impact on the regression results (Rousseeuw et al, 2003)\textsuperscript{343}. The key aberration in the observation is the presence of heteroscedasticity due to outliers. Leverage points are observations that are distinct from the remaining observations based on their independent variable values. Their impact is particularly noticeable in the estimated coefficients for one or more independent variables. Influential observations are the broadest category, including all observations that have a disproportionate effect on the regression results. Influential observations potentially include outliers and leverage points but may include other observations as well. Also, not all outliers and leverage points influence observations (Batnett et al, 1994)\textsuperscript{344}. Identifying Influential Observations are difficult many a time through traditional analysis of residuals for outliers. Their patterns of residuals go undetected because the residual for the influential points (the perpendicular distance from the line of regression) would not be as large as to be classified as an outlier. Thus, focusing only on large residuals would generally ignore these influential observations. Reinforcing, conflicting and shifting of the regression lines will occur due to influential observations. Table 5.5 shows the aberrations and the remedy (Hair et al, 2006)\textsuperscript{345}.

\textsuperscript{344} Barnett et al, Outliers in Statistical Data, 3\textsuperscript{rd} ed., New York: Wiley Pb; 1994
\textsuperscript{345} Hair et al, Multivariate Data Analysis, 6\textsuperscript{th} Ed, Printice Hall Pb; 2006
<table>
<thead>
<tr>
<th>Item No</th>
<th>Influential Observation</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>An error in the observations or in data entry</td>
<td>Correcting the data or deletion of the case.</td>
</tr>
<tr>
<td>2</td>
<td>A valid exceptional observation that is explained by an extraordinary situation</td>
<td>Remedy by deletion of the case unless variables reflecting the extraordinary situation are included in the regression equation.</td>
</tr>
<tr>
<td>3</td>
<td>An exceptional observation with no likely explanation</td>
<td>Presents a special problem as it doesn’t permit the deletion of the case. Inclusion of it cannot be justified either. Analyzing the entire data set with and without the inclusion of this observation for assessment is suggested.</td>
</tr>
<tr>
<td>4</td>
<td>An ordinary observation in its individual characteristics but exceptional in its combination of characteristics</td>
<td>Indicates modifications to the conceptual basis of the regression model and should be retained.</td>
</tr>
</tbody>
</table>

In all of the situations the observations are to be deleted. Each case should be individually studied by the researcher before the deletion as in some outliers cannot be deleted as well. The thumb rules of statistical significance and influential observations are; (i) Always ensure practical significance while using large sample sizes, because the model results and regression coefficients could be deemed irrelevant even when statistically significant due just to the statistical power arising from large sample sizes; (ii) Use the adjusted R-square as an overall measure of model’s predictive accuracy; (iii) Statistical significance is required for a relationship to have validity, but statistical significance without theoretical support does not support validity; (iv) Although outliers may be easily identifiable, the other forms of influential observations requiring more specialized diagnostic methods can be equal to or even more impacting on the results.
It is to be noted that in this research study, the presence of outliers and leverage points are eliminated by closed end questionnaire measured with Likert scales.

5.2.6 Interpreting the Regression Variate

Prediction and Explanation are the integral parts of interpreting regression variate and independent variables. While explaining a regression model, the regression coefficients become indicators of the impact of the independent variables on the dependent variable. Most of the time, the regression coefficients do not explain the relationship completely. To avoid this issue of regression coefficients pretending to explain the variate with higher accuracy, it is necessary to make the independent variables in comparable scales and variability. The coefficient thus obtained after this is called beta coefficient by research arena.

Standardizing Regression coefficients: the variation in the response scale and variability across variables makes direct interpretation problematic. Standardization converts variables to a common scale and variability – the most common being a mean of zero and standard deviation of one. Thus all variables become comparable. Multiple regression not only gives regression coefficients but also coefficients resulting from the analysis of standardized data termed beta (β) coefficients. The problems of dealing with different units are eliminated in these coefficients. The relative impact on the dependent variable by one standard deviation in either variable is reflected better. However beta coefficients are used with 2 cautions. They are; (i) beta coefficients are used as a guide to understand the relative importance of individual independent variable only when collinearity is minimal; (ii) beta values can be interpreted only in the context of other variables in the equation (Hair et al, 2006).346

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346 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
The key issue in interpreting regression variate is the correlation among the independent variables. This problem is due to data and not because of the model specification. The ideal situation for a best model interpretation would be high collinearity between independent and independent variables and less correlation among independent variables. Use of factor scores from factor analysis fixes the problem of multicollinearity among the independent variables. There are 3 key tasks to be done by the researchers to handle the issue of multicollinearity. They are; (i) Assess the degree of multicollinearity; (ii) Determine the impact of results; (iii) Apply the necessary remedies if needed.

**Identifying Multicollinearity:** The simplest and most obvious means of identifying collinearity is the examination of correlation matrix for the independent variables. The presence of high correlations (.90 and above) is the first indication of substantial collinearity. Lack of high correlation values, does not ensure lack of collinearity. Collinearity may be due to the combined effect of 2 or more other independent variables. To assess multicollinearity, we need a measure expressing the degree to which each independent variable is explained by the set of other independent variables. In simple terms, each independent variable becomes dependent variable and regressed against the remaining independent variables. The 2 most common measures of assessing both pair-wise and multiple variable collinearity are tolerance and its inverse, the variance inflation factor (Hair et al, 2006).

A direct measure of multicollinearity is ‘Tolerance’ – the amount of variability of the selected independent variable not explained by the other independent variables. For any regression model with 2 or more independent variables, the tolerance can be simply defined in 2 steps. Step1: take each independent variable, one at a time, and calculate R-square. This is the amount that the independent variable is explained by all of the other independent variables in the regression model. In this process, the selected independent variable is made a dependent

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347 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
variable predicted by all the other remaining independent variables. Step2: tolerance is then calculated as (1 - ‘R-square’). For example, if the other independent variables explain 25% of the independent variable X1, (R-square = 0.25), then the tolerance value of X1 is 0.75 (i.e., 1.0 - 0.25 = 0.75) (Hair et al, 2006).348

Another measure of Multicollinearity is ‘Variance Inflation Factor’ (VIF) which is calculated simply as the inverse of the tolerance value. In the preceding example with a tolerance of 0.75, the VIF would be 1.33 (1.0 / 0.75 = 1.33). Thus instances of higher degrees of multicollinearity are reflected in lower tolerance values and higher VIF values. The VIF gets its name from the fact that the square root of the VIF is the degree to which standard error has been increased due to multicollinearity. VIF translates the tolerance value which directly expresses the degree of multicollinearity, into an impact of estimation process. As the standard error is increased, it makes the confidence intervals around the estimated coefficients larger, thus making it harder to demonstrate that the coefficient is significantly different from zero (Hair et al, 2006).349

The Effects of Multicollinearity: The effects of multicollinearity can be categorized from the point of view of estimation or explanation. In either case the underlying reason is the same. Multicollinearity creates ‘shared’ variance between variables, thus decreasing the ability to predict the dependent measure. The ability to ascertain the relative roles to the independent variables for predicting dependent variable is also reduced.

Impacts of Estimation: Multicollinearity can have substantial effects not only on the predictive ability of the model but also on the estimation of the regression coefficients and their statistical significance tests. The extreme case multicollinearity is that, two or more variables are perfectly correlated, termed singularity, prevents the estimation of any coefficients. Although singularities may occur naturally among the independent variables, many times they are the

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348 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
349 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
results of an error of including all the dummy variables used to represent a non metric variable, rather than omitting one as the reference category. Also actions such as including a summated scale along with the individual variables that created it will result in singularities. These singularities must be removed earlier than the estimation proceedings. As multicollinearity increases, the ability to demonstrate that the estimated regression coefficients are significantly different from zero can become markedly impacted due to increase in the standard error. This is a serious issue with smaller sample sizes, where the standard errors are larger due to sampling error (Hair et al, 2006)\(^{350}\).

Apart from affecting statistical tests of the coefficients or the overall model, high degrees of multicollinearity can also result in regression coefficients being incorrectly estimated and even having the wrong signs. In some instances, the reversal of signs is expected and desirable. This is suppression effect. It denotes instances when the true relationship between the dependent and the independent variable has been hidden in the bivariate correlations (e.g., the expected relationships are non-significant or even reversed in sign). By adding more independent variables and including multicollinearity some unwanted shared variance is accounted for and remaining unique variance allows for the estimated coefficients to be in the expected direction (Cohen et al, 2002)\(^{351}\).

Theoretically supported relationships are reversed due to multicollinearity demanding explanations from the researcher on the findings. In these instances, the researcher needs to revert to bivariate correlations to describe the relationship rather than the estimated coefficients that are impacted by multicollinearity. The reversal of signs may be encountered in all of the estimation procedures, but is seen more often in confirmatory estimation processes where a set of variables is entered into the regression model and the likelihood of weaker variables being affected by multicollinearity increased.

\(^{350}\) Hair et al, Multivariate Data Analysis, 6\(^{th}\) Ed, Printice Hall Pb; 2006  
\(^{351}\) Cohen et al, Applied Multiple Regression / Correlation Analysis for the Behavioral Sciences, 3\(^{rd}\) ed, Hillsdale, NJ: Lawrence Erlbaum Associates; 2002
Impacts of Explanation: The effects of explanation are concerned primarily with the ability of regression procedure and the researcher to represent and understand the effects of each independent variable in the regression variate. As multicollinearity occurs (even at a relatively low levels of 0.30 or so), the process for identifying the unique effects of independent variables becomes increasingly difficult. Remember that the regression coefficients represent the amount of unique variance explained by each independent variable. As the multicollinearity results in larger portions of shared variance and lower levels of unique variance, the effects of the individual independent variables become less distinguishable. It is even possible to find those situations in which multicollinearity is so high that none of the independent regression coefficients are statistically significant, yet the overall regression model has a significant level of predictive accuracy (Hair et al, 2006).352

How much Collinearity is too much? – is a question addressed by all researchers who come across multicollinearity issue. Because the tolerance value is the amount of a variable unexplained by other independent variables, small tolerance values (high VIF values, VIF = 1 / Tolerance) denote high collinearity. A common cut off threshold is a tolerance value of 0.10 which corresponds to a VIF value of 10. Particularly when sample sizes are smaller, the researcher may wish to be more restrictive due to the increases in the standard errors from multicollinearity. With a VIF threshold of 10, this tolerance would correspond to standard errors being ‘inflated’ more than 3 times (square root of 10 = 3.16) what they would be without multicollinearity. Each researcher must determine the degree of collinearity that is acceptable, because most defaults or recommended thresholds still allow for substantial collinearity. For example, the suggested cut off for the tolerance value of 0.1 corresponds to a multiple correlation of 0.95. Moreover, a multiple correlation of 0.9 between one independent variable and all others will result in a tolerance value of 0.19. Thus any variable with tolerance value below 0.19 (or above a VIF of 5.3) would have a correlation of more than 0.9

352 Hair et al, Multivariate Data Analysis, 6th Ed, Printice Hall Pb; 2006
5.2.8 Managing Heteroscedasticity

In classical linear equations, there is an equal spread of the disturbance term throughout. This is *Homoscedasticity*. When the spread is unequal, it becomes *Heteroscedasticity*. A critical assumption of the classical linear regression model is that the disturbances ‘\(U_i\)’ have all the same variance ‘\(\sigma^2\)’. If this assumption is not satisfied, there is heteroscedasticity. Heteroscedasticity does not destroy the unbiasedness and consistency properties of OLS estimators. But these estimators are no longer minimum variance or efficient (i.e., they are not BLUE – best linear unbiased estimator). The BLUE estimators are provided by the method of weighted least squares, provided the heteroscedastic error variances (\(\sigma^2\)) are known. In the presence of heteroscedasticity, the variances of OLS estimators are not provided by the usual OLS – ordinary least squares formulae. But if we persist in using the usual OLS formulae, the t and the F tests based on them can be highly misleading, resulting in erroneous conclusions. Documenting the consequences of heteroscedasticity is easier than detecting it. There are several diagnostic tests available, but one cannot tell for sure which will work in a given situation. Even if heteroscedasticity is suspected and detected, it is not easy to correct the problem. If the sample is large, one can obtain white’s heteroscedasticity corrected standard errors of OLS estimators and conduct statistical inference based on the standard errors. Otherwise, on the basis of OLS residuals, one can make educated guesses of the likely pattern of heteroscedasticity and transform the original data in such a way that in the transformed data there is no heteroscedasticity (Hair et al, 2006)\(^{353}\).

5.2.9 Software for Multiple Regression Analysis

Technique

‘E-views’ is one of the most widely used statistical software package for Multiple Regression Analysis. Like every Multiple Regression Analysis Software, this also takes care of issues of data transformation and heteroscedasticity, we preferred

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\(^{353}\) Hair et al, Multivariate Data Analysis, 6\(^{th}\) Ed, Printice Hall Pb; 2006
E-views. Availability, usability and the familiarity with E-views are the reasons of choosing this software. Data analysis with ‘E-views’ software is discussed in chapter 6.

5.2.10 Hypotheses

Once the model is constructed, the hypotheses related to the factors that construct the model will be proposed. The null and the alternative hypotheses will be defined and validated from the model. This is discussed in chapter 6 in detail.

5.2.11 Validity of Multiple Regression Analysis

The Multiple Regression Models are usually validated with a new set of samples and the results are compared to establish the accuracy of the instrument. R-square value of the model will reveal predictive power of the model and hence the accuracy. The predictive power and the accuracy of the model are determined by the error term in the model equation. Error term or the Residual determines the model validity and the fit. Standard Error Estimate is also considered for determining the Accuracy of the Model.

5.3 Conclusion

In this chapter we discussed the selection of Factor Analysis and the dependence technique - Multiple Regression Analysis and the reason behind selecting them. We also discussed the thumb rules for decision making on factor selections, interpretations of results. Entire research design and execution plans of these analytical techniques are also conversed. In the next chapter we would discuss the Data Analysis and the Findings.
Chapter VI
Analysis & Findings

6.0 Introduction

In the earlier chapter, we discussed the Research Methodology and the research process in detail. We also discussed about the choice of research methods, the reasons behind choosing Factor Analysis and Multiple Regression Analysis for this research study. We also discussed the theory behind these techniques, the thumb rules for interpreting and taking important decisions for further research processes. With this backdrop of understanding of the research processes, we would look at the actual data analysis done, the results and the interpretations behind those findings at different stages of analysis in this chapter. This chapter is divided into five key sections; Exploratory Factor Analysis Findings, Multiple Regression Modeling, Analysis of non-metric variables, Summary of the Findings and Conclusion of the chapter.

Section 6.1 discusses exploratory factor analysis and findings. Factors are identified to have a hidden thread that underlies and connects all the variables, grouped and they accordingly are named suitably. Section 6.2 talks about the analysis of Multiple Regression with the factors obtained from Factor Analysis and the unique variables against each of the 4 metric dependent variables chosen. The regression outputs are discussed and the formulation and testing of the hypothesis are explained. Section 6.3 converses about the results of
Part I

6.1 Exploratory Factor Analysis

6.1.1 Objectives and Variable Selection for Factor Analysis

Here the purpose of the Factor Analysis technique is to condense the information contained in a number of original variables into a smaller set of new, composite dimensions, i.e., into variants with a minimum loss of information. Factor Analysis technique defines the original constructs that underlie the original variables. SPSS version 16.0 was used for Factor Analysis.

Factor Analysis identifies the structure of a set of variables as well as provides a process for data reduction. Obtaining a factor solution through Factor Analysis (principal components analysis) is an iterative process that usually requires repeating the SPSS Factor Analysis procedure a number of times to reach a satisfactory solution.

Out the objective in the Factor Analysis is to understand whether these variables can be grouped. The formation of factors will reduce the 26 variables to a limit for Multiple Regression Analysis further.

Initially we had 40 variables collected represented by the questions on business (Appendix 4). Out of the there are 26 metric variables and 12 dummy variables. These 40 variables got grouped into 8 different factors. Factor 1 consisted of 6 observations from the non-metric variables that explain organizational capabilities of the sample organizations chosen. Section 6.4 talks about other additional findings from the analyses. Section 6.5 discusses the development of the conceptual model of Organizational Intelligence Measurement Scale from 8 different factors and 2 unique variables derived from Exploratory Factor Analysis. Section 6.6 discusses the conceptual model of OI-OP Linkage obtained from Multiple Regression Analysis. Section 6.7 concludes the chapter.
variables. Factor 2 consisted of 2 variables. Factor 3 consisted of 2 variables. Factor 4 consisted of 3 variables. Factor 5 consisted of 3 variables. Factor 6 consisted of 2 variables. Factor 7 consisted of 3 variables. Factor 8 consisted of 3 variables. There were 2 unique variables and 14 nominal variables. ‘Age’ and ‘total experience’ are additional variables representing the maturity level of respondents, making the total number of variables 42. Perceptions of the respondents who were very young and less experienced in their family businesses will largely impact the data, as the questions were designed to target veteran business owners. Most of the respondents in this case were young and less experienced; however they had sufficient interaction with and were mentored by the business owners. These respondents were in the process of taking over their businesses. Keeping this fact in mind, we decided to include age and total work experience of the respondents as variables in the entire analysis, as these factors might affect the results somehow or the other. Table 6.1 lists the names of variables and their abbreviations used in factor analysis. Each set of variables are suitably named to represent a single aspect of the organization for making Multiple Regression Analysis meaningful. The names are listed below each group in 6.1.

### Table 6.1 - List of Factors representing OI

(Independent variables representing OI- Organizational Intelligence)

<table>
<thead>
<tr>
<th>Names of Variables and Factors</th>
<th>Abbreviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to have awareness on stakeholder needs</td>
<td>A_S_N</td>
</tr>
<tr>
<td>Ability to encourage innovation</td>
<td>E_Inn</td>
</tr>
<tr>
<td>Capacity to utilize performance management systems effectively</td>
<td>Pfr_M_S</td>
</tr>
<tr>
<td>Having improvement on cycle time of operating systems</td>
<td>ICTOS</td>
</tr>
<tr>
<td>Having high business process efficiency</td>
<td>Bus_P_Ef</td>
</tr>
<tr>
<td>Having highly efficient quality management systems</td>
<td>Eff_Q_M</td>
</tr>
<tr>
<td><strong>Organizational Value Orientation Index</strong></td>
<td><strong>Factor I</strong></td>
</tr>
<tr>
<td>Age</td>
<td>Age</td>
</tr>
<tr>
<td>Total experience</td>
<td>ttl_exp</td>
</tr>
<tr>
<td><strong>Maturity Index</strong></td>
<td><strong>Factor II</strong></td>
</tr>
<tr>
<td>Capacity to operate on customer-oriented competition analysis reports</td>
<td>CO_CA</td>
</tr>
<tr>
<td>Capacity to utilize customer and market valuation analysis</td>
<td>C_M_Val</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Organizational Competitiveness Index</strong></td>
<td>Factor III</td>
</tr>
<tr>
<td>Ability to encourage organizational learning</td>
<td>E_O_L</td>
</tr>
<tr>
<td>Ability to Apply the learning</td>
<td>A_L</td>
</tr>
<tr>
<td>Capacity to share profit among all employees</td>
<td>Pft_Sh</td>
</tr>
<tr>
<td><strong>Organizational Wisdom Index</strong></td>
<td>Factor IV</td>
</tr>
<tr>
<td>Business continuity capacity</td>
<td>Bus_Cnt</td>
</tr>
<tr>
<td>Ability to know the trade-off between organizational goal and stakeholder Benefits</td>
<td>t_og_s_b</td>
</tr>
<tr>
<td>Having a stable information technology network</td>
<td>S_I_T_N</td>
</tr>
<tr>
<td><strong>Information And Knowledge Deployment Index</strong></td>
<td>Factor V</td>
</tr>
<tr>
<td>Ability to provide schemes on employee welfare</td>
<td>Wlf_Emp</td>
</tr>
<tr>
<td>Capacity to use information effectively</td>
<td>Ef_U_Inf</td>
</tr>
<tr>
<td><strong>Infrastructural Standards Index</strong></td>
<td>Factor VI</td>
</tr>
<tr>
<td>Ability to incorporate societal sensitiveness in the system</td>
<td>Em_Intel</td>
</tr>
<tr>
<td>Ability to focus on high level of stakeholder satisfaction</td>
<td>Stk_Stis</td>
</tr>
<tr>
<td>Capacity to have effective workflow systems</td>
<td>W_F_Sys</td>
</tr>
<tr>
<td><strong>Systems Effectiveness Index</strong></td>
<td>Factor VII</td>
</tr>
<tr>
<td>Ability to incorporate technology and innovation in planning</td>
<td>T_I_Plg</td>
</tr>
<tr>
<td>Ability to deploy new technology for business process planning</td>
<td>N_T_B_P</td>
</tr>
<tr>
<td>Ability to have periodic up-gradation of quality management processes</td>
<td>PU_QPMS</td>
</tr>
<tr>
<td><strong>Process Efficiency Index</strong></td>
<td>Factor VIII</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Table 6.2 - List of Unique Variables</strong></th>
<th><strong>(Representing OI - Organizational Intelligence)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unique Variables (not included as a part of any of the Factors)</strong></td>
<td><strong>Abbreviations</strong></td>
</tr>
<tr>
<td>Ability of incorporating information in strategic planning</td>
<td>Inf_S_Pg</td>
</tr>
<tr>
<td><strong>Proficiency of Planning Index</strong></td>
<td><strong>Unique Var 1</strong></td>
</tr>
<tr>
<td>Ability of tracking the progress of action plans</td>
<td>AT_Prg</td>
</tr>
<tr>
<td><strong>Proficiency of Execution Index</strong></td>
<td><strong>Unique Var 2</strong></td>
</tr>
</tbody>
</table>
There are 5 dependent variables totally, and out of them 4 are metric and 1 is non-metric. The non-metric variables are denoted with a prefix of ‘Dm_’. Other variables are metric, mostly derived from the ordinal scale. This table also indicates the grouping along with the names of the groups. Table 6.2 represents unique variables that are not part of any of these factors from table 6.1. Table 6.3 represents the list of dependent variables. Table 6.4 represents list of independent variables.

**Table 6.3 - List of Dependent Variables**
(Representing Financial Performance)

<table>
<thead>
<tr>
<th>Potential Dependent Variables (4 metric and 1 non-metric)</th>
<th>Abbreviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial returns</td>
<td>Fin_Rts</td>
</tr>
<tr>
<td>Market share growth</td>
<td>Mkt_Sh_g</td>
</tr>
<tr>
<td>Business valuation</td>
<td>Dm_Bus_Val</td>
</tr>
<tr>
<td>Profit growth</td>
<td>Pft_Grw</td>
</tr>
<tr>
<td>Business expansion</td>
<td>Bus_Exp</td>
</tr>
</tbody>
</table>

**Table 6.4 - List of Dummy Variables**
(Independent Variables analyzed in Groups)

<table>
<thead>
<tr>
<th>Dummy Variables Removed from Factor Analysis</th>
<th>Abbreviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic planning efficiency</td>
<td>Dm_D_S_P_F</td>
</tr>
<tr>
<td>Ability to build and manage knowledge assets</td>
<td>Dm_B&amp;M_K_A</td>
</tr>
<tr>
<td>Capacity to manage customer expectations</td>
<td>Dm_C_E_Mgt</td>
</tr>
<tr>
<td>Ability to have decentralized decision making systems</td>
<td>Dm_DC_MK</td>
</tr>
<tr>
<td>Having effective career planning systems</td>
<td>Dm_C_P_Sys</td>
</tr>
<tr>
<td>Having strategic cost management in business processes</td>
<td>Dm_S_C_M_BP</td>
</tr>
<tr>
<td>Having variability reduction in business processes</td>
<td>Dm_VR_BP</td>
</tr>
<tr>
<td>Having high process performance</td>
<td>Dm_Pr_Pfr</td>
</tr>
<tr>
<td>Having standardized quality metrics for production / delivery processes</td>
<td>Dm_S_Q_M_PP</td>
</tr>
<tr>
<td>Presence of quality metrics along the value chain</td>
<td>Dm_QM_VC</td>
</tr>
<tr>
<td>Continuous monitoring of quality</td>
<td>Dm_C_M_Q</td>
</tr>
</tbody>
</table>
The variables listed in Tables 6.1, 6.2 and 6.4 represent OI (Organizational Intelligence). The variables represented by table 6.3 represent Financial Performance. We have chosen consciously the Financial Performance Terms to represent OP (Organizational Performance) for variable measurement conveniences. However, this choice is from the literature.

6.1.2 Factor Analysis Design

Understanding the structure and perceptions of the variables requires R-type factor analysis and a correlation matrix between variables. These variables that are getting grouped in the factor analysis are metric and constitute a homogeneous set of perceptions appropriate for factor analysis.

The number of valid cases for this set of variables is 115. The preferred minimum sample size requirement of 100 valid cases, which in our case, is satisfied. While principal component analysis can be conducted on a sample that has fewer than 100 cases, but more than 50 cases, we should be vigilant about its interpretation.

The ratio of cases to variables in a principal component analysis should be at 5 to 1. With 115 observations and 26 variables, the ratio of cases to variables is 4.12 to 1, which just falls short of the requirement for the ratio of cases to variables. So, it is important to be cautious while interpreting the results of the factor analysis.

6.1.3 Assuming the Appropriateness of Factor Analysis

The underlying statistical assumptions influence factor analysis to the extent that they affect the derived correlations. Departure from normality, homoscedasticity, and linearity can diminish correlations between variables.

A visual examination of the correlations is the first step to ensure that the assumptions are met. Because factor analysis will always derive factors, the
objective is to ensure a base level of statistical correlation within the set of variables, such that the resulting factor structure has some objective basis.

To assess the overall significance of the correlation matrix we take the help of the Bartlett’s test and to assess the factorability of the overall set of variables we use the measures of sampling adequacy. In our case, both of the values are sufficiently high, ensuring the adherence to the assumptions required to be fulfilled. Table 6.5 represents the sampling adequacy and sphericity of this case.

### Table 6.5 - Results of the Test for Sampling Adequacy

<table>
<thead>
<tr>
<th>KMO and Bartlett's Test</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</td>
<td>.732</td>
</tr>
<tr>
<td><strong>Bartlett's Test</strong></td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>856.306</td>
</tr>
<tr>
<td>Df (degrees of freedom)</td>
<td>325</td>
</tr>
<tr>
<td>Sig. (significance)</td>
<td>.000</td>
</tr>
</tbody>
</table>

The set of variables included in the analysis satisfied the suitable criterion for principal component analysis, after removing two variables from the analysis, because of a low MSA Principal Component analysis requires that there be some correlations greater than 0.30 between the variables included in the analysis.

For the set of variables under our consideration, there are several correlations in the matrix greater than 0.30, satisfying this requirement. The MSA Principal Component Analysis (Table 6.6 given in the next page) reveals the correlations above 0.5 and those variables with correlations below 0.5 are removed.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.000</td>
<td>.857</td>
</tr>
<tr>
<td>Total experience</td>
<td>1.000</td>
<td>.864</td>
</tr>
<tr>
<td>E_O_L</td>
<td>1.000</td>
<td>.554</td>
</tr>
<tr>
<td>A_S_N</td>
<td>1.000</td>
<td>.596</td>
</tr>
<tr>
<td>A_L</td>
<td>1.000</td>
<td>.608</td>
</tr>
<tr>
<td>E_Inn</td>
<td>1.000</td>
<td>.556</td>
</tr>
<tr>
<td>Em_Intel</td>
<td>1.000</td>
<td>.647</td>
</tr>
<tr>
<td>Stk_Stis</td>
<td>1.000</td>
<td>.714</td>
</tr>
<tr>
<td>Wlf_Emp</td>
<td>1.000</td>
<td>.688</td>
</tr>
<tr>
<td>Bus_Cnt</td>
<td>1.000</td>
<td>.604</td>
</tr>
<tr>
<td>Pft_Sh</td>
<td>1.000</td>
<td>.577</td>
</tr>
<tr>
<td>CO_CA</td>
<td>1.000</td>
<td>.682</td>
</tr>
<tr>
<td>C_M_Val</td>
<td>1.000</td>
<td>.775</td>
</tr>
<tr>
<td>T_I_Plg</td>
<td>1.000</td>
<td>.534</td>
</tr>
<tr>
<td>t_og_s_b</td>
<td>1.000</td>
<td>.648</td>
</tr>
<tr>
<td>Ef_U_Inf</td>
<td>1.000</td>
<td>.612</td>
</tr>
<tr>
<td>S_I_T_N</td>
<td>1.000</td>
<td>.678</td>
</tr>
<tr>
<td>W_F.Sys</td>
<td>1.000</td>
<td>.600</td>
</tr>
<tr>
<td>Pfr_M_S</td>
<td>1.000</td>
<td>.548</td>
</tr>
<tr>
<td>ICTOS</td>
<td>1.000</td>
<td>.617</td>
</tr>
<tr>
<td>Bus_P_Ef</td>
<td>1.000</td>
<td>.673</td>
</tr>
<tr>
<td>N_T_B_P</td>
<td>1.000</td>
<td>.670</td>
</tr>
<tr>
<td>Eff_Q_M</td>
<td>1.000</td>
<td>.560</td>
</tr>
<tr>
<td>PU_QPMS</td>
<td>1.000</td>
<td>.638</td>
</tr>
</tbody>
</table>
As mentioned earlier, factor analysis procedures are based on the initial computation of a complete table of intercorrelations among the variables. The matrix is then transformed through estimation of a factor model to obtain a factor matrix containing factor loadings for each variable, as given in Table - 6.9. These factor loadings of each variable are then interpreted to identify the underlying structure of the variables, in this case perceptions of organizational intelligence.

After removing Inf_S_Pg and AT_Prg, which had Extraction Values of 0.450 and 0.474, the Communalities of the rest of the variables are given below. It is to be noted that there is no variable with an Extraction Value less than 0.50, as per the required conditions. Even the Measures of Sampling Adequacy (MSA) generates values greater than 0.50 for all the variables considered for the study.

In addition, the overall MSA (Table – 6.5) for the set of variables included in the analysis was 0.732, which exceeds the minimum requirement of 0.50 for overall MSA. The eleven variables in the analysis satisfy this criterion for appropriateness of factor analysis.

Principal component analysis requires that the probability associated with Bartlett's Test of Sphericity be less than the level of significance. The Bartlett's Test of Sphericity is a statistical test for overall significance of all correlations within a correlation matrix. The probability associated with the Bartlett test is p<0.001, which satisfies this requirement.

The variables now included in the analysis satisfy the screening criteria for the appropriateness of factor analysis. The next step is to determine the number of factors that should be included in the factor solution.

Once we remove the variables, which have a low individual MSA, the next adjustment that we make to the factor solution is to examine the communalities (Table – 6.6). The communalities represent the proportion of the variance for each
of the variables included in the analysis that is explained or accounted for by the components in the factor solution. The derived components should explain at least half of each original variable's variance, so the communality value for each variable should be 0.50 or higher.

If one or more variables have a value for communality that is less than 0.50, the variable with the lowest communality should be excluded and the principal component analysis should be computed again.

While other variables in the analysis also had communalities lower than 0.50, Inf_S_Pg and AT_Prg were selected for removal because it had the lowest communality. In this case we followed the sequence of removal of the lowest followed by the next lowest.

Once we get all variables which have an Extraction Value greater than 0.50, we look at Total Variance Explained (Table – 6. 7). Latent root criterion (same as eigenvalues – represents the amount of variance accounted for by a factor) helps us understand the number of factors generated in the factor analysis.

Though eigenvalues of all possible factors are provided, we should consider only those factors where eigenvalues (as given in Table – 6. 7) are greater than 1.0. Thus only 8 factors got generated.

If the percentage of variance explained is less than 60%, we should attach a note of caution to our solution, since using the components as substitutes for the variables may not be all that useful. If the first component contains ordinal variables, or if the proportion of total variance explained is less than 60%, a caution is added to the true answer.

The cumulative proportion of variance criteria would require 8 components to satisfy the criterion of explaining 60% or more of the total variance in the original set of variables. In our case, we have 8-component solution, which explains 64.58% of the total variance.
Table 6.7 - Total Variance Explained

<table>
<thead>
<tr>
<th>Component</th>
<th>Initial Eigen values</th>
<th>Extraction Sums of Squared Loadings</th>
<th>Rotation Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
<td>Cumulative %</td>
</tr>
<tr>
<td>3</td>
<td>2.071</td>
<td>8.629</td>
<td>38.342</td>
</tr>
<tr>
<td>4</td>
<td>1.574</td>
<td>6.560</td>
<td>44.902</td>
</tr>
<tr>
<td>5</td>
<td>1.324</td>
<td>5.517</td>
<td>50.418</td>
</tr>
<tr>
<td>6</td>
<td>1.286</td>
<td>5.360</td>
<td>55.778</td>
</tr>
<tr>
<td>7</td>
<td>1.109</td>
<td>4.620</td>
<td>60.398</td>
</tr>
<tr>
<td>8</td>
<td>1.004</td>
<td>4.183</td>
<td>64.581</td>
</tr>
<tr>
<td>9</td>
<td>.883</td>
<td>3.679</td>
<td>68.260</td>
</tr>
<tr>
<td>10</td>
<td>.816</td>
<td>3.398</td>
<td>71.658</td>
</tr>
</tbody>
</table>

The Figure 6.1 represents the Scree Plot. We know that only those factors are considered which have an eigenvalue greater than 1. Hence, in the Scree Plot we draw a line parallel to the horizontal axis through eigenvalue = 1. This intersects at 8, which gives us the number of factors generated. This is in accordance of the previous analysis as generated in Table – 6.7.
Lastly, we have the Rotated Factor Loadings, based on VARIMAX method. The rotated factor loadings involving the variables are converted to relative loadings by dividing the factor loading of the variable (within a factor) with the sum of the factor loadings of all the variables within the factor considered. As a result, the factor loadings of all the variables considered in Factor 1, for example, will sum up to 1, and so on. This is given in Table – 6.8. These relative factor loadings are used to represent the factors, which in turn represent the variables they represent.
Table 6.8 - Rotated Component Matrix
(Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.)

<table>
<thead>
<tr>
<th>Rotated Component Matrix</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>A_S_N</td>
<td>0.528</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E_Inn</td>
<td>0.597</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pfr_M_S</td>
<td>0.582</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICTOS</td>
<td>0.653</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus_P_Ef</td>
<td>0.649</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eff_Q_M</td>
<td>0.672</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.920</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total experience</td>
<td>0.913</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO_CA</td>
<td>0.763</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C_M_Val</td>
<td>0.856</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E_O_L</td>
<td>0.614</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_L</td>
<td>0.718</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pf_Sh</td>
<td>0.533</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus_Cnt</td>
<td>0.544</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t_g_s_b</td>
<td>0.771</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S_I_T_N</td>
<td>-0.463</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wlf_Emp</td>
<td>0.792</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ef_U_Inf</td>
<td>0.617</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Em_Intel</td>
<td>0.768</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stk_Stis</td>
<td>0.415</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W_F_Sys</td>
<td>0.547</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T_I_Plg</td>
<td>0.383</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N_T_B_P</td>
<td>0.768</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU_QPMS</td>
<td>0.505</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This leaves us with 8 factors and 2 independent variables, which were initially removed as they had MSA and Extraction values less than 0.50. The next part of the analysis is the Regression results.

With 8 factors to be analyzed, we now turn to the interpretation of the factors. In our case, as the unrotated factor matrix did not have a completely clean set of factor loadings (i.e., had substantial cross-loadings of each variable on one factor), a rotational technique is applied to hopefully improve the interpretation.
In our case, we used the VARIMAX rotation and its impact on the overall factor solution and the factor loading are described in Table – 6.9.

Table 6.9 - Rotated Factor Loadings

<table>
<thead>
<tr>
<th>Variables</th>
<th>Rotated Factor Loading</th>
<th>Relative Rotated Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>A_S_N</td>
<td>0.528483</td>
<td>0.143498</td>
</tr>
<tr>
<td>E_Inn</td>
<td>0.597143</td>
<td>0.162141</td>
</tr>
<tr>
<td>Pfr_M_S</td>
<td>0.582499</td>
<td>0.158165</td>
</tr>
<tr>
<td>ICTOS</td>
<td>0.652821</td>
<td>0.177259</td>
</tr>
<tr>
<td>Bus_P_Ef</td>
<td>0.649491</td>
<td>0.176355</td>
</tr>
<tr>
<td>Eff_Q_M</td>
<td>0.672426</td>
<td>0.182582</td>
</tr>
<tr>
<td><strong>FACTOR 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.919506</td>
<td>0.501795</td>
</tr>
<tr>
<td>Total_exp</td>
<td>0.912929</td>
<td>0.498205</td>
</tr>
<tr>
<td><strong>FACTOR 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO_CA</td>
<td>0.763328</td>
<td>0.471381</td>
</tr>
<tr>
<td>C_M_Val</td>
<td>0.856015</td>
<td>0.528619</td>
</tr>
<tr>
<td><strong>FACTOR 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E_O_L</td>
<td>0.613556</td>
<td>0.329021</td>
</tr>
<tr>
<td>A_L</td>
<td>0.718339</td>
<td>0.385211</td>
</tr>
<tr>
<td>Pft_Sh</td>
<td>0.532898</td>
<td>0.285768</td>
</tr>
<tr>
<td><strong>FACTOR 4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus_Cnt</td>
<td>0.544414</td>
<td>0.638528</td>
</tr>
<tr>
<td>t_og_s_b</td>
<td>0.77096</td>
<td>0.904237</td>
</tr>
<tr>
<td>S_I_T_N</td>
<td>-0.462766</td>
<td>-0.54276</td>
</tr>
<tr>
<td><strong>FACTOR 5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wlf_Emp</td>
<td>0.791611</td>
<td>0.561938</td>
</tr>
<tr>
<td>Ef_U_Inf</td>
<td>0.617105</td>
<td>0.438062</td>
</tr>
<tr>
<td><strong>FACTOR 6</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Em_Intel</td>
<td>0.76836</td>
<td>0.444049</td>
</tr>
</tbody>
</table>
We find that the first factor accounts for 21% of the variance, as given in Table - 6.7. All the other factors account within the range of 4 and 9 percent totaling to 64.58%.

These 8 factors along with the 2 unique variables represent OI. OI can be considered to have 10 different components as a whole. Thus,

Factor I = A_S_N x 0.143498 + E_Inn x 0.162141 + Pfr_M_S x 0.158165 + ICTOS x 0.177259 + Bus_P_Ef x 0.176355 + Eff_Q_M x 0.182582
Factor II = Age x 0.501795 + Total_exp x 0.498205
Factor III = CO_CA x 0.471381 + C_M_Val x 0.528619
Factor IV = E_O_L x 0.329021 + A_L x 0.385211 + Pft_Sh x 0.285768
Factor V = Bus_Cnt x 0.638528 + t_og_s_b x 0.904237 + S_I_T_N x x0.54276
Factor VI = Wlf_Emp x 0.561938 + Ef_U_Inf x 0.438062
Factor VII = Em_Intel x 0.444049 + Stk_Stis x 0.239985 + W_F_Sys x 0.315966
Factor VIII = T_I_Plg x 0.231245 + N_T_B_P x 0.463595 + PU_QPMS x 0.305161

All these components contribute to OI along with the 2 unique variables.

6.1.4 Naming the Factors

Factor - I includes variables Ability to have awareness on stakeholder needs, Ability to encourage innovation, Capacity to utilize performance management systems effectively, Having improvement on cycle time of operating systems, Having high business process efficiency, and Having highly efficient quality management system. These parameters drive awareness on stakeholder needs, leadership efficiency, and encouragement towards innovation, performance creating systems, and improvement in the
efficiency of operating systems, business process and quality efficiency. All these variables essentially capture the basic interest of the organization, which is oriented towards creating and delivering value in all its intensely thought and planned activities. Hence, this factor is named *Organizational Value Orientation Index*.

**Factor – II** includes variables namely *Age and Work Experience*. The variables together indicate the level of maturity of respondents representing their organizations and their knowledge in their business to respond to intriguing questions. Hence, this factor is named *Maturity Index*.

**Factor – III** comprises of variables *Capacity to operate on customer-oriented competition analysis reports and Capacity to utilize customer and market valuation analysis that* collectively denote the capacity of the organization to collect data on competitors, customers, markets and best practices and formulate and deploy competitive strategies accordingly. Competitiveness of the organization gets visible from these variables. This factor can be termed as *Organizational Competitiveness Index*.

**Factor – IV** includes issues related to *capability and interest of organization to support and share profits with employees via services, benefits and policies*. It also discusses interest of leaders in *encouraging and being accountable and responsible for organizational learning and incorporates values in business processes*. It includes interest of leaders to incorporate the findings of the employee performance into practice. The three aspects of this factor indicate interest of *leaders in being accountable for putting employee performance results in learning and sharing profits with employees*, implying the three dimensions of leadership – employee benefits. It indicates the wisdom and spiritual responsiveness of the leaders towards employees. This factor can be termed as *Organizational Wisdom Index*.

**Factor – V** includes variables, *Ability to provide schemes on employee welfare, and Capacity to use information effectively*; these variables measure capacity of organization to ensure business continuity for the benefit of employees and
customers, ability of organization to strike a balance between the goals of organization and stakeholder benefits and competency of organization to ensure the knowledge and information infrastructure secured is stable and user friendly. The basic thread between these varied interests of the organization is to use information infrastructure effectively to benefit stakeholders and maintain business continuity, implying the criticality of information and knowledge infrastructure stability. These parameters indicate the interest of the organization to Deploy Knowledge and Information Resources for the benefit of stakeholders and manage crisis for business continuity at difficult and uncertain situations. This factor may be termed as Information and Knowledge Deployment Index.

**Factor – VI** includes variables that measure interest of organization to protect health, safety and security of its employees (such as, health schemes, checkups, safety measure trainings and good ergonomic arrangements) for productivity and competency of organization to ensure the quality, availability and accessibility of information for stakeholders. There is an underlying thread between the two implications of these questions; they are, employee care, and availability of precise information to employees to increase productivity. As a whole, these variables indicate the interest of an organization to have stable and standardized internal and information infrastructural standards for increasing productivity of employees. This factor can be termed around the motivation of the organization to establish high standards for ergonomic & safe Infrastructure along with stable information infrastructure – i.e., Infrastructural Standards Index.

**Factor – VII** consists of variables such as, Ability to incorporate societal sensitiveness in the system, Ability to focus on high level of stakeholder satisfaction, and Capacity to have effective workflow systems. These variables reveal the hidden thread behind the interest of the leaders to stay proactive in sensing the opinions and concerns of employees and society about its products and services and dynamic in understanding the presence of processes and scales to measure and determine the satisfaction and dissatisfaction of customers and employees and the cordial relationship between them. It indicates the ability of the organization to realize and insist on sustainable and effective work flow systems. Thus, these three
variables together imply the presence of efficient work-flow systems to measure apprehensions and satisfaction of employees and stakeholders and optimal maintenance of those systems. This factor can be termed as **Systems Effectiveness Index**.

**Factor – VIII** includes variables *Ability to incorporate technology and innovation in planning, Ability to deploy new technology for business process planning, and Ability to have periodic up-gradation of quality management processes* - that measure capability of organization to incorporate new technology and innovations and periodic up-gradation of quality management programs. Incorporation of innovations, new technology and periodic up-gradation would tend to alter the efficiency of the business processes being followed in an organization largely. Organizations that have these three abilities have innate strength to correct their processes quickly and adapt the changes and innovations to maintain and to improvise the efficiency in spite of the changes faced. Thus this factor can be termed as **Process Efficiency Index**.

The answers to why organizations would want to have the abilities (variables) that got churned out by factor analysis would give us insights to locate the hidden threads that connect the grouped variables. These hidden values behind these eight groups are now indicated by the names of these factors.

It is important now to build a model to measure OI with the above mentioned 8 factors and the 2 unique variables. We would leave those variables that got removed from the factor analysis as they had low Communality and MSA Values for the design of OI Instrument. Hence, our complete list of independent variables for Multiple Regression Analysis is as follows:

*(i) Factor – I:* Organizational Value Orientation Index

*(ii) Factor – II:* Maturity Index

*(iii) Factor – III:* Organizational Competitiveness Index

*(iv) Factor – IV:* Organizational Wisdom Index

*(v) Factor – V:* Information and Knowledge Deployment Index

*(vi) Factor – VI:* Infrastructural Standards Index
(vii) Factor – VII: Systems Effectiveness Index

(viii) Factor – VIII: Process Efficiency Index

(ix) Unique Variable1: Inf_S_Pg - Ability of incorporating information in strategic planning - the hidden value in this variable is proficiency in planning and it can be denoted now on as Proficiency in Planning Index

(x) Unique Variable2: AT_Prg - Ability of tracking the progress - this represents proficiency in execution of the plans and it can be denoted as Proficiency in execution Index

Each of the above discussed factors can be measured with 8 factors constructed with the variables as listed below with the coefficients represented by the rotated factor loadings (Table 6.9). These 8 factors along with the 2 unique variables represent OI. Hence, OI can be considered to be constructed by 10 different components as a whole. The Equations of those 10 components are:

i) Organizational Value Orientation Index = A_S_N x 0.143498 + E_Inn x 0.162141 + Pfr_M_S x 0.158165 + ICTOS x 0.177259 + Bus_P_Ef x 0.176355 + Eff_Q_M x 0.182582

ii) Maturity Index = Age x 0.501795 + Total_exp x 0.498205

iii) Organizational competitiveness Index = CO_CA x 0.471381 + C_M_Val x 0.528619

iv) Organizational Wisdom Index = E_O_L x 0.329021 + A_L x 0.385211 + Pft_Sh x 0.285768

v) Information and Knowledge Deployment Index = Bus_Cnt x 0.638528 + t_og_s_b x 0.904237 + S_I_T_N x (-0.54276)

vi) Infrastructural Standards Index = Wlf_Emp x 0.561938 + Ef_U_Inf x 0.438062

vii) Systems Effectiveness Index = Em_Intel x 0.444049 + Stk_Stis x 0.239985 + W_F_Sys x 0.315966

viii) Process Efficiency Index = T_I_Plg x 0.231245 + N_T_B_P x 0.463595 + PU_QPMS x 0.305161

ix) Proficiency in Planning Index = Inf_S_Pg x 1.0

x) Proficiency in Execution Index = AT_Prg x 1.0
OI can be measured by measuring these 10 independent variables and substituting the variables in a Multiple Regression Model that determines the Relationship between all or some of these 10 components with the 5 dependent variables that represent OP.

Part II

6.2 Multiple Regression Analysis

As given in Table - 6.3, we have 5 variables to measure organizational performance. Exploratory Factor Analysis created 8 factors and 2 unique independent variables, which implies 10 independent variables (Table 6.1 and Table 6.2). There are two ways to analyze further the relationship between these 10 variables with the dependent ones; they are, Multivariate Analysis of Variance (MANOVA) or Multiple Regression taking one dependent variable at a time. Multiple Regressions are run with the software for all the 4 dependent variables except Business valuation as it is a non metric variable. We choose Multiple Regression over MANOVA or Multiple Discriminant Analysis as we have 4 metric dependent variables and the linear equations are compared for best predictability. Discriminant analysis is appropriate for research problems that have categorical non metric dependent variables for study. MANOVA uses single dependent metric variables and non metric independent variables for analysis. From Exploratory Factor Analysis we collected 10 independent variables grouped from metric independent variables. Therefore we choose Multiple Regression Analysis as the suitable analytical technique for this research problem.

6.2.1 Regression Analysis of Dependent Variables

Before we come to the interpretation of the regression results, it is important to explain the terms given in the regression outputs. We have used E-Views 5 for generating regression output. Using matrix notation, the standard regression may be written as: \[ Y = X\beta + \xi \]; where \( Y \) is a \( T \)-dimensional vector containing
observations on the dependent variable, $X$ is a $T \times k$ matrix of independent variables, $\beta$ is a $k$-vector of coefficients, and $\xi$ is a $T$-vector of disturbances. $T$ is the number of observations and $k$ is the number of right-hand side regressors.

A typical regression output in E-Views looks as given below; Table 6.10 lists the date and time at which the regression is done; number of samples; assumptions such as White heteroscedasticity and consistent standard errors and covariance.

**Table 6.10 - Regression Output** – (sample to explain the terms in the table)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_1$</td>
<td>0.431833</td>
<td>0.106640</td>
<td>4.049451</td>
<td>0.0001</td>
</tr>
<tr>
<td>$X_2$</td>
<td>0.000765</td>
<td>0.001086</td>
<td>0.704572</td>
<td>0.4827</td>
</tr>
<tr>
<td>$X_3$</td>
<td>-0.077211</td>
<td>0.069013</td>
<td>-1.118783</td>
<td>0.2658</td>
</tr>
<tr>
<td>$X_4$</td>
<td>0.048216</td>
<td>0.087716</td>
<td>0.549686</td>
<td>0.5837</td>
</tr>
<tr>
<td>$X_5$</td>
<td>-0.188878</td>
<td>0.044135</td>
<td>-4.279575</td>
<td>0.0000</td>
</tr>
<tr>
<td>$X_6$</td>
<td>0.270535</td>
<td>0.081410</td>
<td>3.323119</td>
<td>0.0012</td>
</tr>
<tr>
<td>$X_7$</td>
<td>0.180137</td>
<td>0.070412</td>
<td>2.558313</td>
<td>0.0120</td>
</tr>
<tr>
<td>$X_8$</td>
<td>0.180137</td>
<td>0.070412</td>
<td>2.558313</td>
<td>0.0120</td>
</tr>
<tr>
<td>$X_9$</td>
<td>-0.014688</td>
<td>0.068594</td>
<td>-0.214128</td>
<td>0.8309</td>
</tr>
<tr>
<td>$X_{10}$</td>
<td>0.007582</td>
<td>0.072472</td>
<td>0.104614</td>
<td>0.9169</td>
</tr>
<tr>
<td>C</td>
<td>0.563344</td>
<td>0.435046</td>
<td>1.294907</td>
<td>0.1982</td>
</tr>
</tbody>
</table>

**R-squared** 0.488204  Mean dependent var 2.643478
**Adjusted R-squared** 0.438993  S.D. dependent var 0.938376
**S.E. of regression** 0.702848  Akaike info criterion 2.223410
**Sum squared resid** 51.37544  Schwarz criterion 2.485968
**Log likelihood** -116.8461  F-statistic 9.920586
**Durbin-Watson stat** 2.006621  Prob(F-statistic) 0.000000

The Model Equation is, $Y = \alpha + \beta_1 \times X_1 + \beta_2 \times X_2 + \beta_3 \times X_3 + \beta_4 \times X_4 + \beta_5 \times X_5 + \beta_6 \times X_6 + \beta_7 \times X_7 + \beta_8 \times X_8 + \beta_9 \times X_9 + \beta_{10} \times X_{10} + \xi$.  

This Model is depicted by the Regression Output as shown in the Table 6.10. The terms in this table are explained below. However for our case, the overall Model fit is measured with ‘The R-squared ($R^2$)’. The accuracy of the Model is
determined by Standard error of the estimate. The resulted values of the Coefficients are explained by *regression coefficients*.

**Regression Coefficients**: The column labeled "Coefficient" depicts the estimated coefficients. The least squares regression coefficients $b$ are computed by the standard OLS (Ordinary Least Square) formula:

$$ b = (XX)^{-1} XY $$

If the equation is specified by list, the coefficients will be labeled in the "Variable" column with the name of the corresponding regressor. If the equation is specified by formula, EViews lists the actual coefficients, C(1), C(2), etc.

For the simple linear models considered here, the coefficient measures the marginal contribution of the independent variable to the dependent variable, holding all other variables fixed. If present, the coefficient of the C is the constant or intercept in the regression. It is the base level of the prediction when all of the other independent variables are zero. The other coefficients are interpreted as the slope of the relation between the corresponding independent variable and the dependent variable, assuming all other variables do not change.

**Standard Errors**: The "Std. Error" column reports the estimated standard errors of the coefficient estimates. The standard errors measure the statistical reliability of the coefficient estimates – the larger the standard errors, the more statistical noise in the estimates. If the errors are normally distributed, there are about 2 chances in 3 that the true regression coefficient lies within one standard error of the reported coefficient, and 95 chances out of 100 that it lies within two standard errors.

The covariance matrix of the estimated coefficients is computed as:

$$ \text{var}(b) = s^2 (XX)^{-1}; \quad s^2 = \hat{\xi}'\hat{\xi}/(T-k) \quad \hat{\xi} = Y - Xb $$

Where $\hat{\xi}$ is the residual. The standard errors of the estimated coefficients are the square roots of the diagonal elements of the coefficient covariance matrix.
**t-Statistics:** The t-statistic, which is computed as the ratio of an estimated coefficient to its standard error, is used to test the hypothesis that a coefficient is equal to zero. To interpret the t-statistic, you should examine the probability of observing the t-statistic given that the coefficient is equal to zero. This probability computation is described below. In cases where normality can only hold asymptotically, EViews will report a z-statistic instead of a t-statistic.

**Probability:** The last column of the output shows the probability of drawing a t-statistic (or a z-statistic) as extreme as the one actually observed, under the assumption that the errors are normally distributed, or that the estimated coefficients are asymptotically normally distributed.

This probability is also known as the *p*-value or the *marginal significance level*. Given a *p*-value, one can tell at a glance whether to reject or accept the hypothesis that the true coefficient is zero against a two-sided alternative that it differs from zero. For example, if one is performing the test at the 5% significance level, a *p*-value lower than 0.05 is taken as evidence to reject the null hypothesis of a zero coefficient. If one wants to conduct a one-sided test, the appropriate probability is one-half that reported by EViews.

For the above example output, the hypothesis that the coefficient on FACTOR_7 is zero is rejected at the 5% significance level but not at the 1% level. However, if theory suggests that the coefficient on TB3 cannot be positive, then a one-sided test will reject the zero null hypothesis at the 1% level.

The *p-values* are computed from a t-distribution with degrees of freedom.

**Summary Statistics:**

(i) **R-squared:** The R-squared ($R^2$) statistic measures the success of the regression in predicting the values of the dependent variable within the sample. In standard settings, $R^2$ may be interpreted as the fraction of the variance of the dependent variable explained by the independent variables. The statistic will equal one if the regression fits perfectly, and zero if it fits no better than the simple mean of the dependent variable. It can be negative for a number of reasons. For example,
if the regression does not have an intercept or constant, if the regression contains
coefficient restrictions, or if the estimation method is two-stage least squares or
ARCH.
EViews computes the (centered) $R^2$ as:

$$R^2 = 1 - \frac{\hat{\sum}_i \hat{\xi}_i^2}{\sum_i (Y_i - \bar{Y}) (Y_i - \bar{Y})}; \quad \bar{Y} = \frac{\sum_i Y_i}{T}$$

Where $\bar{Y}$ is the mean of the dependent (left-hand) variable.

(ii) Adjusted $R$-squared: One problem with using $R^2$ as a measure of goodness of
fit is that the $R^2$ will never decrease when more regressors are added. In the
extreme case, one can always obtain an $R^2$ of one if one includes as many
independent regressors as there are sample observations.

The adjusted $R^2$, commonly denoted as $R^2$, penalizes the $R^2$ for the addition of
regressors which do not contribute to the explanatory power of the model. The
adjusted $R^2$ is computed as:

$$\overline{R}^2 = 1 - (1 - R^2) \frac{T - 1}{T - k}$$

The $\overline{R}^2$ is never larger than the $R^2$, can decrease as you add regressors, and for
poorly fitting models, may be negative.

Standard Error of Regression (S.E. of regression): The standard error of
regression is a summary measure based on the estimated variance of the
residuals. The standard error of the regression is computed as:

$$s = \sqrt{\frac{\sum \hat{\xi}_i^2}{T - k}}$$

This is a measure of accuracy of the model predictions. It is the square root of the
sum of the squared errors divided by the degrees of freedom. It represents an
estimate of the standard deviation of the actual dependent values around the
regression line; (i.e.), it is a measure of variation around the regression line. The
standard error of the regression can be viewed as the standard deviation of the
prediction errors and thus becomes a measure to assess the absolute size of the prediction error (Neter et al, 1996).354

**Sum-of-Squared Residuals:** The sum-of-squared residuals can be used in a variety of statistical calculations, and is presented separately:

\[ \hat{\xi}^2 = \sum_{i=1}^{T} \left(Y_i - X_i \hat{b}\right)^2 \]

**Log Likelihood:** EViews reports the value of the log likelihood function (assuming normally distributed errors) evaluated at the estimated values of the coefficients. Likelihood ratio tests may be conducted by looking at the difference between the log likelihood values of the restricted and unrestricted versions of an equation.

The log likelihood is computed as:

\[ l = -\frac{T}{2} \left(1 + \log(2\pi) + \log\left(\hat{\xi}^2 / T\right)\right) \]

When comparing EViews output to that reported from other sources, note that EViews does not ignore constant terms.

**Durbin-Watson Statistic:** The Durbin-Watson statistic measures the serial correlation in the residuals. The statistic is computed as:

\[ DW = \frac{\sum_{t=2}^{T} \left(\hat{\xi}_t - \hat{\xi}_{t-1}\right)^2}{\sum_{t=1}^{T} \hat{\xi}_t^2} \]

Johnston and DiNardo (1997, Table D.5) can be referred to for a table of the significance points of the distribution of the Durbin-Watson statistic.

As a rule of thumb, if the DW is less than 2, there is evidence of positive serial correlation. The DW statistic in our output is very close to one, indicating the presence of serial correlation in the residuals. Serial Correlation Theory can be referred to for a more extensive discussion of the Durbin-Watson statistic and the consequences of serially correlated residuals.

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354 Neter et al., Applied Linear regression models, 3ed Ed, Homewood, IL:Irwin, 1996
There are better tests for serial correlation. In Testing for Serial Correlation, we discuss the Q-statistic, and the Breusch-Godfrey LM test, both of which provide a more general testing framework than the Durbin-Watson test. The Durbin-Watson test is not applicable in our case as our data is a cross section data, which is usually free from serial correlation, as there is no time dimension.

**Mean and Standard Deviation (S.D.) of the Dependent Variable:** The mean and standard deviation of are computed using the standard formulae:

\[
\bar{Y} = \frac{1}{T} \sum_{t=1}^{T} Y_t; \quad s_Y = \sqrt{\frac{1}{T-1} \sum_{t=1}^{T} (Y_t - \bar{Y})^2}
\]

**Akaike Information Criterion:** The Akaike Information Criterion (AIC) is computed as:

\[
AIC = -2l/T + 2k/T
\]

The AIC is often used in model selection for non-nested alternatives-smaller values of the AIC are preferred. For example, you can choose the length of a log distribution by choosing the specification with the lowest value of the AIC.

**Schwarz Criterion:** The Schwarz Criterion (SC) is an alternative to the AIC that imposes a larger penalty for additional coefficients:

\[
SC = -2l/T + (k \log T)/T
\]

**F-Statistic:** The F-statistic reported in the regression output is from a test of the hypothesis that all of the slope coefficients (excluding the constant, or intercept) in a regression are zero. For ordinary least squares models, the F-statistic is computed as:

\[
F = \frac{R^2/(k-1)}{(1-R^2)/(T-k)}
\]

Under the null hypothesis with normally distributed errors, this statistic has an F-distribution with \( k - 1 \) numerator degrees of freedom and \( T - k \) denominator degrees of freedom.
The p-value given just below the F-statistic of the output, denoted as Prob(F-statistic), is the marginal significance level of the F-test. If the p-value is less than the significance level you are testing, say 0.05, you reject the null hypothesis that all slope coefficients are equal to zero. For the example above, the p-value is essentially zero, so we reject the null hypothesis that all of the regression coefficients are zero. Note that the F-test is a joint test such that even if all the t-statistics are insignificant, the F-statistic can be highly significant.

**Heteroscedasticity and Autocorrelation Consistent Covariances (HAC):** When the form of heteroscedasticity is not known, it may not be possible to obtain efficient estimates of the parameters using weighted least squares. OLS provides consistent parameter estimates in the presence of heteroscedasticity, but the usual OLS standard errors will be incorrect and should not be used for inference. Before we describe the techniques for HAC covariance estimation, we must note that, Using the White heteroscedasticity consistent or the Newey-West consistent covariance estimates does not change the point estimates of the parameters, but only the estimated standard errors. There is nothing to keep one from combining various methods of accounting for heteroscedasticity and serial correlation. For example, weighted least squares estimation might be accompanied by White or Newey-West covariance matrix estimates.

**Heteroscedasticity Consistent Covariances (White):** White’s heteroscedasticity consistent covariance matrix estimator which provides correct estimates of the coefficient Covariances in the presence of heteroscedasticity of unknown form. The White covariance matrix is given by:

$$
\hat{\Sigma}_w = \frac{T}{T-k} (X'X)^{-1} \left( \sum_{t=1}^{T} U_t^2 x_t x_t' \right) (X'X)^{-1}
$$

Where, $T$ is the number of observations, $k$ is the number of regressors, and $U_t$ is the least squares residual.

EViews estimates equation and computes the variances using White's covariance estimator. One can always tell when EViews is using White Covariances, since the output display will include a line. So, in this way, our multiple regression
takes care of Multicollinearity problem by using factor analysis on the independent variables, and heteroscedasticity by using White’s Test.

6.2.2 Analysis and Hypotheses

Based on the above analysis we can now present the hypotheses used in the multiple regression in detail. Let is assume that the regression model is as follows.

\[ Y = \alpha + \beta_1 \times AT\_PRG + \beta_2 \times INF\_S\_PG + \beta_3 \times FACTOR\_1 + \beta_4 \times FACTOR\_2 + \beta_5 \times FACTOR\_3 + \beta_6 \times FACTOR\_4 + \beta_7 \times FACTOR\_5 + \beta_8 \times FACTOR\_6 + \beta_9 \times FACTOR\_7 + \beta_{10} \times FACTOR\_8 + \xi; \]

where, ‘\( \xi \)’ - Error Term & ‘\( \alpha \)’ - Constant term

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACTOR_1</td>
<td>0.431833</td>
<td>0.106640</td>
<td>4.049451</td>
<td>0.0001</td>
</tr>
<tr>
<td>FACTOR_2</td>
<td>0.000765</td>
<td>0.001086</td>
<td>0.704572</td>
<td>0.4827</td>
</tr>
<tr>
<td>FACTOR_3</td>
<td>-0.077211</td>
<td>0.069013</td>
<td>-1.118783</td>
<td>0.2658</td>
</tr>
<tr>
<td>FACTOR_4</td>
<td>0.048216</td>
<td>0.087716</td>
<td>0.549686</td>
<td>0.5837</td>
</tr>
<tr>
<td>FACTOR_5</td>
<td>-0.188878</td>
<td>0.044135</td>
<td>-4.279575</td>
<td>0.0000</td>
</tr>
<tr>
<td>FACTOR_6</td>
<td>0.270535</td>
<td>0.081410</td>
<td>3.323119</td>
<td>0.0012</td>
</tr>
<tr>
<td>FACTOR_7</td>
<td>0.180137</td>
<td>0.070412</td>
<td>2.558313</td>
<td>0.0120</td>
</tr>
<tr>
<td>FACTOR_8</td>
<td>-0.014688</td>
<td>0.068594</td>
<td>-0.214128</td>
<td>0.8309</td>
</tr>
<tr>
<td>AT_PRG</td>
<td>0.007582</td>
<td>0.072472</td>
<td>0.104614</td>
<td>0.9169</td>
</tr>
<tr>
<td>INF_S_PG</td>
<td>0.078347</td>
<td>0.053951</td>
<td>1.452182</td>
<td>0.1495</td>
</tr>
<tr>
<td>C</td>
<td>0.563344</td>
<td>0.435046</td>
<td>1.294907</td>
<td>0.1982</td>
</tr>
</tbody>
</table>

\[ R^2 \text{= 0.488204} \]

\[ \text{Mean dependent var} = 2.643478 \]

\[ \text{Adjusted R-sq} = 0.438993 \]

\[ \text{S.D. dependent var} = 0.938376 \]

\[ \text{S.E. of regression} = 0.702848 \]

\[ \text{Akaike info criterion} = 2.223410 \]

\[ \text{Schwarz criterion} = 2.485968 \]

\[ \text{F-statistic} = 9.920586 \]

\[ \text{Prob(F-statistic)} = 0.000000 \]
In the output above, $Y$ is FIN_RTS, $X$ consists of 11 variables $C$, FACTOR_1, FACTOR_2, ..., FACTOR_8, AT_PRG and INF_S_PG, where $T = 115$ and $k = 11$. The equation 6.1 can be written as below for better clarity while defining Hypotheses.

$$Y = \alpha + \beta_1 \times \text{Ability to Track Progress of action Plans} + \beta_2 \times \text{Ability of Incorporating Information in Strategic Planning} + \beta_3 \times \text{Organizational Value Orientation} + \beta_4 \times \text{Maturity} + \beta_5 \times \text{Organizational Competitiveness} + \beta_6 \times \text{Organizational Wisdom} + \beta_7 \times \text{Information and Knowledge management} + \beta_8 \times \text{Infrastructural Standards} + \beta_9 \times \text{Systems Effectiveness} + \beta_{10} \times \text{Process efficiency} + \xi; \text{ where, } \xi \text{ – Error Term & } \alpha \text{ – Constant term}$$

---

**Hypothesis 1:** The Null Hypothesis can be stated as AT_PRG (unique variable 2 - Proficiency in Execution Index), i.e., Ability of Tracking the Progress has no influence on Financial Returns vis-à-vis Ability of Tracking the Progress influences Financial Returns. It can be mathematically represented as follows:

$$H_{01} : \beta_1 = 0$$
$$H_{11} : \beta_1 \neq 0$$

From the regression output given in Table 6.11, it is evident (p-value > 0.05) that the null hypothesis is accepted. This indicates $\beta$ value becoming zero in the Model equation 6.2. This proves that the variable ‘Ability of Tracking the Progress of Action plans’ does not affect financial returns.

**Hypothesis 2:** The Null Hypothesis can be stated as INF_S_PG (unique variable 1 - Proficiency in Planning Index), i.e., Ability of Incorporating Information in Strategic Planning has no influence on Financial Returns vis-à-vis Ability of Incorporating Information in Strategic Planning influences Financial Returns. It can be mathematically represented as follows:

$$H_{02} : \beta_2 = 0$$
$$H_{12} : \beta_2 \neq 0$$

From regression output given in Table 6.11, it is evident (p-value > 0.05) that the null hypothesis 2 is accepted. This indicates $\beta$ value becoming zero in the Model equation 6.2. This proves that the variable ‘Ability of Incorporating Information in Strategic Planning’ does not influence financial returns.
**Hypothesis 3:** The Null Hypothesis can be stated as FACTOR_1, i.e., Organizational Value Orientation Index has no influence on Financial Returns vis-à-vis Organizational Value Orientation Index influences Financial Returns. It can be mathematically represented as follows:

\[ H_{03} : \beta_3 = 0 \]
\[ H_{13} : \beta_3 \neq 0 \]

From regression output given in Table 6.11, it is evident (p-value < 0.05) that the null hypothesis is rejected. This indicates \( \beta \) value not becoming zero in the Model equation 6.2. This proves that the variable ‘Organizational Value Orientation index’ influences financial returns.

**Hypothesis 4:** The Null Hypothesis can be stated as FACTOR_2, i.e., Maturity Index has no influence on Financial Returns vis-à-vis Maturity Index influences Financial Returns. It can be mathematically represented as follows:

\[ H_{04} : \beta_4 = 0 \]
\[ H_{14} : \beta_4 \neq 0 \]

From regression output given in Table 6.11, it is evident (p-value > 0.05) that the null hypothesis is accepted. This indicates \( \beta \) value becoming zero in the Model equation 6.2. This proves that the variable ‘Maturity Index’ does not influence financial returns.

**Hypothesis 5:** The Null Hypothesis can be stated as FACTOR_3, i.e., Organizational Competitiveness Index has no influence on Financial Returns vis-à-vis Organizational Competitiveness Index influences Financial Returns. It can be mathematically represented as follows:

\[ H_{05} : \beta_5 = 0 \]
\[ H_{15} : \beta_5 \neq 0 \]

From regression output given in Table 6.11, it is evident (p-value > 0.05) that the null hypothesis is accepted. This indicates \( \beta \) value becoming zero in the Model equation 6.2. This proves that the variable ‘Organizational Competitiveness Index’ does not influence financial returns.
**Hypothesis 6:** The Null Hypothesis can be stated as FACTOR_4, i.e., Organizational Wisdom Index has no influence on Financial Returns vis-à-vis Organizational Wisdom Index influences Financial Returns. It can be mathematically represented as follows:

\[ H_{06} : \beta_0 = 0 \]
\[ H_{16} : \beta_0 \neq 0 \]

From regression output given in Table 6.11, it is evident (p-value > 0.05) that the null hypothesis is accepted. This indicates \( \beta \) value becoming zero in the Model equation 6.2. This proves that the variable ‘Organizational Wisdom Index’ does not influence financial returns.

**Hypothesis 7:** The Null Hypothesis can be stated as FACTOR_5, i.e., Information and Knowledge Deployment Index has no influence on Financial Returns vis-à-vis Information and Knowledge Deployment Index influences Financial Returns. It can be mathematically represented as follows:

\[ H_{07} : \beta_7 = 0 \]
\[ H_{17} : \beta_7 \neq 0 \]

From regression output given in Table 6.11, it is evident (p-value < 0.05) that the null hypothesis is rejected. This indicates \( \beta \) value not becoming zero in the Model equation 6.2. This proves that the variable ‘Information and Knowledge Deployment Index’ ability influences financial returns.

**Hypothesis 8:** The Null Hypothesis can be stated as FACTOR_6, i.e., Infrastructural Standards Index has no influence on Financial Returns vis-à-vis Infrastructural Standards Index influences Financial Returns. It can be mathematically represented as follows:

\[ H_{08} : \beta_8 = 0 \]
\[ H_{18} : \beta_8 \neq 0 \]

From regression output given in Table 6.11, it is evident (p-value < 0.05) that the null hypothesis is rejected. This indicates \( \beta \) value not becoming zero in the Model equation 6.2. This proves that the variable ‘Infrastructural Standards Index’ influences financial returns.
**Hypothesis 9:** The Null Hypothesis can be stated as FACTOR_7, i.e., *Systems Effectiveness Index* has no influence on Financial Returns vis-à-vis *Systems Effectiveness Index* influences Financial Returns. It can be mathematically represented as follows:

\[ H_{09} : \beta_7 = 0 \]
\[ H_{19} : \beta_7 \neq 0 \]

From regression output given in Table 6.11, it is evident (p-value < 0.05) that the null hypothesis is rejected. This indicates \( \beta \) value not becoming zero in the Model equation 6.2. This proves that the variable ‘*Systems Effectiveness Index’* influences financial returns.

**Hypothesis 10:** The Null Hypothesis can be stated as FACTOR_8, i.e., *Process Efficiency Index* has no influence on Financial Returns vis-à-vis *Process Efficiency Index* influences Financial Returns. It can be mathematically represented as follows:

\[ H_{010} : \beta_{10} = 0 \]
\[ H_{110} : \beta_{10} \neq 0 \]

From regression output given in Table 6.11, it is evident (p-value > 0.05) that the null hypothesis is accepted. This indicates \( \beta \) value becoming zero in the Model equation 6.2. This proves that the variable ‘*Process Efficiency Index’* does not influence financial returns.

Summing up all of the above hypotheses, the Model Equation reduces to,

\[ Y = \alpha + \beta_3 \times \text{FACTOR}_1 + \beta_7 \times \text{FACTOR}_5 + \beta_8 \times \text{FACTOR}_6 + \beta_9 \times \text{FACTOR}_7 + \xi; \]

where, ‘\( \xi \)’ – Error Term & ‘\( \alpha \)’ – Constant term. \hspace{1cm} -------- Equation 6.3

The same equation can be written as below for better clarity while defining Hypotheses.

\[ Y = \alpha + \beta_3 \times \text{Organizational Value Orientation Index} + \beta_7 \times \text{Information and Knowledge Deployment Index} + \beta_8 \times \text{Infrastructural Standards Index} + \beta_9 \times \text{Systems Effectiveness Index} + \xi; \]

where, ‘\( \xi \)’ – Error Term & ‘\( \alpha \)’ – Constant term. \hspace{1cm} --------Equation 6.4

Substituting \( \beta_3, \beta_7, \beta_8 \) and \( \beta_9 \) from the regression output given in Table 6.10 in equation 6.4,
\[ Y = (0.563344) + (0.4318833) \times \text{Organizational Value Orientation Index} + (-0.188878) \times \text{Information and Knowledge Deployment Index} + (0.270535) \times \text{Infrastructural Standards Index} + (0.180137) \times \text{Systems Effectiveness Index} + \xi \] where, ‘\( \xi \)’ – Error Term & ‘\( \alpha \)’ – Constant term

\text{--------- Equation 6.5.}\]

From Equation 6.5, we can understand that Information Knowledge Deployment Index affect Financial Returns negatively, where in, Organizational Value Orientation, Infrastructural Standards and Systems Effectiveness affect financial returns positively.

Next, let us consider \textit{Market Share Growth} (MKT\_SH\_G) as the dependent variable and the 10 variables (8 factors and 2 variables) as mentioned above as independent. The output is as given in table 6.12.

\begin{table}[h]
\centering
\caption{Regression Output 2}
\begin{tabular}{llllll}
\hline
\textbf{Variable} & \textbf{Coefficient} & \textbf{Std. Error} & \textbf{t-Statistic} & \textbf{Prob.} \\
\hline
AT\_PRG & -0.030584 & 0.110424 & -0.276967 & 0.7824 \\
INF\_S\_PG & 0.031450 & 0.080519 & 0.390588 & 0.6969 \\
FACTOR\_1 & 0.400534 & 0.183950 & 2.177412 & 0.0317 \\
FACTOR\_2 & 0.007390 & 0.001917 & 3.854257 & 0.0002 \\
FACTOR\_3 & -0.061262 & 0.083162 & -0.736660 & 0.4630 \\
FACTOR\_4 & 0.038966 & 0.145579 & 0.267664 & 0.7895 \\
FACTOR\_5 & 0.008046 & 0.074775 & 0.107609 & 0.9145 \\
FACTOR\_6 & 0.029256 & 0.109091 & 0.268180 & 0.7891 \\
FACTOR\_7 & 0.056575 & 0.102220 & 0.553464 & 0.5811 \\
FACTOR\_8 & 0.090447 & 0.103191 & 0.876497 & 0.3828 \\
C & 1.999860 & 0.871131 & 2.295707 & 0.0237 \\
\hline
\textbf{R-squared} & 0.202605 & & & 4.243478 \\
\textbf{Adjusted R-squared} & 0.125932 & & & 1.151592 \\
\textbf{S.E. of regression} & 1.076641 & & & 3.076333 \\
\textbf{Sum squared resid} & 120.5523 & & & 3.338891 \\
\textbf{Log likelihood} & -165.8891 & & & 2.642470 \\
\textbf{Durbin-Watson} & 1.796441 & & & 0.006546 \\
\end{tabular}
\end{table}
It is to be noted that the $R^2$ is very low (0.2026). Only two variables namely FACTOR_1 and FACTOR_2 have a significant impact. This is because both these two factors have a p-value less than 0.05. However, all the other variables/factors appear to be insignificant.

Let us assume that the regression model is as follows:

$$Y = \alpha + \beta_3 \times \text{FACTOR}_1 + \beta_4 \times \text{FACTOR}_2 + \xi; \quad \text{where, } \xi - \text{Error Term } \& \alpha - \text{Constant term.} \quad \text{------- Equation 6.6}$$

The same equation can be written as below for better clarity while defining Hypotheses.

$$Y = \alpha + \beta_3 \times \text{Organizational Value Orientation Index} + \beta_4 \times \text{Maturity Index} + \xi; \quad \text{where}$$

$\xi$ - Error Term and $\alpha$ - Constant term

$\text{------- Equation 6.7}$

Let us consider null Hypotheses that get rejected and not those that get accepted.

There are 2 factors that affect market share growth. They are organizational value Orientation and Maturity of the Respondents.

Thus the Hypotheses are,

**Hypothesis 11:** The Null Hypothesis can be stated as FACTOR_1, i.e.,
*Organizational Value Orientation Index* has no influence on Market Share Growth vis-à-vis *Organizational Value Orientation Index* influences Market Share Growth.

It can be mathematically represented as follows:

$$H_{05} : \beta_3 = 0$$

$$H_{15} : \beta_3 \neq 0$$

From regression output given in Table 6.12, it is evident (p-value < 0.05) that the null hypothesis is rejected. This indicates $\beta$ value not becoming zero in the Model equation 6.2. This proves that the variable ‘*Organizational Value Orientation Index*’ influences Market Share Growth.

**Hypothesis 12:** The Null Hypothesis can be stated as FACTOR_2, i.e., *Maturity Index* has no influence on Market Share Growth vis-à-vis *Maturity Index* influences Market Share Growth. It can be mathematically represented as follows:
From regression output given in Table 6.12, it is evident (p-value < 0.05) that the null hypothesis is rejected. This indicates $\beta$ value not becoming zero in the Model equation 6.2. This proves that the variable ‘Maturity Index’ influences Market Share Growth. Summing up hypotheses 11 and 12, the Model Equation reduces to,

$$Y = \alpha + \beta_3 \times \text{Organizational Value Orientation Index} + \beta_4 \times \text{Maturity Index} + \xi;$$

where, ‘$\xi$’ – Error Term & ‘$\alpha$’ – Constant term. 

The same equation can be written as below for better clarity while defining Hypotheses.

$$Y = \alpha + \beta_3 \times \text{Organizational Value Orientation Index} + \beta_4 \times \text{Maturity Index} + \xi;$$

where, ‘$\xi$’ – Error Term & ‘$\alpha$’ – Constant term.

Substituting $\beta_3$ and $\beta_4$ from the regression output given in Table 6.11 in equation 6.9,

$$Y = (1.999860) + (0.400534) \times \text{Organizational Value Orientation Index} + (0.007390) \times \text{Maturity Index} + \xi;$$

where, ‘$\xi$’ – Error Term & ‘$\alpha$’ – Constant term.

From Equation 6.10, we can understand that Organizational value Orientation and Maturity of Respondents affect Market Share Growth positively. Maturity Index indicates only the age and total experience of respondents and not any capability of the organization. It can be excluded from the Equation.

$$Y = (1.999860) + (0.400534) \times \text{Organizational Value Orientation Index} + \xi;$$

Where, ‘$\xi$’ – Error Term & ‘$\alpha$’ – Constant term

Next we consider Profit Growth (PFT_GRW) as the dependent variables and the same variables as independent as before.

The output is as given in table 6.13.
Table 6.13 - Regression Output 3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT_PRG</td>
<td>-0.046504</td>
<td>0.138611</td>
<td>-0.335503</td>
<td>0.7379</td>
</tr>
<tr>
<td>INF_S_PG</td>
<td>0.068649</td>
<td>0.092899</td>
<td>0.73865</td>
<td>0.4616</td>
</tr>
<tr>
<td>FACTOR_1</td>
<td>0.397745</td>
<td>0.179195</td>
<td>2.219617</td>
<td>0.0286</td>
</tr>
<tr>
<td>FACTOR_2</td>
<td>0.000402</td>
<td>0.001759</td>
<td>0.228828</td>
<td>0.8195</td>
</tr>
<tr>
<td>FACTOR_3</td>
<td>-0.160450</td>
<td>0.087002</td>
<td>-1.844215</td>
<td>0.0680</td>
</tr>
<tr>
<td>FACTOR_4</td>
<td>-0.013879</td>
<td>0.150539</td>
<td>-0.092198</td>
<td>0.9267</td>
</tr>
<tr>
<td>FACTOR_5</td>
<td>-0.099440</td>
<td>0.077926</td>
<td>-1.276079</td>
<td>0.2048</td>
</tr>
<tr>
<td>FACTOR_6</td>
<td>-0.091664</td>
<td>0.110544</td>
<td>-0.829215</td>
<td>0.4089</td>
</tr>
<tr>
<td>FACTOR_7</td>
<td>0.299019</td>
<td>0.110579</td>
<td>2.704119</td>
<td>0.0080</td>
</tr>
<tr>
<td>FACTOR_8</td>
<td>-0.005375</td>
<td>0.103766</td>
<td>-0.051797</td>
<td>0.9588</td>
</tr>
<tr>
<td>C</td>
<td>2.570295</td>
<td>0.836169</td>
<td>3.073894</td>
<td>0.0027</td>
</tr>
</tbody>
</table>

_R-squared_ | 0.159652  | Mean dependent var | 3.686957 |
_Adjusted R-squared_ | 0.078849  | S.D. dependent var | 1.165026 |
_S.E. of regression_ | 1.118152  | Akaike info criterion | 3.151995 |
_Sum squared resid_ | 130.0274  | Schwarz criterion | 3.414553 |
_Log likelihood_ | -170.2397 | F-statistic | 1.975823 |
_Durbin-Watson stat_ | 1.697352  | Prob(F-statistic) | 0.043298 |

In this regression, it is to be noted that there are 2 variables which has a p-value less than 0.05 and they are, FACTOR_1 and FACTOR_7. FACTOR_2, which was significant in the previous regression, is no longer significant in this regression. Moreover, the $R^2$, fell from 0.202 to 0.159 in this regression, depicting that Profit Growth is a weaker dependent variable as compared to Market Share Growth.

In the next regression we consider business expectation (BUS_EXP) as the dependent variable and continue with the same set of independent variables. The output is as given in table 6.14.
This regression output is completely different from the previous two and has little or no similarity. A new independent variable has emerged to be significant at 10 percent level of significant – it is FACTOR_4. However, as none of the variables are significant as 5 percent level of significance, we note that the $R^2$ is as low as 0.10. Hence, it proves that Business Expectation is the weakest of the 4 dependent variables considered so far. The overall Prob (F-Statistic) is also very high, much higher than the 0.10, which is the threshold level of acceptance for any regression.

Thus we decided to drop the models created for dependent variables Market share growth, Profit growth and Business expansion; however, we decided to chose the financial performance to be represented by the variable Financial
Returns as the regression model generated by this variable is strongest of all dependent variables.

Now, let us consider the first regression output where with FIN_RTS as the dependent variable. $R^2$ is 0.4882. This implies the best fitness of the model, and indicates the variable FIN_RTS as the most powerful representative of Financial Performance. In this regression, 4 factors emerge as highly significant at 5% level of significance.

These variables are FACTOR_1, FACTOR_5, FACTOR_6 and FACTOR_7. While FACTOR_1, FACTOR_6 and FACTOR_7 have positive coefficients, FACTOR_5 has a negative coefficient. This implies that, other than FACTOR_5, FIN_RTS changes positively with the other 3 factors. So we decided to run a regression of the model depicted by Equation 6.4.

The regression Outputs are as shown in Table 6.15

<table>
<thead>
<tr>
<th>Table 6.15 - Regression Output 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable:</strong> FIN_RTS (Y)</td>
</tr>
<tr>
<td>Method: Least Squares</td>
</tr>
<tr>
<td>Date: 03/25/09  Time: 14:51</td>
</tr>
<tr>
<td>Sample: 1 115</td>
</tr>
<tr>
<td>Included observations: 115</td>
</tr>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>FACTOR_1</td>
</tr>
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<td>FACTOR_7</td>
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<td>FACTOR_6</td>
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<td>FACTOR_5</td>
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<tr>
<td>C</td>
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<tr>
<td><strong>R-squared</strong></td>
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<tr>
<td><strong>Adjusted R-squared</strong></td>
</tr>
<tr>
<td><strong>S.E. of regression</strong></td>
</tr>
<tr>
<td><strong>Sum squared resid</strong></td>
</tr>
<tr>
<td>Log likelihood</td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
</tr>
</tbody>
</table>

This Regression reveals that the variable ‘Financial Returns’ as the best proxy for Financial Performance and in turn Organizational Performance OP.
Therefore, the equation can be re-written as, \( Y = 0.644 + 0.444 \times \text{Organizational Value Orientation} - 0.171 \times \text{Information and Knowledge Deployment} + 0.259 \times \text{Infrastructural Standards} + 0.188 \times \text{Systems Effectiveness} + \xi \quad \text{--- Equation 6.12} \)

Where, \( Y \) is the predicted value of Organizational performance and \( \xi \) indicates the error in prediction. This is an optimal model for measuring organizational performance in terms of some independent factors which depict organizational intelligence.

The final Equation - 6.12 qualifies to be the best model for discussing the relationship between OI and OP from the R-Square value being 0.468 and Standard Error of the regression being 0.697. These values indicate the best fit and the model being validated respectively. Inferences from these findings will be discussed in next chapter.

6.2.3 Validation of the Models

Validation of the model is done to establish the reliability of the research process so that the results are generalizable. The direct approach is in view of obtaining a fresh set of variables from a new set of sample to do Regression Analysis. Repetition of the same R-Square will validate the model. In our case, the data collection from small and medium businesses had been tedious and collecting another set of data would consume more than 2 years. Thus validation of the model could not be done.

6.3 Findings from the Non Metric Independent Variables

There are dummy variables which could not be considered for the multivariate analysis techniques as they are non-metric. However, they can be analyzed with the help of simple histograms.
6.3.1 Strategic Planning Efficiency Variable

Figure 6.2 - Strategic planning efficiency of Organizations

(Dm_D_S_P_F)

The figure reveals a fact that almost 50% of the sample organizations have at least one specific way of planning their strategic processes of the following:
Roles and responsibilities, Resource allocation, Action plan execution duration, Crisis anticipation, Disaster management

6.3.2 Group A variables

Business Valuation - Dm_Bus_VaL, Ability to Build and Manage Knowledge Assets - Dm_B&M_K_A, Capacity to Manage Customer Expectations - Dm_C_E_Mgt, Having Standardized Quality Metrics for Production / Delivery Processes - Dm_S_Q_M_PP, Continuous Monitoring of Quality - Dm_C_M_Q are the variables that fetch answers in binary (yes or no) from the respondents. The comparison of these variables is shown as in Figure 6.3.
This information indicates that the organizations that do not manage Information. Knowledge assets have interest in business valuation. These two variables behave complementary to each other. Managing customer expectations, maintaining quality along the value chain and continuous monitoring of quality are all followed by more than 50% of the sample.

6.3.3 Group B variables

Ability to have Decentralised Decision Making Systems - Dm_DC_MK, Having Effective Career Planning Systems - Dm_C_P_Sys, Having Strategic Cost Management in Business Processes - Dm_S_C_M_BP, Having Variability Reduction in Business Processes - Dm_VR_BP, Having High Process Performance - Dm_Pr_Pfr. This second group of independent non-metric variables is compared below in Figure 6.4. The variables that capture answers in unclear form (yes / somewhat / no) are grouped and compared.
Figure 6.4 - Comparison between the Independent non metric variables

(Group B)

(1. Agreeing fully to the variable’s presence; 2. Somewhat agreeing; 3. Completely disagreeing)

Study of the comparison of Group B variables indicate that almost 50% of the organizations have a vague ability to decide decentrally, career planning systems, cost management systems, interest in reducing variability in the business process and high process performance interest. This indicates that there is a scope to improvise these variables to improve organizational Intelligence with the help of the regression model equation constructed. Process performance interest is getting ignored in these samples wherein other variables are attempted to be improvised by these organizations.

Thus Group A, B and the strategic Planning efficiency variables individually indicate the presence of interest in these organizations to attempt to improvise these variables amongst 50% of the organizations taken as samples. We perceive from these three figures that more than 50% of the organizations are indistinctly having principles represented by these variables for the improvisation of organization and roughly around 25% of organizations are already following the principles. This clearly indicates the interest of organizations to thrive and move...
ahead for better competitiveness. Performance and growth is also indicated, making the research more meaningful and useful.

6.4 More Findings from the Analyses

The key findings from Multiple Regression Analysis are;

i) Analysis reveals that Financial Returns is the best fit representative variable of OP out of all the 5 dependent variables. Financial Returns (FR) is most impacted by the components of independent variables representing OI compared to other dependent variables such as Market share growth, profit growth, business valuation and business expansion.

ii) It is evident that Organizational Value Orientation Index, Infrastructural Standards Index impact OP more than Information and Knowledge Deployment Index.

iii) The impact of Information and Knowledge Deployment Index on OP is lesser and negative compared to the rest of the OI components.

iv) The impacts of Organizational Value Orientation Index, Infrastructural Standards Index and Systems Effectiveness Index are larger and positive on OP.

v) The non metric independent variable ‘strategic planning efficiency’ is prominent in almost 50% of the samples.

vi) Study of Group A dummy variables indicates a few key findings:
   1. Observations of the behavior of variables: ‘Business valuation’ and ‘ability to manage knowledge and information assets’ are complementary. Those organizations that are interested in valuing their business periodically are disinterested in managing knowledge assets.
2. 70% of the organizations show interest in managing
customer expectations maintain quality along the value
chain and monitor quality continuously.

vii) Study of Group B dummy variables indicates the following findings
1. 60% of the organizations have high process performance.
2. 65% of the organizations ‘somewhat’ care to:
   a. Empower employees for decision making,
   b. Have effective career planning for employees,
   c. Have strategic planning for cost management,
   d. Reduce variability in the business processes.

viii) OI can be measured by 4 key indices. They are, Organizational Value
Orientation Index, Information and Knowledge Deployment Index,
Infrastructural Standards Index and Systems Effectiveness Index.
1. $OI_1$ (Organizational Intelligence component 1) = $f$
   {Organizational Value Orientation Index}
2. $OI_2$ (Organizational Intelligence component 2) = $f$ {Information
   and Knowledge Deployment Index}
3. $OI_3$ (organizational Intelligence component 3) = $f$
   {Infrastructural Standards Index}
4. $OI_4$ (Organizational Intelligence component 4) = $f$ {Systems
   Effectiveness Index}

ix) There is a relationship established between OP and OI. OI represented by
variables such as Organizational value Orientation, Information and Knowledge
Deployment, Infrastructural Standards and Systems Effectiveness triggers OP.
1. $OP$ (Organizational Performance) = Financial Performance
   Component1= f [Financial Returns]
2. OI - OP relationship Model is represented by Equation
   6.12. $Y = 0.644 + 0.444 \times Organizational Value Orientation
   Index - 0.171 \times Information and Knowledge Deployment Index
   + 0.259 \times Infrastructural Standards Index + 0.188 \times Systems
Effectiveness Index + \( \xi \) where, ‘\( \xi \)’ – Error Term & ‘\( \alpha \)’ – Constant term of the multi variate equation

These findings from Exploratory Factor Analysis and Multiple Regression Analysis could lead us to develop the conceptual models as defined by our research objectives. They are discussed below.

### 6.5 Conceptual Model of Organizational Intelligence Instrument

- **Organizational Value Orientation Index**
  \[
  = A_S_N \times 0.143498 + E_{Inn} \times 0.162141 + Pfr_M_S \times 0.158165 + ICTOS \times 0.177259 + Bus_P_Ef \times 0.176355 + Eff_Q_M \times 0.182582
  \]

- **Maturity Index**
  \[
  = Age \times 0.501795 + Total_{exp} \times 0.498205
  \]

- **Organizational competitiveness Index**
  \[
  = CO_CA \times 0.471381 + C_M_{Val} \times 0.528619
  \]

- **Organizational Wisdom Index**
  \[
  = E_O_L \times 0.329021 + A_L \times 0.385211 + Pft_Sh \times 0.285768
  \]

- **Information and Knowledge Deployment Index**
  \[
  = Bus_{Cnt} \times 0.638528 + t_{og_s_b} \times 0.904237 + S_I_T_N \times (-0.54276)
  \]

- **Infrastructural Standards Index**
  \[
  = Wlf_{Emp} \times 0.561938 + Ef_U_{Inf} \times 0.438062
  \]

- **Systems Effectiveness Index**
  \[
  = Em_{Intel} \times 0.444049 + Stk_{Stis} \times 0.239985 + W_F_{Sys} \times 0.315966
  \]

- **Process Efficiency Index**
  \[
  = T_I_{Plg} \times 0.231245 + N_T_B_P \times 0.463595 + PU_{QPMS} \times 0.305161
  \]

- **Proficiency in Planning Index**
  \[
  = Inf_S_{Pg} \times 1.0
  \]

- **Proficiency in Execution Index**
  \[
  = AT_{Prg} \times 1.0
  \]

These 10 representations can be re-written with the complete names of the variables that got grouped in the factors, as 10 different equations as below.
i) Organizational Value Orientation Index = Ability to have awareness on stakeholder needs $x \times 0.143498 + \text{Ability to encourage innovation } x \times 0.162141 + \text{Capacity to utilize performance measurement systems effectively } x \times 0.158165 + \text{Having improvement on cycle time on operating systems } x \times 0.177259 + \text{Having high business process efficiency } x \times 0.176355 + \text{Having highly efficient quality management systems } x \times 0.182582 \tag{Equation 6.13}

ii) Maturity Index = Age $x \times 0.501795 + \text{Total work experience } x \times 0.498205 \tag{Equation 6.14}

iii) Organizational Competitiveness Index = Capacity to operate on customer oriented competition analysis reports $x \times 0.471381 + \text{Capacity to utilize customer and market valuation analysis } x \times 0.528619 \tag{Equation 6.15}

iv) Organizational Wisdom Index = Ability to encourage organizational learning $x \times 0.329021 + \text{ability to apply the learning } x \times 0.385211 + \text{Capacity to share profit among the employees } x \times 0.285768 \tag{Equation 6.16}

v) Information and Knowledge Deployment Index = Business continuity capacity $x \times 0.638528 + \text{ability to know the trade off between organizational goal and stakeholder benefits } x \times 0.904237 + \text{having stable information technology network } x \times (-0.54276) \tag{Equation 6.17}

vi) Infrastructural Standards Index = Ability to provide schemes on employee welfare $x \times 0.561938 + \text{capacity to use information effectively } x \times 0.438062 \tag{Equation 6.18}

vii) Systems Effectiveness Index = Ability to provide societal sensitiveness in the system $x \times 0.444049 + \text{Ability to focus on High level of stakeholder satisfaction } x \times 0.239985 + \text{Capacity to have effective workflow systems } x \times 0.315966 \tag{Equation 6.19}

viii) Process efficiency Index = Ability to incorporate technology and innovation in Planning $x \times 0.231245 + \text{Ability to deploy new technology for business process planning } x
0.463595 + ability to have periodic up gradation of quality management processes x 0.305161  

\[ \text{Equation 6.20} \]

 ix) \textbf{Proficiency in Planning Index} = Ability of incorporating information in strategic planning \times 1.0  

\[ \text{Equation 6.21} \]

\[ \text{Equation 6.22} \]

Organizational Intelligence is thus a function comprising of these 10 components (8 factors and 2 unique variables) represented by Equations 6.13 to 6.22. Thus, Conceptually, Organizational Intelligence can be measured through a quotient that may be represented as,

\[ \text{Organizational Intelligence Quotient} = f \{ \text{Organizational Value Orientation Index}, \text{Maturity Index}, \text{Organizational Competitiveness Index}, \text{Organizational Wisdom Index}, \text{Information and Knowledge Deployment Index}, \text{Infrastructural Standards Index}, \text{Systems Effectiveness Index}, \text{Process efficiency Index}, \text{Proficiency in Planning Index}, \text{Proficiency in Execution Index} \} \quad \text{-- Equation 6.23} \]

This Equation 6.23 can be called as the Conceptual Model of Organizational Intelligence Quotient. Predictions and applications of this model are discussed in the next chapter.

\[ \text{6.6 Conceptual Model of OI-OP Linkage} \]

Out of these 10 components, 4 become prominent from the Multiple Regression Analysis (Equation 6.12) when \textit{Financial Returns} is found to be the best fitting proxy variable for Financial Performance of the given sample set for Multiple Regression Analysis. They are, \textit{Organizational Value Orientation, Information and Knowledge Deployment, Infrastructural Standards and Systems Effectiveness}. 
When ‘Organizational Performance’ is measured only in terms of “Financial Performance” and if Financial Returns represents best Financial Performance, Organizational Value Orientation, Information and Knowledge Deployment, Infrastructural Standards and Systems Effectiveness would represent ‘Organizational Intelligence’
i) OI1 (Organizational Intelligence component 1) = f {Organizational Value Orientation Index}
ii) OI2 (Organizational Intelligence component 2) = f {Information and Knowledge Deployment Index}
iii) OI3 (organizational Intelligence component 3) = f {Infrastructural Standards Index}
iv) OI4 (Organizational Intelligence component 4) = f {Systems Effectiveness Index}
v) OP (Organizational Performance) = Financial Performance Component1 = f {Financial Returns}

Conceptually the relationship between OI and OP can be written as,

\[ OP = f (OI1, OI2, OI3, OI4) \]

\[ \text{---------- Equation 6.24} \]

This Equation 6.24 can be termed as the Conceptual Model of OI-OP Linkage. Interpretations and applications of this model are discussed in the next chapter.

### 6.7 Conclusion

In this chapter, we have discussed in detail the Exploratory Factor Analysis of the chosen Variables. Variable selection, types and grouping of variables, Factor Analysis design, sampling adequacy tests and the results, component analysis, estimation of factor model and the factor loading calculations and the formation of 8 factors have been explained. Those 8 factors and 2 unique variables have been considered for Multiple Regression modeling. Four different dependent and metric variables were chosen for regression analysis, and the model with the best fit was selected to explain the relationship between OP and OI. The assumptions such as Heteroscedasticity and Multicollinearity are explored. The behavior of non metric variables explains other organizational capabilities
present in these organizations. Had these been metric variables, there might have been changes in the constructs of factors of OI from exploratory factor analysis.

The key findings here lead to develop the instrument for measuring OI. The conceptual model representing the relationship between OI and OP is developed. However, validation of the model will depend on the consistency of the results on repeating the entire experiment a few times with new sets of samples. This validation of the model is not done as sampling and data collection and sorting would consume a large amount of time. This exercise can be done as an empirical study of verification of the instrument design done in this research work.

In the next chapter, we will discuss the predictions of OI Measurement Model developed here and OI – OP Linkage in detail. The merits and demerits of the model, deliverables, benefits of this study to organizations and suggestions for the future are also included in the next chapter.
Chapter VII
Conclusion

7.0 Introduction

In the Earlier Chapter we discussed the Data Analysis and the Findings and the summary of findings. In this Chapter we will discuss about the Inferences from the findings, Implications and recommendations to achieve strategic advantage for the small and medium enterprises (SME) which are the main population of this study. This chapter will speak about the suggestions and the business policy design needs of small and medium businesses for gaining competitive advantage. This chapter will also discuss about the key deliverables from the research study and the benefits to SMB (Small and Medium Businesses) and the recommendations for future study. Section 7.1 discusses the inferences from key findings of the earlier chapter. Section 7.2 discusses the model developed for measuring OI. Section 7.3 discusses the model that establishes the linkage between OI and OP. Section 7.4 discusses other capabilities found with the organizations studied. Section 7.5 discusses the applications of this research study. Section 7.6 discusses the recommendations in the current study. Section 7.7 discusses the recommendations for the future. Section 7.8 concludes the chapter.
7.1 Inferences from Findings

The entire research is largely based on the perspectives on their business results, performance and organizational capabilities of business owners and senior business executives of small and medium business managed by joint families of rural and urban sectors of India. These businesses perceive Organizational Intelligence with certain specific aspects which are churned out to be the factors driving Organizational Intelligence in this population of study. These businesses define Organizational Performance from the Financial Performances of the businesses. They also consider Financial Performances as Financial Returns largely as we find, these businesses looking at Financial Returns depending on 26 variables governed by Organizational Intelligence. There are two important outcomes of this research study. One is a scale for measuring OI and the other is the linkage between OI (Organizational Intelligence) and OP (Organizational Performance).

Part I

7.2 Components of OI Scale

We constructed an instrument that measures OI through ten different indices. They are, Organizational Value Orientation Index, Maturity Index, Organizational Competitiveness Index, Organizational Wisdom Index, Information and Knowledge Deployment Index, Infrastructural Standards Index, Systems Effectiveness Index, Process Efficiency Index, Proficiency of Planning Index and Proficiency of Execution Index. Each of these indices is measured with some capabilities.

Organizational Value Orientation Index: This index is a construction of variables, Ability to have awareness on stakeholder needs, Ability to encourage innovation, Capacity to utilize performance management systems effectively, having improvement on cycle time of operating systems, having high business process efficiency, and having highly efficient quality management systems.
**Maturity Index:** This index is governed by the maturity of the business leaders indicated with the variables such as age and experience.

**Organizational Competitiveness Index:** This Index is triggered by variables such as, Capacity to operate on customer-oriented competition analysis reports and Capacity to utilize customer and market valuation analysis.

**Organizational Wisdom Index:** This Index measures the wisdom present in the organizations for decision making and benefiting stakeholders effectively. This is measured through variables, Ability to encourage organizational learning, Ability to apply the learning and Capacity to share profit among all employees.

**Information and Knowledge Deployment Index:** This Index reveals the strength of the organization to deploy Knowledge and Information Intelligently. It is measured with variables, Business continuity capacity, Ability to know the trade-off between organizational goal and stakeholder Benefits and having a stable information technology network for information sharing.

**Infrastructural Standards Index:** This Index measures the infrastructural standards. It is measured through the variables that measure the Ability to provide schemes on employee welfare and the Capacity to use information effectively, as these are possible with good infrastructural standards.

**Systems Effectiveness Index:** This Index indicate strong and effective work systems in the organization and is measured through variables such as, Ability to incorporate societal sensitiveness in the system, Ability to focus on high level of stakeholder satisfaction, and Capacity to have effective workflow systems.

**Process Efficiency Index:** This Index measures the efficiency of the Processes through the Ability to incorporate technology and innovation in planning, Ability to deploy new technology for business process planning and Ability to have periodic up-gradation of quality management processes.
**Proficiency of Planning Index:** this Index indicates the proficiency in strategic planning and measured through the Ability of the organization to incorporate information in strategic planning.

**Proficiency of Execution Index:** This Index indicates the strength of the organization in executing the plans effectively. It is measured through the variable - Ability of tracking the progress of action plans.

The variables of Organizational Value Orientation Index indicate certain basic values of business owners such as Learning the needs, innovation, process efficiency, performance management, quality, operational efficiency. These aspects largely point towards the capabilities of the organization and are expected to be the inherent aspects of organizational values based on business realities unlike the values such as emotional intelligence of leaders etc. This is because the entire research work is based on business realities that bite business owners rather than the softer aspects business management. Thus strategically focusing on these aspects would enhance the value system that would lead to better business realities such as financial performances.

Maturity Index is measured with the aspects such as age and total experience of the respondents. Perceptions on business understanding depend on the experiences in life and these perceptions affect the presence or dispelling of other variables in the research study. The entire study depends on perceptions of business owners and presence of maturity indicate the presence of other indices are from the perspectives of young business owners of small and medium family managed business in India. Maturity determines the perspectives about the intelligence of organizations. The entire research results should be looked at with the background of the young business owners who responded to the questionnaire.

The Third Index Organizational Competitiveness indicates the interest of the organization to organize analysis on market, customers and competitions to
enhance profitability. This Index reveals the interest of Business owners to improve competitiveness of the organization that would indicate the presence of Intelligence in Organizations.

The next Index Organizational Wisdom indicates the wisdom of leaders to encourage learning amongst employees, apply the learning suitably and obtain profits to share amongst the employees and other stakeholders. Leadership wisdom plays a considerable role in determining Organizational Intelligence.

The variables of Information and Knowledge Deployment index indicate the effective usage of information to ensure the business continuity risks at the times crisis, and identify the trade off between the objectives of the organization and the benefits of stakeholders and to strike a balance between them. This requires a constant up gradation of information and knowledge systems to study the trends of variability between goals and benefit sharing amongst the stakeholders. Having stable information and knowledge network can enhance this ability of leaders. Effective deployment of information and knowledge is achieved by the using information and knowledge wisely by the leaders. This fact comes out to be another key index driving the intelligence or organizations.

There are two key aspects considered in Infrastructural Standards Index. They are information infrastructure and infrastructure related to employee welfare, such as ergonomic conditions. According to the respondents, stable and high quality infrastructural standards can influence organizational Intelligence.

The index of Systems Effectiveness indicates having standardized systems of work flow, sensitivity to societal changes in the system, and stakeholder satisfaction will enable the organization to be well equipped to manage changes from the environments effectively. The effectiveness indicates the desire of the business to stay stable and systematic in their approach towards businesses. This is perceived to be another key factor for determining organizational Intelligence. Stability is achieved by effective systems.
The eighth index Process Efficiency reveals that periodic upgradation on innovation technology and quality will drive organizational intelligence. Having efficient processes to upgrade quality systems, increase innovative approaches and processes and incorporating state of the art technologies in business processes are believed to be the surest ways of improving the intelligence factor in the organization. There are indices indicating proficiency in planning and execution. These indices also designate Intelligence of organizations.

Thus measuring these variables will reveal 10 different components of Organizational Intelligence of the population considered. The entire scale development is based on business realities that impact business and the financial component of organizational performance.

Part II

7.3 Linkage Between OI and OP

The other important finding from this research is: ‘OP is affected by four important Indices that construct OI’. They are, Organizational Value Orientation Index, Information and Knowledge Deployment Index, Infrastructural Standards Index and Systems Effectiveness Index.

Variables such as Organizational value Orientation, Information and Knowledge Deployment, Infrastructural Standards and systems effectiveness trigger OP.

\[\text{OP (Organizational Performance)} = \text{Financial Performance Component1} = f \{\text{Financial Returns}\}\]

\[\text{OI1 (Organizational Intelligence component 1)} = f \{\text{Organizational Value Orientation Index}\}\]

\[\text{OI2 (Organizational Intelligence component 2)} = f \{\text{Information and Knowledge Deployment Index}\}\]

\[\text{OI3 (organizational Intelligence component 3)} = f \{\text{Infrastructural Standards Index}\}\]

\[\text{OI4 (Organizational Intelligence component 4)} = f \{\text{Systems Effectiveness Index}\}\]
The relationships is given by the Model,

\[ Financial\ Performance\ (Organizational\ Performance) = 0.644 + 0.444 \times \text{Organizational Value Orientation Index} - 0.171 \times \text{Information and Knowledge Deployment Index} + 0.259 \times \text{Infrastructural Standards Index} + 0.188 \times \text{Systems Effectiveness Index} + \xi \]  
where, ‘\(\xi\)’ – Error Term & ‘\(\alpha\)’ – Constant term 

---Equation 7.1

This Equation indicates that Financial Performance is positively affected by the orientation of the organization towards values. These values are based on business realities and different capabilities such as, Ability to have awareness on stakeholder needs, Ability to encourage innovation, Capacity to utilize performance management systems effectively, having improvement on cycle time of operating systems, having high business process efficiency, and having highly efficient quality management systems. Focusing on the development of capabilities to track and meet stakeholders’ needs, encouraging innovation, designing and using performance management systems, improving cycle time of operations, will increase the financial performance and thereby organizational performance of small and medium enterprises. Having high quality work systems and efficient processes are two important areas to orient the organization towards better business value which increases financial performance.

Standardizing infrastructure includes the abilities such as, Ability to provide schemes on employee welfare and the Capacity to use information effectively, enables the organization to get the best from employees as well as information for the betterment of financial returns and therefore organizational performance. Similarly systems effectiveness indicates abilities such as, Ability to incorporate societal sensitiveness in the system, Ability to focus on high level of stakeholder satisfaction, and Capacity to have effective workflow systems affect financial performance positively. Having sensitivity towards the societal changes, business environmental changes, ion towards adapting oneself with and sensing the impact of product and services on the society around the organization will
orient organizations towards adapting to the changes and contribute better to the society and in turn gaining competitive advantage. Having effective workflow systems and managing them effectively also contributes to financial performance of the organization as indicated by the equation above.

However, the information and knowledge deployment index would affect financial performances negatively. This indicates that the business owners do not believe that having stable information technology networks, interest in planning for business continuity at crisis and calculating the trade off between stakeholder needs and organizational goals would enhance financial performance. This might be because of the large investments that go into information infrastructure investment which is seen as an expense and most of the organizations do not get enough financial returns by investing in information technology networks and ERP (Enterprise Resource Planning) systems. Crisis planning and business Continuity plans are not made in most of the small and medium businesses as these organizations do not see business continuity crisis as a serious issue. They change business operations whenever required to obtain optimal financial returns except investing in insurance policies when dealing with business such as logistic services. This is revealed from a discussion with the respondents on the results of this research. (The results are capabilities and performances and the quotient of intelligence of their organizations).

The trade off between Organizational Goals and Stakeholder needs is not perceived to be substantial as in most of the small and medium businesses managed by family members. This index Information and Knowledge Management Index might turn out to be positive with large corporations where these aspects play key roles in deciding financial returns and stock market conditions unlike small and medium businesses considered for this research work. Thus this theory proposed here is verifiable against data collected from very large profit making public sector enterprises. In the same way, this index could be negative for entrepreneurial organizations where these variables constructing this factor are not very important, and thus small and medium business owners and entrepreneurs can focus on the capabilities that positively
affect the firm performance. Having high information and knowledge deployment index might drastically affect financial performance.

The same result would differ if non-financial performances are taken into account for this research work for these organizations.

7.4 Interpretations from Other Capabilities

A Score-Card can be developed from the behavior of dummy variables captured in this research study (Table 7.1).

<table>
<thead>
<tr>
<th>Item</th>
<th>Capability</th>
<th>Presence of capability in Organizations (Approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strategic planning efficiency</td>
<td>60%</td>
</tr>
<tr>
<td>2</td>
<td>Ability to build and manage knowledge assets</td>
<td>60%</td>
</tr>
<tr>
<td>3</td>
<td>Capacity to manage customer expectations</td>
<td>50%</td>
</tr>
<tr>
<td>4</td>
<td>Ability to have decentralized decision making systems</td>
<td>80%</td>
</tr>
<tr>
<td>5</td>
<td>Having effective career planning systems</td>
<td>80%</td>
</tr>
<tr>
<td>6</td>
<td>Having strategic cost management in business processes</td>
<td>80%</td>
</tr>
<tr>
<td>7</td>
<td>Having variability reduction in business processes</td>
<td>80%</td>
</tr>
<tr>
<td>8</td>
<td>Having high process performance</td>
<td>85%</td>
</tr>
<tr>
<td>9</td>
<td>Having standardized quality metrics for production / delivery processes</td>
<td>60%</td>
</tr>
<tr>
<td>10</td>
<td>Presence of quality metrics along the value chain</td>
<td>70%</td>
</tr>
<tr>
<td>11</td>
<td>Continuous monitoring of quality</td>
<td>70%</td>
</tr>
<tr>
<td>12</td>
<td>Business valuation Practices</td>
<td>80%</td>
</tr>
</tbody>
</table>
These fundamentally are diverse capabilities of the organizations. Interestingly, these small and medium business organizations have interest in studying process performance, strategic planning, and empowering employees for decentralized decision-making. They have the ability to build and manage knowledge assets. More than 70% of the organizations display these capabilities. Their wakefulness of these aptitudes indicates a scope to develop them in the Small and Medium Business sector.

7.5 Predictions of OIQ (Organizational Intelligence Quotient) Instrumentation Model

This research study enabled us to understand important capabilities of small and medium Enterprises in Indian rural and urban sectors which are interested in identifying their intelligence and improving their capabilities to attain competitive advantage. The indices such as organizational wisdom and organizational value orientation point out the desire in these organizations to grow and apply their learning for more optimal performance. Indices such as organizational competitiveness designate clearly that these organizations are interested in endowing themselves to address competition effectively.

These organizations look at themselves to develop better self-awareness and consciously improve upon their systems effectiveness and process efficiency. Using infrastructure to deploy tacit and explicit knowledge effectively is distinguished by these organizations as a key factor for increasing their Organizational Intelligence Quotient.

Organizational Performance Equation given by 7.1. This equation establishes the relationship between some of the components of organizational intelligence with that of financial performance. Financial performance is an accepted form of measuring Organizational Performance and hence, this linkage helps us focus on improvising key indices to improve organizational performance.
Thus Organizational Intelligence Quotient can be calculated as a function of the indices given above. This quotient improvement will directly enable organizations to become aware of their strengths and weaknesses.

Thus OIQ (Organizational Intelligence Quotient) can be defined as,

\[
OIQ = f\{\text{Organizational Value Orientation Index, Maturity Index, Organizational Competitiveness Index, Organizational Wisdom Index, Information and Knowledge Deployment Index, Infrastructural Standards Index, Systems Effectiveness Index, process Efficiency Index, Proficiency in Planning Index, Proficiency in execution index}\}

--- Equation 7.2

Considering the population of small and medium businesses in India, it is evident that many of the businesses have those 26 capabilities together constructing 10 different indices on which OIQ is depending on; however these capabilities are present at different percentages.

Considering the samples taken for this study, it is possible to rank the factors based on the number of variables that get grouped into each of these variables that represent different capabilities.

Equation 7.2 can be re-written as a linear equation as below.

\[
OIQ = a_1 \times \text{Organizational Value Orientation Index} + a_2 \times \text{Maturity Index} + a_3 \times \text{Organizational Competitiveness Index} + a_4 \times \text{Organizational Wisdom Index} + a_5 \times \text{Information and Knowledge Deployment Index} + a_6 \times \text{Infrastructural Standards Index} + a_7 \times \text{Systems Effectiveness Index} + a_8 \times \text{Process Efficiency Index} + a_9 \times \text{Proficiency in Planning Index} + a_{10} \times \text{Proficiency in execution index}

-----Equation 7.3

Where, \(a_1, a_2, a_3, \ldots, a_{10}\) represent the weightages of these factors.

\(a_1\) represents six variables that construct the factor Organizational Value Orientation Index from the total of 26 variables.
Thus $a_1$ is calculated as, $a_1 = (6/26) \times 100 = 23.07\%$;

Similarly other coefficients $a_2, a_3, \ldots, a_{10}$ are calculated as,

- $a_2 = (2/26) \times 100 = 7.69\%$;
- $a_3 = (2/26) \times 100 = 7.69\%$;
- $a_4 = (3/26) \times 100 = 11.53\%$;
- $a_5 = (3/26) \times 100 = 11.53\%$;
- $a_6 = (2/26) \times 100 = 7.69\%$;
- $a_7 = (3/26) \times 100 = 11.53\%$;
- $a_8 = (3/26) \times 100 = 11.53\%$;
- $a_9 = (1/26) \times 100 = 3.84\%$;
- $a_{10} = (1/26) \times 100 = 3.84\%$;

Substituting these coefficients in Equation 7.3, we get,

$$OIQ = 23.07 \times \text{Organizational Value Orientation Index} + 7.69 \times \text{Maturity Index} + 7.69 \times \text{Organizational Competitiveness Index} + 11.53 \times \text{Organizational Wisdom Index} + 11.53 \times \text{Information and Knowledge Deployment Index} + 7.69 \times \text{Infrastructural Standards Index} + 11.53 \times \text{Systems Effectiveness Index} + 11.53 \times \text{Process Efficiency Index} + 3.84 \times \text{Proficiency in Planning Index} + 3.84 \times \text{Proficiency in Execution Index}$$

Equation 7.4 represents the mathematical definition of OIQ. This instrument measures the Intelligence quotient of organizations that fall in the category of small and medium businesses.

Comparing Equations 7.4 and 7.1, it is to be noted that an Organization might score high in quotient of organizational intelligence (OIQ) due to the scoring from information and knowledge deployment index. This large score of Information and Knowledge deployment index negatively affects Financial Performance as per Equation 7.1 for small and medium businesses. Thus focusing and investing on all other indices more will enhance OIQ scores as well performance for small and medium enterprises.

These results were communicated to the respondents and the experts and leaders fro large corporations who took part in focus group discussion at various stages of research work. This outcome was agreeable to the way they see the financial and organizational performances in their organization. However the theory proposed should be validated with new set of samples from small and medium enterprises.
businesses. New set of samples such as large corporations and entrepreneurs of own small businesses can be studied and compared to confirm the predictions discussed here.

7.6 Interpretations and Applications of OIQIM (Organizational Intelligence Quotient Instrumentation Model)

It is evident from the above equations that some of the indices are more important than others considering the population of study and perceptions on variables. Thus prioritizing and altering the weightages will enable one to apply the scale developed with better precision. There are indices with equal weightages. According to the nature of the organization the priority can be allotted.

For an Instance, Amongst indices, maturity index and organizational competitiveness index (7.69% of alpha coefficient), the priority may be given to organizational competitiveness index. For some organizations, Intelligence of organizations is more triggered by competitiveness than the maturity of the leaders, where in for some other organizations such as it is the reverse. Compared to Infrastructure Standards Index, Maturity of the business leaders is valued higher in family managed businesses. Thus the ranking amongst these three indices can be, 9.0 for Organizational Competitiveness Index, 8.0 for Maturity Index and 6.07 for Infrastructural Standards Index.

In the same way, Indices having alpha coefficient 11.53% can be prioritized. Amongst Organizational Wisdom, Information and Knowledge Management, System Effectiveness and Process Efficiency Indices, The priorities can be set highest for Organizational wisdom Index followed by Information and Knowledge Management Index. Process Efficiency Index can get lower Priority compared to System Effectiveness Index in family managed businesses. Organizational wisdom and tacit knowledge deployment from older stake
holders of businesses take higher priority compared to systems effectiveness and process efficiency in these organizations.

Therefore the weightages can be re-distributed as, 14.0 for Organizational Wisdom Index, 12.0 for Information and Knowledge Deployment Index, 11.0 for System Effectiveness Index and 9.12 for Process Efficiency Index. Similarly amongst other two Indices Proficiency of execution can get higher ranking than Proficiency of Planning as we found, most of the successful small and medium businesses from the samples believe in proficiency in execution being more important in planning. Thus 5.0 can be the weightage for Proficiency in execution index and 2.68 to proficiency in planning index.

Thus the Equation 7.4 changes to be,
\[ OIQ = 23.07 \times \text{Organizational Value Orientation Index} + 8.0 \times \text{Maturity Index} + 9.0 \times \text{Organizational Competitiveness Index} + 14.0 \times \text{Organizational Wisdom Index} + 12.0 \times \text{Information and Knowledge Deployment Index} + 6.07 \times \text{Infrastructural Standards Index} + 11.0 \times \text{Systems Effectiveness Index} + 9.12 \times \text{Process Efficiency Index} + 2.68 \times \text{Proficiency in Planning Index} + 5.0 \times \text{Proficiency in Execution Index} \]

This kind of subjective distribution of weightages will depend on the type of business organization for which OIQ is measured. This distribution will be different for different types business depending on the size and nature. Also the choice of the variables that is predominant in an organization can enable the distribution of the weightages amongst the indices.

A dynamic business strategy involves planning on internal competency and utilization of wisdom of the organizations in the long run to perform better. Improvising factors such as organizational value orientation, raising infrastructural standards, maintaining stable systems lead to more finished performances as indicated in this research. Higher the OIQ, greater the competitive advantage of the firm as the indices constructing OIQ are the capabilities required by the organization to be competitive. Business owners and
entrepreneurs can identify these capabilities and devise strategies focused on fine tuning the respective factors.

7.7 Comparison of OIQ Instrumentation Model with the Models from Literature

Most models given in literature revolve around measuring OI with one or two variables such as, Environmental Scanning Model based on the ability of the organization to scan the business environment, Creative and Innovative Model of OI based on the ability to innovate and create new products and processes, Intellectual Capital Model of OI based on the total Intellectual Capital of the organization, and Information Managing Model of OI based on the ability to manage information effectively.

Smart Organizations Model is based on the Ability of the Organization to achieve goals through 9 different skills such as, Value Creation Culture, Creating Alternatives, Continual Learning, Embracing Uncertainty, Outside-In Strategic Perspective, Systems Thinking, Disciplined Decision Making, Alignment and Empowerment and Open Information Flow which are completely based on the softer cognitive and cultural aspects of the organization.

Action based model of OI measures OI as an ability to mobilize its brain power to achieve goals. Strategic vision, appetite for change, alignment and congruence, performance pressure, knowledge deployment, heart, and shared fate are the variables that represent OI This scale measures heart felt approaches, fate sharing qualities on emotional perceptions. Decision based Model of OI calculates OI through the Decisions taken in Organization, Learnings in Organization, Risk Taking in Organization and The Giving and Taking of Advice amongst employees in organization alone. Information Utilization model of OI measures OI as an ability of an organization to use information effectively.
Neural Network Cognitive Learning Model of OI intuitively explains OI as an innate cognitive ability to learn from the experiences. Combined Human and System Model of OI says, integrating human intelligence with interdependent system intelligences can improve performance of organizations. It speaks of the collective human and system intelligences alone at a cognitive level. Learning abilities Model is completely based on cognitive learning abilities and Organizational Design and Structure.

Organizational Capabilities based models such as Tata Business Excellence Model and Malcolm Baldrige Model are practically used by large organizations for business performance achievements. William Halal’s Model of OI measures OI as a cognitive ability to create and use knowledge for strategic adaptation to the environment. In this Model OI is measured through five aspects; Organizational Information Technology Systems, Stakeholder Relations, Knowledge Management, Strategic Processes and Leadership. Innovation Capabilities model of OI defines OI as innovation performance.

Karl Albrecht Model of OI defines OI as the capacity of an enterprise to mobilize all of its brainpower, and to focus that brainpower on accomplishing its mission. It is measured with softer aspects such as Strategic Vision, Shared Fate, Appetite for Change, Heart (or spirit), Alignment & Congruence (the structure, systems, and rules), Knowledge Deployment, and Performance Pressure.

Cross Cultural Model of OI is oriented towards organizational structure, knowledge and communication largely. OL-IOI Linkage Model (Ivana Simic, 2005)355 depicts Organizational Learning (OL) as a component of Organizational Intelligence (OI). Human Organization Memory Model of OI defines OI is an organization's capability to process, interpret, encode, manipulate, and access information in a purposeful, goal-directed manner, so it can increase its adaptive

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potential in the environment in which it operates; fundamentally based on information management abilities for decision making.

Complexity Model defines OI as the knowledge-based capacity inherent in the organization. This capacity forms the basis of success in the rapidly changing or highly competitive environment of the knowledge organization.

Most of all these models focus on only one or a fewer aspects of organizational capabilities to measure or define OI. Wherein, OIQ Model is a comprehensive model containing 26 different variables grouped under 8 factors and 2 unique variables for measuring OI in the form of quotient. This attempt is not seen the literature so far. Most of the models in the literature are not verified but intuitively proposed concepts. Our Model measures the intelligence quotient of Organizations based on business realities.

Models such as Tata Business Excellence Model and Malcolm Baldrige Model cover very large number of capabilities thereby having applications to very large enterprises such as Tata groups. This OIQ model is designed from the data collected from Small and Medium Enterprises largely making the model applicable to Small and Medium Enterprises in addition to larger corporations.

The variables used for the measurement of OIQ here are completely based on business reality with rationale on the information provided. These information can be obtained from many an organizations except for entrepreneurial set ups getting yet to develop their business processes and systems. Thus this OIQ scale designed here is comprehensive and has wider spread of applications and is a verifiable model as compared to other intuitive conceptual propositions made.
7.8 Issues and Probable Solutions of the Instrument Developed

This research involved a two pronged objective; one to develop a scale for measuring OIQ and the other to explore a linkage between OI and OP, so that the benefit of measuring OIQ can be established. The issues and the demerits of this work can be seen from two different angles. One is based on practicality and the other, perspectives.

7.8.1 Practicality Related

(i) **Data Collection related:** The key question is in sample selection and data collection. The study on OI and OP demands the respondents of the questionnaire to be business owners or chiefs of the organizations. Getting them to contemplate and answer questions on capability and organizational awareness related questions is time consuming and tedious. These questions demanded an audit on their awareness on business and organizations which have to be answered with thorough contemplation.

(ii) **Questionnaire related:** If we look at Appendix 1 and 2, it is apparent that many capabilities that can be captured for calculating OIQ are not considered due to the length of the questionnaire and the demand of the statistical methods of analysis for a larger number of data. There are many additional facets that could have been considered for this specific research. But since they might alter the findings and thus the interpretations in this study, they have not been measured.

(iii) **Validity of the Model related:** the model developed is not validated as collecting fresh data of sample size 100 or more to establish the consistency of results would span a time of two years or so. As the entire study is based on perspectives, the results might differ and we might have to repeat it a few times in order to realize reliability and accuracy. Thus this study would consume
another five years for repeating the research procedures for different set of samples. Accuracy of the model is not established, which itself is an interesting task for further study, keeping the variables unchanged.

(iv) **Trend related:** We have done a cross sectional study of the samples where data is collected at any given point of time. However intelligence related capabilities tend to change with time, technological breakthroughs, market dynamics, change of policies of trade and economical conditions. It would be preferable to measure OIQ (Organizational Intelligence Quotient) over a period of time and studying the trend of OIQ with time will enable us understand an organization better. This will enable a strategist to estimate the business outcomes and organizational performance in prospect and include it in strategic planning. The internal capabilities and competencies of the organization can be improved from the trend study.

### 7.8.2 Perspectives Related

(i) **Business Reality based:** Entire research was done with the perspective of finding OIQ based on business realities, created from organizational capabilities such as systems, processes, leadership, competition management, infrastructural and information utilization. These actualities have real data to be pondered on and they also answer the questionnaire. Though we can fully rely on this data, there are softer aspects such as culture, leadership styles, family issues and relationship dynamics between partners and stakeholders affecting the actual performances of business and organizations that are not considered in this research study.

(ii) **Non financial performance aspect of organizational Performance:** There are financial performances and non-financial performances that amount to organizational performance. We have considered only the perspectives of the respondents on their business performances, which is from business reality. The non-financial performance aspects can also be considered while studying the
relationship between factors driving OI and OP enabling better population benefit from this study.

(iii) **Precision:** The same model can be simulated using the questionnaire (Appendix 2) which has more than 150 questions (variables) which increases the sample size requirement by 5 times. If this limitation of data collection from 750 samples and other statistical limitations are overcome, the precision of the model can be improved. This research would consume another 5 years, however will be beneficial to small and medium businesses.

(iv) **Sample:** The same model can be simulated for different set of samples that are multinationals and corporate offices. There are many higher ranked organizations having business excellence models for self-introspection and development of capabilities. However their OIQ is not being calculated for any kinds of assessment. Long lived multinational organizations must measure OIQ for self assessment and improvement. Assessment of OIQ will help the business arena to identify high performing organizations not just by revenues alone but also by other parameters that can forecast and determine future trends of organizational sustainability against competition and future shocks.

### 7.9 Conclusions Derived from this Research Study

There are two distinct conclusions from this research work. One is, it confirms that Organizations are like human systems and they have intelligence. This intelligence can be measured in terms of Organizational Intelligence Quotient. The next is, Organizational Performance is affected by some of the capabilities that construct Organizational Intelligence. Thus Organizational Intelligence Quotient can be adjusted by improving the capabilities of the organization to increase performance. The results are applicable to the population of small and medium Business enterprises.
7.10 Specific Contributions to the Field of Management Research

There are few specific contributions to management research arena and business executives. This exploratory research work is based on the business reality as the questionnaire collects data based on business realities. There are also various angles with which Organizational Intelligence can be looked at and measured. There are future research opportunities for management research academia in section 7.9

Though there is a lot of research done on Organizational Intelligence, there is no relationship identified between Organizational Intelligence and Organizational Performance. This research proves that financial performance of the organizations can be improved by working on certain organizational Intelligence Indices. This fact can be used by organizations for improvising their capabilities. Such kinds of capabilities are being identified, measured and controlled by organizations such as Tata Groups in India. Research was done after piloting questionnaire and studying the opinions of some of the executives of such large corporations that this kind of work would help small and medium enterprises largely to identify their capabilities to attain advantage competitively.

The exhaustive literature survey is a collection of Organizational Learning, Organizational Intelligence and it differentiates both. There are plenty of variables found in various conceptual models are common and used in different contexts. They are identified and compared. The OL, OI literature collection is a concrete support to researchers in this area.

This research re-establishes that organizations are humanistic systems. They are proactive and reactive like that of human beings. That is, the fact that Organizational Learning triggers Organizational Intelligence is established from
the literature study directly by studying the exhaustive number of variables used by researchers to measure OL and OI.

7.11 Scope for Future Work

This research depended largely on the study of different capabilities of organizations that evolve from business realities exclusively. The direction of this study based on business realities is based on the publications of Professor William Halal of Harvard Business School on Organizational Intelligence. However the parameters for measuring the intelligence are picked up from the literature on Organizational Intelligence completely. The limited literature survey done for this research work with the help of just 250 references did not indicate the presence of a scale to measure OIQ. And thus the objective of this work is set to devise a scale to measure OIQ from the common perspective based on business realities to begin with.

The theory presented here can be verified with new set of samples from the same population over a period of time such as 5 years. The same study can be done for large enterprises and group of companies and entrepreneurial organizations and the results can be compared. The key benefit of this comparative study is to assess and enhance intelligence and performance which is the dire need of future organizations to compete.

OIQ can be studied with softer aspects of the organizations such as culture, leadership, interpersonal dynamics amongst stakeholders, client relationships and their relationships with business performance. OIQ can be studied as a function of Human Intelligence, Systems Intelligence and Process Intelligence Perspectives. This scope of research work would contribute to the softer and component of OIQ. A vector combination of the softer and harder aspects would complete the definition of OIQ.

OIQ can also be studied with the perspective of looking at organizations with human intelligence (HIQ - Human Intelligence Quotient), System Intelligence
System Intelligence Quotient (SIQ) and Process Intelligence (PIQ), as we see these aspects of capabilities are being studied separately to improvise these aspects in the organization. Study and the assessment of these aspects might contribute to the financial as well non-financial performances of the organization. This aspect can be explored and compared with the theory of OI-OP Linkage proposed in this thesis.

OIQ can be studied with Intellectual Intelligence Quotient of organizations (IQ), Emotional Intelligence Quotient of organizations (EQ), and Spiritual Intelligence Quotient of organizations (SQ); where Intellectual Quotient would depend on Business Realities. Emotional Quotient can be calculated from the people - or stakeholder-centric abilities of the organizations. Spiritual Quotient could emanate from the social sensitivity and social responsibility of organizations. This would be a complete humanistic approach towards organically growing organizations. The resolved components of intellectual, emotional and spiritual aspects of OIQ can explain about organizations their dynamics and behavior with greater depth and more dimensions. This research calculates OIQ looking at the Intellectual Component from the data based on the business realities exclusively. The three dimensional study of this intellectual component along with emotional and spiritual components would open new avenues to look at organizations and build them stronger and beneficial to society.

7.12 Conclusion

In this chapter we have discussed the interpretations of results, model applications, specific contributions to researchers and business owners and executives are put forth. Recommendations for the future research work are listed. Conclusions from the research work are drawn. Potential issues and the possible solutions are mentioned.

From this work we found that Improvising OIQ yields value based growth of the organization, social responsiveness, competitive advantage and high
performance benefiting growing organizations with small and medium businesses. This work is applicable in measuring intelligence of business units of larger enterprises as well individually within very large enterprises to improvise capabilities to sustain their strategic competitive advantages.

This Research is an attempt to pave a way for exploring further on Organizational Intelligence with various new perspectives. These perspectives and research on such aspects of organizations would help business entities understand their organizations better and formulate strategies to improvise Organizational Intelligence Quotient and in turn financial business results. Raising such long lasting organizations would be one of the greatest contributions to society and country.

With this chapter, this thesis is concluded.
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