INFLUENCE OF FORECASTING, PLANNING AND CONTROLLING ON THE PERFORMANCE OF SMALL AND MEDIUM ENTERPRISES

A thesis

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Certificate

*This is to certify that the thesis entitled "**Influence of Forecasting, Planning and Controlling on the performance of Small and Medium Enterprises**" which is being submitted by **Biju Augustine P** in partial fulfillment of the requirements for the award of the degree of Doctor of Philosophy, to the Cochin University of Science and Technology is a record of the bona-fide research work carried out by him under our supervision and guidance, in School of Engineering, Cochin University of Science and Technology, Cochin – 682 022 and no part of the work reported in this thesis has been presented for the award of any degree from any other institution.*

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Declaration

*I hereby declare that, the work presented in this thesis entitled "**Influence of Forecasting, Planning and Controlling on the performance of Small and Medium Enterprises**" is based on the original research work carried out by me, under the guidance and supervision of Dr. M. Bhasi (Guide), Professor, School of Management Studies and Dr. G. Madhu (Co-Guide), Professor, Division of Safety Engineering, Cochin University of Science and Technology, Cochin – 682 022 and no part of the work reported in this thesis has been presented for the award of any degree from any other institution.*

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Curriculum Vitae

Biju Augustine P was born in Ernakulam district of Kerala, India in 1968. He obtained B.Tech degree in Mechanical Engineering from Calicut University in the year 1990. He completed M Tech degree in Production Engineering from the School of Engineering, Cochin University of Science and Technology, Cochin in the year 1997. He is having Chemical Process Industry Experience in the areas of Mechanical Maintenance, Design and Operations Management for 8 Years in Hindustan Insecticides Limited, Udyogamandal, Kerala. He got selected through PSC for appointment as Lecturer in Mechanical Engineering in 1999. He has been teaching in Government Engineering Colleges in Kerala since then. Presently he is working as Associate Professor in the Mechanical Engineering Department at Rajiv Gandhi Institute of Technology, Kottayam, Kerala. He teaches in the B. Tech Mechanical Engineering and M. Tech Industrial Engineering and Management courses run in the Department. He has published research papers in four international journals and presented more than fifteen conference papers in the national and international levels. His areas of interest include Production Planning and Control, Marketing Management and Theory of Machines.

ABSTRACT

Production Planning and Control (PPC) systems have grown and changed because of the developments in planning tools and models as well as the use of computers and information systems in this area. Though so much is available in research journals, practice of PPC is lagging behind and does not use much from published research. The practices of PPC in SMEs lag behind because of many reasons, which need to be explored.

This research work deals with the effect of identified variables such as forecasting, planning and control methods adopted, demographics of the key person, standardization practices followed, effect of training, learning and IT usage on firm performance. A model and framework has been developed based on literature. Empirical testing of the model has been done after collecting data using a questionnaire schedule administered among the selected respondents from Small and Medium Enterprises (SMEs) in India. Final data included 382 responses. Hypotheses linking SME performance with the use of forecasting, planning and controlling were formed and tested. Exploratory factor analysis was used for data reduction and for identifying the factor structure. High and low performing firms were classified using a Logistic Regression model. A confirmatory factor analysis was used to study the structural relationship between firm performance and dependent variables.

Perceived use of forecasting, planning, controlling and standardization influenced the SME performance and take a role in determining high and low performing firms. Forecasting was identified as the most important PPC element influencing firm performance. Higher level forecasting supported with formal planning instruments resulted in better firm performance. Enough importance was not given to planning and training for use of PPC. Positive and significant linkage between SME performance and education of key manager involved in PPC was observed. Standardization practices such as ISO 9000 influenced SME performance and research finding agreed with other researchers in this issue. Education, IT usage, learning and standardization influenced the use of forecasting and firm performance. It was identified that professional managers contributed to better performance than

conventional owners. Similar results were observed for the use of planning and controlling. Detailed case studies were conducted and case studies confirmed the major findings from the statistical tests.

Conceptual and measurement models are useful to the researchers for improving the existing models. Education, top management support, IT usage and learning orientation of user managers/supervisors were at lower levels in low performing firms. This study gives guidelines to upgrade their PPC.

Key Words: ***Forecasting, Planning, Controlling, Firm Performance, SMEs, Top management support.***

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List of Abbreviations

ABC	A type of inventory classification
ADB	Asian Development Bank
AMOS	Analysis of Moment Structures
AMT	Advanced Manufacturing Technology
ANOVA	Analysis of Variance
ASEAN	Association of South East Asian Nations
ATO	Assemble to Order
BOM	Bill of Materials
CBS	Constraint Based Scheduling
CEO	Chief Executive Officer
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CR	Construct Reliability
CRP	Critical Resource Planning
DTO	Design to Order
EC	European Commission
EDI	Electronic Data Interchange
EFA	Exploratory Factor Analysis
ERP	Enterprise Resource Planning
ETO	Engineer to order
et al.	and others
etc	Etcetera
FCS	Finite Capacity Scheduling
FIQ	Forecast Information Quality
FMS	Flexible Manufacturing System
GATT	General Agreement on Trade and Tariff
GDP	Gross Domestic Product
GFI	Goodness of Fit Index
GOF	Goodness of Fit
ILO	International Labour Organization
IS	Information System
ISO	International Standards Organization
IT	Information Technology
JIT	Just in time
K-M-O	Kaiser – Mayor – Olkin Criteria
K-S test	Kolmogorov – Smirnov test
LISREL	Linear Structural Relationship
LL	Log Likelihood
MAD	Mean Absolute Deviation
MAE	Mean Absolute Error
MAPE	Mean Absolute Percentage Error
ME	Mean Error
MPC	Manufacturing Planning and Control system
MPS	Master Production Schedule
MRP	Materials Requirement Planning
MRP II	Materials Requirement Planning II

MSA	Measure of Sample Adequacy
MSE	Mean Square Error
MTO	Make to order
MTS	Make to stock
NFI	Normed Fit Index
OEM	Original Equipment Manufacturer
OPT	Optimized Production Technology
PERT	Program Evaluation Review Techniques
PFS	Process Flow Scheduling
PLS	Partial Least Squares
PPC	Production Planning and Control
PR	Parsimony Ratio
R&D	Research and Development
RMSEA	Root Mean Square Error Approximation
RNI	Relative Non centrality Index
ROA	Return on Assets
ROI	Return on Investment
ROP	Re-Order Point
SEM	Structural Equation Modeling
SIDCO	Small Industries Development Corporation
SMEA	Small and Medium Enterprise Association
SMEs	Small and Medium Enterprises
SMI	Small and Medium Industry
SPSS	Software Package for Social Surveys
SSI	Small Scale Industries
SWOT	Strengths – Weakness – Opportunities - Threats
TAM	Technology Acceptance Model
TLI	Tucker Lewis Index
TOC	Theory of Constraints
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UK	United Kingdom
UNDP	United Nations Development Project
US	United States
USA	United States of America
USSBA	United States Small Business Association
VM	Versatile Manufacturing
WIP	Work In process
WLC	Work Load Control
WTO	World Trade Organization

Chapter 1

INTRODUCTION

Contents

1.1. Overview of Production Planning and Control

Production planning and control has been emerged as a tool to achieve production objectives such as delivering the required quantity of good quality products at the right place in the right time. The complexity of production is increased due to the increase in the specific environmental complexities. Anticipation of future and maintenance of optimal conditions are very critical to modern business firm. Selection of the best course of action needs special models, which led to the development of new planning methods. Matching the supply – demand gaps in the economic and efficient sense necessitate versatile methods of production. The capacity issues combined with the competition has resulted in newer production planning and control (PPC) systems.

Early decades of twentieth century witnessed emergence of the re-order point system based inventory planning and batch production to meet the production requirements based on rough estimates. Increased offerings due to competition and changes in the customer specific orders necessitated separation of production planning and control systems. The technological advances resulted in customer specific tooling and flexible production. Better technology back up helped to plan for the short term and for the smaller volumes.

In the last seventy five years, the Production Planning and Control (PPC) systems have managed to develop from very rudimentary systems to reasonable levels

of sophistication. With the development in planning tools and applications, the use of computers and information systems in this area, the present PPC systems are used to manage planning and control of complex production systems in an effective way. The changes in the manufacturing system design and the supply chains structures combined with the market forces raise newer challenges for the planning and control functions. The use of machines, technology and IT in the area of office automation and accounting have taken place in large firms to a great extent, but the same cannot be said about the use of PPC in small and medium enterprises (SMEs).

1.2.Use of PPC in Industries

Alford & Beatty (1951) defined PPC as a system that comprises of planning, routing, scheduling, dispatching and follow up functions in the production process in such a way that the movement of the materials, the performance of the machines and the operation of the labour are directed and controlled to ensure both the quality and the quantity adhering to the time and the place. Ray Wild (1980) defined production planning as the determination, acquisition and arrangement of all the facilities necessary for the production. Berry *et al* (1992) and Shrader *et al.* (1989) established that the mismatch between market requirements and process choice affects the firm performance.

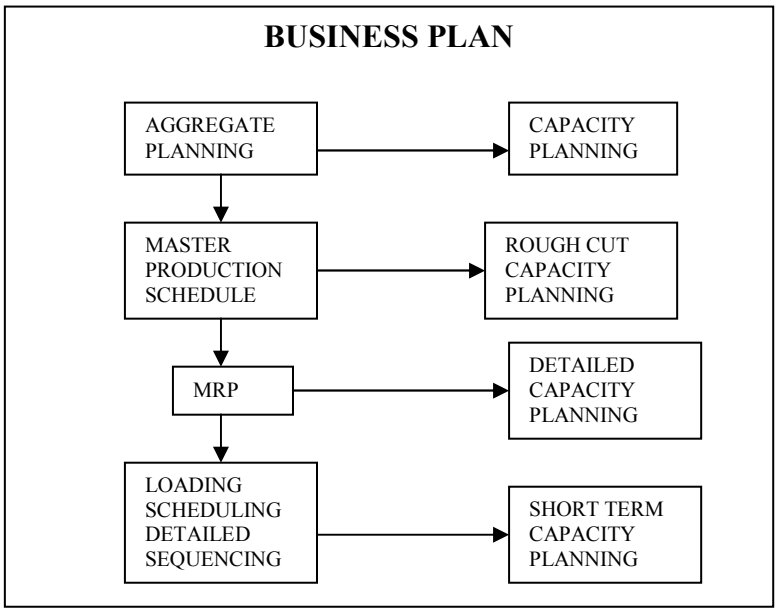


Figure 1.1 Production Planning and Scheduling System (Ref: Everett & Ebert 1989)

Chen *et al.* (2008) classified Manufacturing Planning and Control system (MPC) approaches into two: the system approach and the quantitative approach. The system approach includes the methods such as materials requirement planning, period batch control, manufacturing resource planning, enterprise resource planning, just in time production and optimized production technology. The quantitative approach includes re-order point systems, statistical inventory control and aggregate production planning. Research on the work sophistication practices shows that adequate PPC systems are established for high technology applications (Chen 2008). Systematic and developed practices are common with those firms that follow learning, innovation and advanced manufacturing technology.

Deployment of PPC is explained by the model shown in figure 1.1. Matching the rough cut capacity planning with master production schedule is very difficult. The current PPC application fields are classified according to the complexity of operations. Just in time (JIT) is suitable for repetitive or flow manufacturing environments, especially for the Flexible Manufacturing System (FMS) or Cellular manufacturing, where aggregate demand is stabilized. PERT/CPM is suitable for the production of large one-off item over an extended period of time. Constraint Based Scheduling (CBS) is used where bottlenecks are present (Everett & Ebert 1989).

1.3. Linking PPC Methods with Manufacturing Environment and Market

Manufacturing environment is classified from jobbing to continuous according to the demand, rate of production and complexity. High fashion garments and customer focused capital equipments necessitate labour intensive and flexible production facility. In flow production such as automotive manufacturing, large volumes of standard products are produced in small batches with almost stable demand condition (Dangayach & Deshmukh 2001). Small or medium volume of production is economically justified by batching the production process (Newman & Sridharan 1996). Highly customized capital intensive items are made by offering large scale inputs in a coordinated fashion. Such type of production is termed as complex production.

Master production schedules are prepared on the basis of manufacturing system criteria such as Assemble to Order (ATO), Make to Order (MTO) or Make to Stock

(MTS) with slight exception on Engineer to Order (ETO) (Berry *et al.* 1992; Porter *et al.* 1999). Jonsson *et al.* (2003) pointed out the difficulty of making a single fit between one single production planning system and one manufacturing environment. A good planning and control system within a short span is found invalid due to changes in market directions (Newman & Sridharan 1996; Persona *et al.* 2004).

Business firms are driven by the market forces and therefore they have to choose suitable forecasting, production planning and scheduling systems. Even when large, medium, small and micro firms deal with the same product they have different capacities and follow different production planning and scheduling systems. For a large firm with short to medium term planning of the nearly steady state of demand, Materials Requirement Planning (MRP) and finite scheduler are found useful. For the same firm project planning schedulers are suitable for product launch/ pre launch options (Persona *et al*. 2004). Firm specific cases of this sort are not much explored and empirical evidences are rare**.** Most of the research findings are related to large firms and their subsidiaries.

1.4. Features of PPC in the Small and Large Firm Contexts.

Large business firms are centrally organized and managed by a group of managers in a well-maintained and controlled fashion (Singh *et al*. 2007). Small and medium enterprises (SMEs) are owned by small owners or entrepreneurs, and are managed with limited resources. Planning systems for big businesses are established at the corporate level. They have appropriate systems for planning and controlling the individual business units. For SMEs, the planning systems often encompass the firm as a whole (Uddin & Saeed 2010). Planning systems in SMEs usually de-emphasize the need of written documentation and formal procedures (Lyles *et al.*1993). These firms try to maintain and leverage flexibility by keeping their systems and plans less structured and rigid. Unpredictable lead times and highly variable shop floor routings limit the usage of planning and control in make to order type SMEs (O'Regan & Ghobadian 2002).

Empirical studies of MRP and JIT have been largely available since 1990s (Agarwal 1985; Salaheldin *et al*. 1998 and Fullerton *et al*. 2001). The application of MRP increased productivity, lowered inventory level, shortened lead time and improved market forecasting (Agarwal 1985; Hitt 2002). But the application of MRP is limited to large firms as MRP required computer assistance, which remained a limitation to SMEs, where

intuitive methods are more common. Implementation of MRP necessitates error free forecasts for the preparation of master production schedule and management initiative to change the mindset of people. It is not easy for small firms to digest these concepts quickly (Fransoo *et al.* 1994). Large firms consider innovation and training as vital but these are of little use in small firms (Islam & Karim 2011). Very few case studies dealing with improvement of PPC in the small firm context is available.

1.5. Relevance of SMEs.

SMEs are not the miniature of large firms. They are very different type of organizations with their own peculiar problems. Small business firms are characterized by the high level of dependence on the owner/ manager, ease of starting up business, freedom to operate with owner's capital, simple organization structures, ease of innovation and adaptability to the changes in environment (Zhang 1995). SMEs invite attention in the modern business environment due to its contribution for making changes in the social and attitudinal engineering (Kalpande *et al*. 2010). SMEs contributed 66 per cent of the total employment and 55 per cent of the total revenues of the private sector in the European Union. In Malaysia, Small and Medium Industries accounted 92.6 per cent of the whole manufacturing firms and created 42.6 percent of employment (Islam & Karim 2011). United States Small Business Administration Reports (USSBA) says that over 50 per cent of employment and 45 per cent of wages paid are contributed by SMEs.

In the middle of 1990s, the business world witnessed major setbacks in the large firm sector and most commercial banks and donor agencies such as ADB, World Bank, UNDP etc have started initiatives for promoting the SMEs (Reddy 2008). Cagliano (2001) has identified the reason for less work published in the area linking manufacturing practice with SME performance. First reason is because operations management research assumed equal importance for manufacturing practices applied to both small and large firms. Secondly the SME literature emphasized more importance to technical and technological skills than planning and controlling. Islam & Karim (2011) observed that the Malaysian SMEs performed in a better way than large firms due to the characteristics such as better customer relations, Government support, less formalities

and good human relations. It is also reported that Malaysian SMEs are linked in a better manner to the socio economic fabric of the region than large firms.

Demographics such as key person's age, education, experience, skills and formal education influence SME performance (Bhutta *et al*. 2008). Learning is the core function to promote small business growth, but formal learning is seldom practiced (Zhang 1995). Governments are realizing the worth of promoting knowledge acquisition and innovation in SMEs (Islam & Karim 2011). Introduction, growth and survival of SMEs depend on the entrepreneurial abilities and capabilities of the owner/ manager (Ritchie 2005). Reluctance to change is the main barrier to the adoption of new learning practices (Keskin 2006). Market orientation helps SME to gain excellent market information and processing abilities (Pelham 2000). Keskin (2006) reported that the market orientation is positively related to SME performance. SMEs should be innovative to respond effectively to counter the limitations such as limited resources, high rate of uncertainty and demand fluctuation (Keskin 2006). Learning in SMEs is firm – specific, work – based and reactive in nature (Badger 2001).

In India, SMEs accounted 95 per cent of industrial units and 40 per cent value addition in manufacturing sector and contributed 6.29 per cent to the GDP (Singh *et al*. 2008). Because of limited resources, SMEs are not able to devote time and resource to evolve production planning and control strategies for sustainable growth (Singh 2010). In India, globalization and developments in Information Technology made radical changes in business but the benefits are very less utilized by the small sector firms (Todd *et al*. 2007). To become competitive and to respond effectively to the increased competition from new entrants, SMEs should use better production planning and control methods and information processing (Todd *et al*. 2007, Singh *et al*. 2010; Sharma 1996).

Saini *et al*., (2008); Singh *et al*. (2010) and Todd *et al.* (2007) pointed out the strengths and weaknesses of Indian SMEs as follows:

The strengths of the SMEs:

1) The flexibility due to the absence of a formal organizational structure and the ability to respond quickly to the demand of the customers and market conditions.

2) Intended strategy, incrementalism and realized strategy are all enabled by a well organized leadership.

The weaknesses of the SMEs:

1) Cost leadership is not possible due to the lack of capital.
2) Many owner- managers prioritize the survival and the independence above the growth and the development.
3) SMEs are more labour intensive than large firms so that manpower planning is difficult.
4) Lower economies of scale

Todd & Javalgi (2007) have reported that the employment and the export growth of Indian SMEs indicated steady growth. In India the challenges faced by SMEs (such as inadequate telecommunication networks, stringent rules and regulations made by government, discouraging political and socio cultural elements etc) have changed very much favoring the industry (Todd & Javalgi 2007). Liberalization policy after 1991 stopped the protection for Indian SMEs from external competition. The ASIAN treaty and membership in WTO indicate that Indian SMEs are no longer protected, at the same time they are exposed to immense export opportunities abroad (Todd & Javalgi 2007). Industry specific challenges necessitate proactive measures for improved production planning and control. Firm specific challenges like raising capital is easy due to better single window facilities by government agencies and banks. Better consultancy, training and R&D facilities are available. Entrepreneurial mindset and views of the key persons and employees go on changing due to competition.

1.6. PPC Usage in India and Abroad

PPC system study raises some fundamental questions. The first is how to develop multiple PPC systems that aids different manufacturing environments. The second is the matching of PPC system with the appropriate manufacturing environment. Studies focused largely on well established firm due to the availability of measurable quantitative data (Jonsson & Matsson 2003). Tailor made PPC system packages are

widely used. Many firms use PPC systems without examining their suitability with the manufacturing environment (Newman & Sridharan 1996).

MRP system users performed well in a steady state of demand with small variations. Firms dealing with make to stock and make to order environment performed well with uniform demand. The situation changed in the case of volatile demand and firms managed with Re-Order-Point (ROP) systems. SMEs operating as job shops are more comfortable with using ROP and MRP systems. Indian SMEs operating in the domestic market and prefer ROP systems (Singh *et al*. 2007). In the case of international and export markets, demand prediction is easier and sophisticated methods are used.

High forecast errors have resulted in increased expenditure and loss of competitiveness. Studies indicate more dissatisfaction with complex forecasting methods than simple models (Wacker *et al*. 1998). Complex models did not increase accuracy beyond a limit, and they cost more. Combining several simple models improved the forecast accuracy but such methods are inconvenient (Lobo & Nair 1990). Switching over to formal/statistical forecasting methods by small firms is often resisted by the traditional practitioners. Lack of management support, relevant data and knowledge base resulted in unfit forecasting practice (Smith *et al*. 1996). Sharma *et al*. (2006) observed that less than 2 per cent SME owner/managers of Northern India were using computers for forecasting.

Studies conducted among the SMEs of Ireland, US, UK, Pakistan, Australia, Ghana, India and Korea revealed that the key person's characteristics such as cultural differences, race, gender, age, experience and longevity influence managerial decision making and the quality of PPC activities (Beaver & Prince 2002; Bhutta *et al.* 2008; Boohene *et al*. 2008). Karami (2006) observed that age, education and experience of the CEO significantly influence the implementation of planning decisions.

1.7. The Research Problem

In large and modern industries, there exists a well-developed professional management system. For the industries of small, unorganized and non-certified sector,

such systems are very rare. Many of such firms are lacking scientific and systematic methods, without which, resulting in poor performance.

Thus the problem is to study the use of forecasting, planning and control by selected small and medium enterprises to find and suggest alternatives for improving the use of forecasting, planning and control in SMEs.

Following research questions were proposed with respect to SMEs:

1. Are forecasting, planning and control important to firm performance and what are their linkages?
2. What are the factors, which influence the use of forecasting, planning and control?
3. How do the above factors, as viewed by key persons of the firms influence the usage of forecasting, planning and controlling to improve its performance?
4. What conclusions/ generalizations can be drawn and the steps can be taken to increase the use of PPC in SME to improve firm performance?

1.8. Steps Followed in the Study

1. Formulate the model and framework suitable for the study based on the literature review and the consultation with experts.
2. Identify the firms belonging to SME in a particular geographic area specified, which are representative of product type, ownership/ management type and exhibiting different types of demand characteristics and select a suitable sample.
3. Design and test a questionnaire and use it for conducting the survey.
4. From the encoded and tabulated data, identify and interpret the relationship between the factors selected and PPC elements used.
5. Use case studies to check the findings and for throwing light on improvements possible.

The steps followed are illustrated by means of the figure 1.2, as given below:

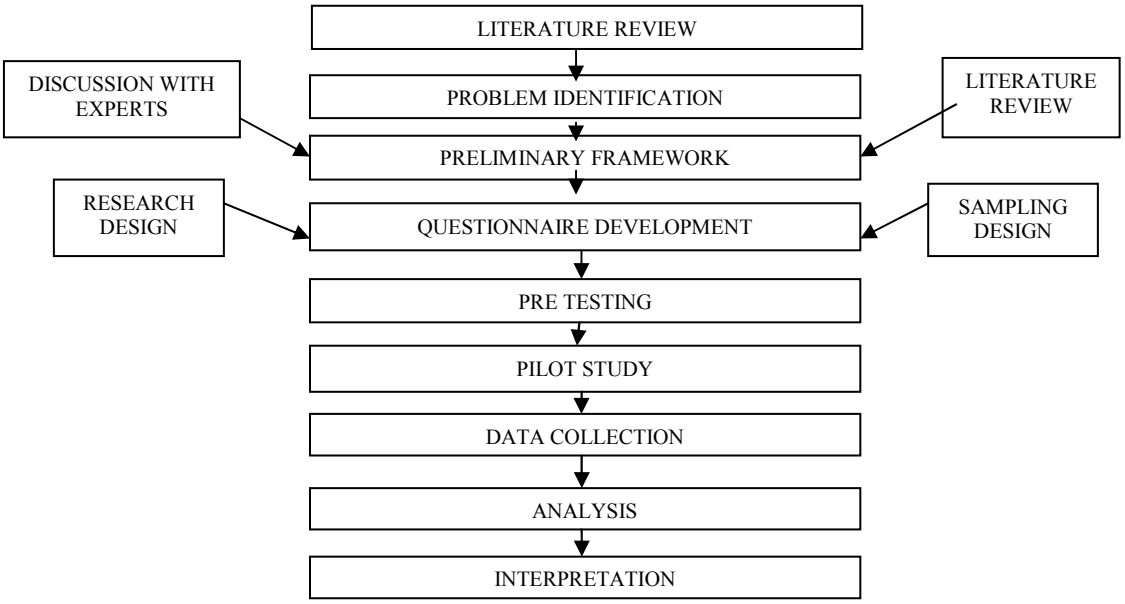


Figure 1.2 Steps followed in the Study

1.9. Structure of the Thesis

This thesis is organized in the following manner: The second chapter is devoted to the review of literature. The third chapter deals with the study of forecasting and its linkage with planning, controlling and firm performance. The fourth and fifth chapters discuss the effect of planning and control respectively on the firm performance. The chapter six focuses on the analysis of the combined influence of forecasting, planning and controlling and the other variables on firm performance and on one another. The seventh chapter is the presentation of case studies. The last chapter of the thesis presents the limitations of the study, the summary, the conclusion and the scope for further research. The references are listed at the end.

Chapter 2

LITERATURE REVIEW

Contents

2.1. Introduction

This chapter is organized in the following manner. The PPC system developments over the last 30 years are reviewed first. Manufacturing Planning and Controlling (MPC) approaches and its progress with respect to the market development are explained then. The role of forecasting and its developments in the PPC context are detailed thereafter. The usage of production planning and production controlling systems in manufacturing industries are reviewed then. After reviewing the operational differences between small and large firms, the literature on Small and Medium Enterprises (SME) is discussed. The knowledge gaps identified are also presented.

2.2. PPC Developments over the Past 30 Years

A large number of articles dealing with the theory, practice and various streams of forecasting planning and control have been published over the last 50 years. Untill1950, the stock replenishment and the reorder point monitoring was considered as the main PPC activity and it was done manually (Mc Garrie 1998). The ABC classification and the economic order quantity were used to control inventory during the sixties and the seventies. It was only in the middle of 1970s, the concept of Materials Requirement Planning (MRP) came into the picture (Schonberger 1983). The inclusion of labour and financial aspects in the production planning domains resulted in MRP II (Upton 1998). JIT philosophy was first used by Toyota in the 1970s and later it was accepted internationally that the implementation of JIT resulted in labour efficiency,

low inventory costs, superior quality, timely delivery, low throughput time and better machine utilization (Billesbach 1994; Chakrovarty 1995; White 1999).

Many large firms invest heavily in manufacturing infrastructure without having proper understanding about the markets (Berry & Hill 1995). MPC systems have been developed from internal knowledge and information based on latest system developments. Such systems often face production and capacity management issues due to the mismatch between the design environment and the actual environment which the firm is exposed to (Newman & Sridharan 1996).

2.3. Manufacturing System Classifications

Operations management and manufacturing planning and control theory have classified the material planning methods into many types. Fogerty *et al.* (1991), Vollmann *et al.* (1997), Olhager (2000) and Hill (1991) have classified the manufacturing environment in more than twenty ways. The classification of the manufacturing system by Newman & Sridharan (1996) is based on the product volume/variety, the competitive priorities, the process technology and the infrastructure. The most common manufacturing classifications, listed by Porter *et al*. (1999) are: Jobbing to continuous, Make to stock (MTS), Assemble to order (ATO), Make to order (MTO), Engineer to order (ETO) and Design to order (DTO) as explained by figures 2.1, 2.2 and 2.3 respectively.

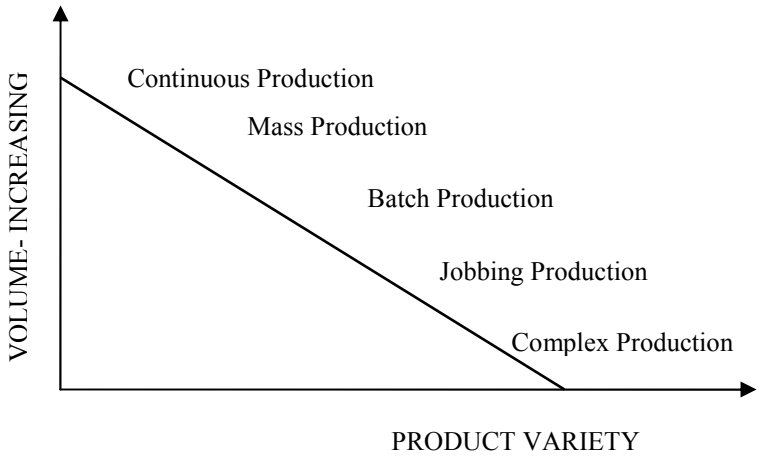


Figure 2.1 Volume – Variety Constraint of Manufacturing Classification: Source: Porter *et al.* (1999)

Jobbing production is characterized by the lower volume production of a wide range of products. In jobbing production, the capacity utilization is difficult. The large firms manage the capacity with sophisticated algorithms and high level planning, while the small firms manage the same with heuristics and thumb rules. In flow or mass

production, large volumes of identical, standard products are manufactured. Much easier planning and controlling is observed in the flow production due to the easy predictability of demand and capacity. Batch production is characterized by the difficulty in the predictability of demand for individual products and determination of capacity. Larger firms dealing with batch production use specialized methods and algorithms. Use of thumb rules and heuristics, followed by the small firms, affect the production efficiency in batch production.

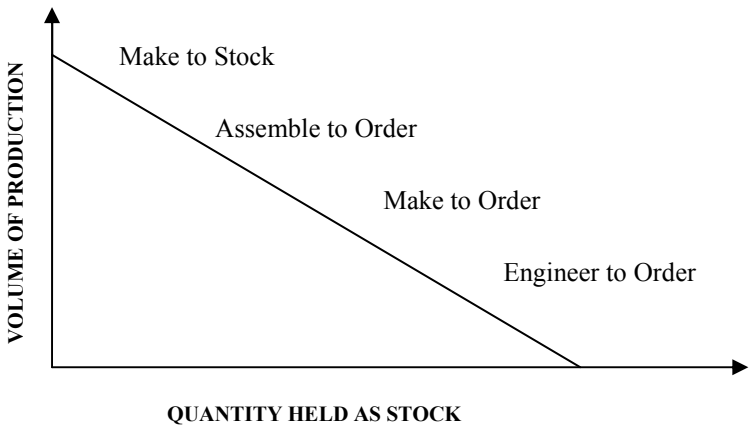


Figure 2.2 Manufacturing Classification based on the Production Volume and the Stock held:
Source: Porter *et al.* (1999)

The salient features of the manufacturing environments are described in table 2.1 (Ref: Persona *et al*. 2004). Based on the complexity and demand uncertainty, products are grouped into four, namely, "Capital equipment", "Consumer durables", "Fashion and jobbing products" and "FMC products". Planning and controlling complexities of each type of production are illustrated in figure 2.3. The features of different manufacturing environments are described in table 2.1.

Table 2.1 Characteristics of Manufacturing Environments

Characteristics	MTS	ATO	MTO	ETO
Product	Standard	Defined family	No typical family	Customized
Product demand	Can be forecast	------	----	Cannot forecast
Capacity	Can be planned	-------	----	Cannot planned
Lead-time	Unimportant	Important	Most important	Most important
Key function	Logistics	Final assembly	Assembly	Whole process
Main task	Distribution	Assembly	Components	Engineering
Uncertainty	Lowest	-------	-------	Highest
Top Management focus	Distribution	Innovation	Capacity	Customer order
Middle management focus	Stock control	Customer order	Shop floor control	Project management

Source: Porter et al. (1999)

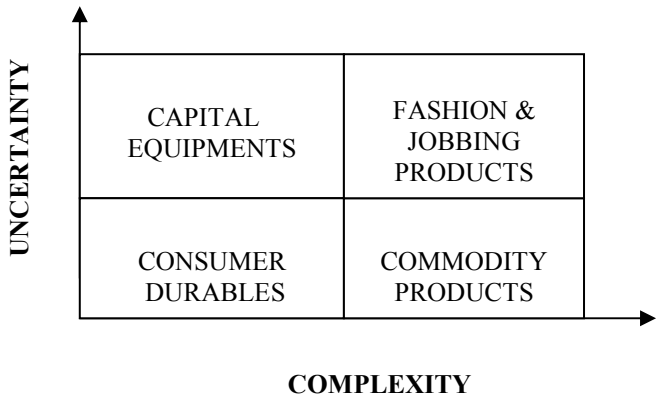


Figure 2.3 Classification of Products according to Complexity and Demand Uncertainty
Source: Persona et al. (2004)

Other classifications include the categorization based on product types (for example soaps, electronic goods etc), bill-of material topography, grading on the basis of customer specific requirements, capital and labour intensive items and number of components per end item (Persona *et al*. 2004). From the classification of manufacturing systems, it can is inferred that the MPC systems differ in many aspects and are beyond generalization. Selection of the best suited PPC method is a very difficult task. Findings of the research in the respective environments and manufacturing typology are applicable to the very limited fields.

2.4. Current Production Planning Approaches

Traditional Re-order Point (R-O-P) systems are applied to the simpler systems of lower lead-time and manual or semi-automatic units, with independent demand inventory. Increased product complexity, demand uncertainty, supply chain structures and financial constraints necessitate the use of more variables for deciding on the production plan. Just in time (JIT) is used in repetitive or flow manufacturing environments. Constraint based scheduling is found suitable in processes where bottlenecks exist. Process Flow Scheduling (PFS) is developed for process structures and is used in high volume and repetitive manufacturing environments. Materials Requirement Planning (MRP) is used for product structures with dependent demand inventory. Finite Capacity Scheduling (FCS) is preferred when short-term visibility to the user is desired. Comparison of different PPC methods is given in table 2.2.

Newman & Sridharan (1996) observed that no one system is superior to other systems, but the applicability is connected to the firm's production environment. Firm's infrastructure support system needs to be aligned with the manufacturing environment.

Infrastructural resources, attitude, culture, economic and financial reasons cause the mismatch between the planning methods and planning environment. Most of the research works in this area deal with the large firm context. Of the available literature on SMEs, very little is found in the developing countries such as India and Pakistan (Dangayach 2001; Bhutta 2006; Sharma 2006; Todd 2007; Singh 2010).

Table 2.2 Comparison of Various Production Planning Methods

Type of mechanism	MRP	JIT	PERT/CPM	Shop floor scheduling	Process scheduling
Production	Jobbing	Batch	Complex	Mass	Continuous
Environment	MTO	MTO	DTO/MTO	MTS/ATO	MTS
Uncertainty	High	Low	High	High	Low
Components	Many	Few	Many	Many	Few
Intervals	Long	Short	Long	Short	Short
WIP	Low	Low	Low	More	High
Capital	High	Low	High	Low	High
Labour	High	Low	High	Low	Low

In case of non standard, low volume products, in order to reduce risk, most organizations prefer the make to order or the engineer to order type production over produce to stock system. Review of the literature reports very limited studies conducted in the area of stock driven production. To reap the benefits of economies of scale, organizations prefer moving from jobbing to continuous production. At the same time, it is not possible to go ahead, because of the need to go for customization. In high volume process environments, the firms manage the production with the help of finite capacity scheduling tools. At present, the cost of acquiring modern PPC software can be afforded by large firms only. The small firms often manage the production with crude practices and thumb rules, which prevent them from improving the performance. Literature review shows that there is lack of research findings to improve the production performance of firms following stock driven production, which is still followed by the SMEs of developing countries.

2.4.1. Comparison of MRP, JIT, ROP and CBS systems

During 1970s and 80s, theoretical and comparative literature on MRP and JIT were published, but the empirical studies of MRP and JIT are largely available from 1990s. The papers by Agarwal (1985); Yusuf *et al*. 1998; Hitt (2002) and Hunton *et al*.

(2003) in the area of MRP and the works by Salaheldin *et al*. (1998); Sriparavastu *et al*. (1998) and Fullerton *et al*. (2001) in the field of JIT have provided empirical results on the use of MRP and JIT. Salaheldin (1998) listed the key factors of MRP as management support, organization climate, market strategy, education, training, support from vendor, age of firm and IT usage. Wilson (1994); Lau *et al*. (2002) and Petroni *et al.* (2002) established the use of MRP for improved PPC, short lead times, better quality and easy scheduling. The need of computer assistance for implementing MRP remains as a limitation to SMEs, where intuitive methods are more common.

The benefits of JIT are reported as labour efficiency, low inventory costs, good quality, timely delivery, low throughput time and better machine utilization (Billesbach 1994; Upton 1998 and White 1999). Schonberger (1983) empirically analyzed ROP, MRP and Kanban systems, and established that ROP is the least efficient among the three. Miltenburg (1997) made a comparative study of MRP, JIT and TOC systems based on output, inventory level, cycle time and material shortages and revealed that both JIT and TOC are better than MRP. Table 2.3 lists the research issues covered in the large firm context, in the field of MRP, JIT, OPT and hybrid combinations.

Table 2.3 Application of MPC Systems in Large Firms

Firm	Issues covered	Researcher
Ingersoll - Rand	MPC system, communication process and human aspects in the MRP context	Davis (1978)
Hewlett-Packard	Internal aspects of JIT implementation	Schonberger (1986)
Harley Davidson	Internal aspects of JIT implementation	Reid (1990)
General Motors	External aspects of JIT implementation	Aggarwal (1985)
IBM and Ford	External aspects of JIT implementation	O'Neal *et al.*(1991)
Toyota	Both internal and external aspects of JIT implementation	Ohno (1988)
Xerox	Both internal and external aspects of JIT implementation	Ferguson (1989)
General Electric	Hybrid approach , JIT and TOC	Johnson (1986)
AT&T	Hybrid approach , JIT and TOC	Fogarty *et al.* (1991)
Black&Dekker	Shifting from MRP to JIT	Kolodziej (1986)

Newman & Sridharan (1996) observed that the MRP is most widely used and the ROP is advisable in managing steady demand. The OPT is found in less complicated

process environment and Kanban is found suitable in repetitive manufacturing environment. Easy predictability of demand combined with the usage of computer and the active involvement of the planning and forecasting make the MRP most suitable for the MTO environment. Stevenson *et al.* (2005) reviewed the classical concepts of PPC such as MRP, Kanban, TOC etc and recent concepts such as Work Load Control (WLC) and concludes that customer enquiries, shop floor configurations, firm size and degree of customization play an important role in the applicability of planning and control concepts.

The comparative features of MRP, JIT, ROP and CBS systems are described in this section. Studies reported from 1970s to 2012 dealing with the respective PPC tools and their applicability in the respective environments is reviewed. Most of the findings are reported from large firms. Literature suffers from limitations such as tailor made packages, affordable to large firms and mainly applicable to well trained and educated team of workers. Studies for improving the PPC in SMEs are very limited and the firms in the SME sector are working with limited resources. The literature review identifies the need of developing adaptive PPC systems suitable to the SMEs.

2.4.2. The need of studying the Use of Forecasting, Planning and Controlling

Demand (either in the form of orders agreed upon or the expected sales from historical data) is the main input of production planning. The production control is followed from the detailed plan formed. Forecasts or orders are used to start the rest of the PPC process. The errors brought into the system through forecast are carried through the rest of the PPC process and this in turn affects the system performance (Sanders 1996). Factors influencing the forecasting and the influence of forecast on other PPC elements is to be investigated, because the choice of the forecast is often decided externally or is made by the subjective preference by the key person/persons (Makridakis 1996; Wacker & Sheu 2006).

Characteristics of the manufacturing system such as type of production, volume of production, nature of a product, technology, standardization practices and production process influence the forecasting, planning and controlling system. The demographics of the key person (age, education, experience etc of the owner / manager/ entrepreneur) and the organization culture also act as control variables for the implementation of PPC

functions (Karami 2006). In large firms and subsidiary firms of large corporations, the implementation of theory is more practical because of the presence of structured systems. In small firms, however, lack of such systems result in the adoption of PPC by the personal preferences of key person, where demographics play a vital role.

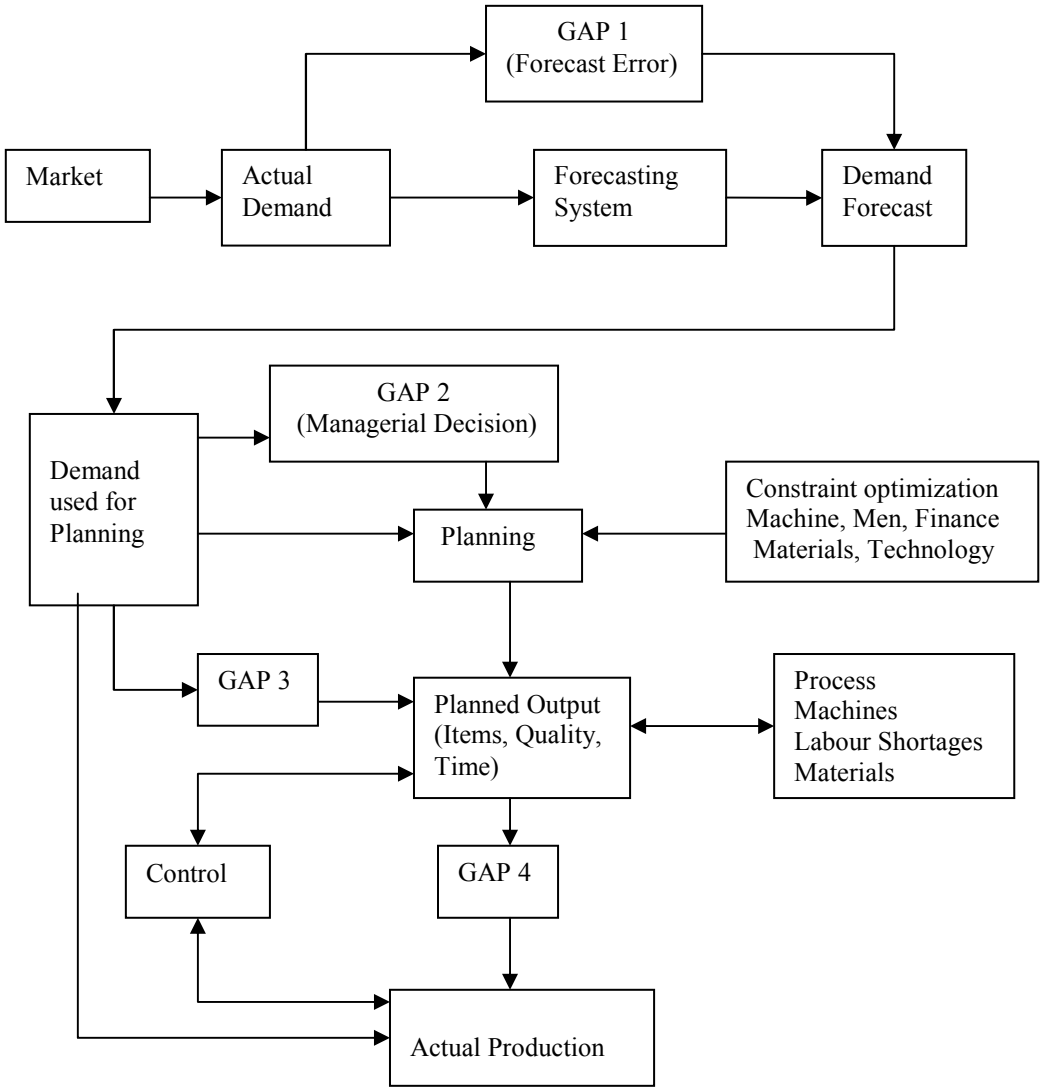


Figure 2.4 Forecasting, Planning and Controlling System

Different characteristics of the firm (demographics of key person, team work and number of levels, power distance, IT usage, learning and training etc) take part in deciding the forecast choice and usage level. The gaps between the forecast and the planned production and that between the planned and produced, indicate the firm's ability to manage production. The interdependence between forecasting, planning and

controlling are illustrated in figure 2.4, which explain the need for studying forecasting, planning and control.

2.5. Linking PPC with the Market

The market influences the production planning and scheduling operations. Tailor made forecasting; planning and scheduling systems are not applicable to large, medium, small and micro firms, because these firms are dealing with the same product, with different capacities and product mix. Customizing the production process by linking it with the production environment resulted in highly firm specific systems. However such systems are applicable only to a limited number of firms.

Computer and IT enabled practices enhanced the production environment and the methods by the use of rule bases and models. Howard *et al.* (2000) integrated the company specific environmental characteristics and PPC systems with PPC functions in the strategic, operational and functional levels. Introduction of maximum number of input characteristics and constraints increased the accuracy of rule bases, but were not accepted universally, due to the difficulty in grasping. The workflow modeling languages performed well in their field, but was of limited use because of limited acceptance outside the firm. Hvolby & Trienekens (2010) discussed the challenges of business system integration in the modern era as matching with the product development, order fulfillment and supply system integration. But such concept required more IT and IS involvement and matured human interaction.

MTO firms were of limited capacity to forecast demand, order materials and produce in advance. Distinct material and production requirements paved the way for variable job routings. This in turn has increased the difficulties of planning and controlling. The MRP methods are criticised for the lack of providing feasible plans and high level of work in process inventory (Newman & Sridharan 1996). Implementation of the MRP requires trouble free forecasts (for the preparation of master production schedule) and management initiative to change the mindset of people (Persona 2004). Modern manufacturing firms are attempting to increase the value of their products by eliminating unnecessary operations and waste materials. Lean manufacturing methods contribute a lot to PPC (Garengo *et al.* 2012), however the status of SMEs in lean manufacturing is very limited due to the lack of resources and knowledge. It is not easy

for small firms to digest these concepts quickly, but is inevitable to acquire global competencies. The study of the work sophistication practices shows that adequate PPC systems are established for high technology applications. Environmental compulsions necessitate modification of present systems. Larger firms consider innovation and training essential, but this aspect is of little value for smaller firms.

Section 2.5 discusses the current status of linking PPC with the market. It is understood that the work sophistication practices explained in the research literature are appropriate and consistent, but they are developed and used for high technology applications. Environmental compulsions necessitate the modification of present PPC systems of the small firms. Large firms consider innovation and training essential, but this aspect is of little value to the small firms. Very few studies linking firm performance and sophistication in work practices, in the SME sector are reported.

2.6. Development of Forecasting Practices

Forecasting gained more attention in business due to the following reasons (Wheelwright & Makridakis 1985; Waddel & Sohal 1994):

1) Production environment became complex and the decision makers found it difficult to weigh all the influencing factors without some explicit and systematic aids.
2) When the firms grow, the complexity and the vitality of individual decisions also grow. The situation warrant special and thorough analysis through forecasts.
3) Systematic decision making requires explicit justification of actions.
4) Along with the growth rate of both the industry and the firm, newer relationships are formed. Forecasting is needed to value and anticipate the outcome.
5) Industry goes through a change of phase in which conflict between forecast users and forecasting experts has emerged.

Fischhoff (1994) classified numerical forecasts into four levels. The highest level is derived from the causal analysis based on the theory. The second level is derived from theoretical models hypothesized from the causal relationship. The third level consists of computer approximations, and the lowest level is derived from statistical modeling

without considering causality. Economic and business advancements invite mathematical and logical attention to forecasting. Industry users prefer judgmental and time series forecasts because of the ease of use other than accuracy (Smith *et al.* 1996). In the modern, dynamic business environment, it is not easy to anticipate the future requirements (Wacker *et al.* 2002). This results in the shifting from the traditional practices (then that time convenience, judgmental and salesmen types) to quantitative methods. Difficulties in estimating the demand and large pay off cost for wrong forecast invite attention to the forecast error and to the forecast accuracy. The studies indicate that statistical methods are superior to judgmental methods in terms of accuracy and timeliness (Armstrong 1984; Sanders 1994). The development of forecasting practices and the thrust areas are shown in figure 2.5.

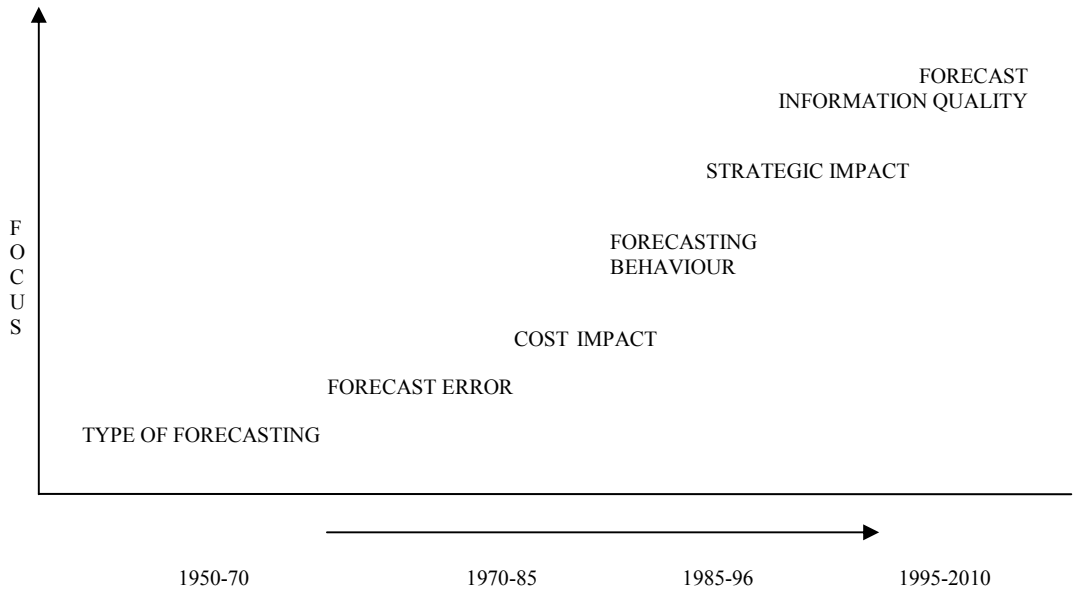


Figure 2.5 Developments in Forecasting and Thrust Areas

When a firm crosses the stages of its development, many decisions warrant special forecasts and thorough analysis. Explicit justification of managerial action necessitates regular and systematic procedures (Wacker *et al*. 1995). Forecasting has become the subject area of managers, more than mathematicians. Smith *et al.* (1996) observed that in large firms more people are involved in forecasting and they use more complex, quantitative and objective methods. Less attention by small firms towards forecasting are due to low operating volume, less competition and lack of knowledge and resources.

The forecast errors results in re-planning. If the re-planning is inflexible, the forecast accuracy is set at higher value (Annastiina *et al*. 2009). If the accuracy cannot be improved further, the managers plan their resources effectively by adopting resource decisions to specific forecasts. The resource decisions are linked with immediate, short, medium, long and very long time frame forecasts. Generally forecasts for durable goods are less accurate than that for perishable goods (Wacker *et al*. 2002). The statistical sophistication alone will not increase accuracy, a combination of different forecasting methods is found a good alternative (Wacker *et al*. 2002). Employees in the firms have to be trained to use the correct forecast choice.

Smith *et al*. (1996) found no difference in the timeliness, accuracy and overall satisfaction in forecasting by small and large firms. The duration between forecasts is shorter for small firms than large firms. Herbig *et al*. (1994) highlighted the difference between forecasting practices by consumer product and industrial product firms. Wacker *et al*. (2002) examined the ways for utilizing forecasting to support managerial decision making and suggested that the forecasting can be as much as good as the themes on which it is made.

Forecast usage is critical for the supply chain environment. The supply chain performance is found higher for the suppliers who have access to customer forecasts (Forslund *et al.* 2007). In a supply chain OEMs, the 1st tier suppliers and the 2nd tier suppliers share common forecast information. Timeliness, accuracy, convenience and reliability are generally used to measure "Forecast Information Quality" (FIQ). The supply chain performance is positively correlated with FIQ (Forslund *et al.* 2007).

Following are the eight principles of forecasting (Makridakis 1996; Smith *et al.* 1996) found important in all types of forecasting contexts.

1) **Accuracy of forecasts**: Forecasts always contain some errors. Business firms can tolerate some amount of error (acceptable error).

2) **Time horizon of forecasting**: The accuracy of forecasts decreases when time horizon increases.

3) **Technological change**: Forecasting accuracy decreases with the increase in the rate of technological change.

4) **Barrier to entry**: With the lowering of barriers to entry, new competitors enter and distort the demand-supply pattern. This results in inaccurate forecasts.

5) **Dissemination of information**: The faster dissemination of information reduces the relevance of accurate forecasts, because everyone can avail themselves of the right information.

6) **Elasticity of demand**: More elasticity in demand reduces the forecast accuracy.

7) **Consumer versus industrial products**: It is relatively easy to forecast the demand of the consumer products accurately when compared with the industrial products because of the availability of more customers in the former.

8) **Aggregate versus disaggregate forecasts**: Demand data for the aggregate forecasts did not change rapidly so great accuracy is observed in aggregate forecasts.

2.6.1. Comparison of Forecasting Methods

Judgmental methods are mostly informal and are susceptible to bias and anchoring (Sniezek 1989). The control over the sources of information is treated as a source of power in organizations. The individuals, who used the judgmental forecasting, feared the loss of such power (Sanders 1994). Readily accessible information channels are given more preference because such channels provided easy results (Mentzer & Cox 1984; Sanders 1994). Thus "ease of use" take a major role in the adoption of the forecast method.

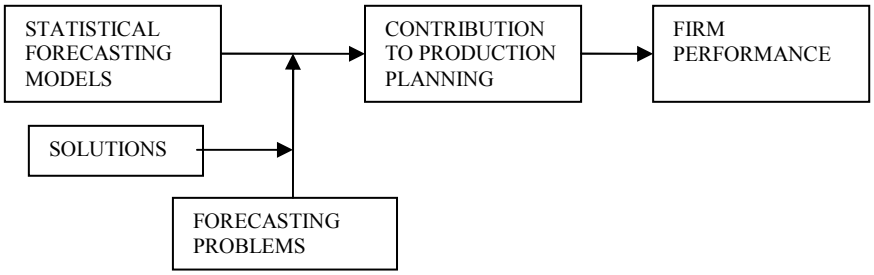


Figure 2.6 Model Describing Statistical Forecasting (Ref: Sanders 1994)

The practitioners and the originators of the statistical forecasting methods failed to communicate effectively in many situations. The practitioners, in many occasions adjusted judgmentally. Lack of awareness, training, confidence and management

initiative reduced the popularity of the statistical forecasting in SMEs (Sanders 1994). Larger firms use many of the expensive quantitative techniques because of the larger budget allocation, the usage of computer and the complex production – demand relationships. Figure 2.6 explains a model for improving statistical forecasting methods (Sanders 1994).

Literature shows that the sales force estimate without identifying causes is very common among manufacture firms (Smith *et al.* 1996). Mahmoud (1996) observed that the long range forecasts failed due to over confidence, the ignorance of the needs of the customers and over reliance on technologies. Industrial forecasts suffer from excessive optimism, inadequate definition of markets, poor attention to inflation and price fluctuations (Herbig *et al*. 1994). The literature review provide insights into the factors affecting the success of business forecasts, but the solution presented in the literature are highly situation specific and lack the inclusion of many variables. Generalization of different forecasting practices is also very difficult due to tedious calculations.

2.6.2. Shortcomings of Forecasting used in Industries

The poor prediction of the explanatory variables resulted in errors in causal forecasts. Thus the models that fit the available data the best need not be the most accurate ones for predicting that which is beyond the data (Makridakis 1996). Forecast errors are caused by fluctuations in internal sources such as price, product quality, distribution system and promotion plan (Wacker *et al.* 1998). Precision in forecasting is important for strategic planning (Graman & Sanders 2009).

Vollman *et al.* (2005) explained the cost impact due to inaccurate forecasts. Biggs (1982); Lee *et al.* (1986) and Wacker (1995) are of the opinion that forecasts are not costing much to the firm. The effect of the forecast inaccuracy on the inventory cost was studied by Ritzman *et al.* (1993). The adverse effect of the forecast bias was studied by Weinstein *et al.* (1987), Mantrala *et al.* (1990), Makridakis *et al*. (1996) and Wacker *et al.* (2002). Carbone (1982) observed that both the accuracy of the forecast and firm performance are positively correlated. All research findings stress on the necessity of minimizing the adverse effect of the forecast error on managerial decisions.

The shortcomings of the forecasting practices are listed below:

- The causal methods depend on explanatory variables. These variables need another prediction, which increases the forecast error (Makridakis *et al*. 1996).
- The non clarity of the item demanded the time periods induced significant errors. The time series forecasts failed to explain the reason for sales fluctuation. Moving averages are commonly used but are susceptible to the forecast errors (Annastiina *et al*. 2009).
- High forecast errors result in increased expenditure and loss of competitiveness.
- Forecast flexibility and ease of use are equally important as accuracy. Benefits of forecasting are to be correlated with performance (Wacker *et al*. 2002).
- Higher order models did not increase accuracy beyond a limit, and they cost more. Combination of several models improves accuracy (Lobo & Nair 1990).
- Resistance to change, lack of management support lacking relevant data and poor knowledge base resulted in unfit forecasting practice (Smith *et al*. 1996).
- Poor communication between forecast prepares and users create issues (Sanders 1994).
- More dissatisfaction is observed towards the quantitative methods. Learning and IT usage can be used to improve the forecasting techniques (Mahmoud 1996).

2.6.3. Measuring the Use of Forecasting

Smith *et al.* (1996) measured the use of forecasting with eight indicators, namely Simplicity, Understandability, ease of use, Comprehensiveness, Effectiveness, Timeliness, Accuracy and Overall satisfaction. Herbig *et al.* (1994) used above measures to rate the use of forecasting among industrial product and consumer product firms. Forecast error is measured as a baseline data indicating the deviation of forecast and realized demand. It is often represented as mean absolute deviation (MAD) or mean square error (MSE) or mean absolute percentage error (MAPE). In the supply chain structures, Forecast Information Quality (FIQ) is an important concept (Forslund 2007). Forslund used “timeliness”, “accuracy”, “convenience to access” and “reliability” as the indicators of FIQ. Timeliness is defined as the ability to arrive in time (Clikeman 1999). Accuracy is defined as the freedom from mistakes (English 1999). Convenient to access is defined as the easy access without further processing (Closs *et al.* 1997; Keebler *et al*.

1999 and English 1999). Reliability is defined as the probability that the forecast is unchanged (Moberg *et al*. 2002).

2.7. Features of Various Production Planning Approaches

Chen *et al.* (2008) classified PPC approaches into two: the system approach and the quantitative approach. The system approach includes methods such as materials requirement planning, periodic batch control, manufacturing resource planning, enterprise resource planning, just in time production and optimized production technology. The quantitative approach includes reorder point systems, statistical inventory control and aggregate production planning systems. The system approach is superior to quantitative approach as it minimizes the inventory. The supply chain environments have been benefited from the system approach.

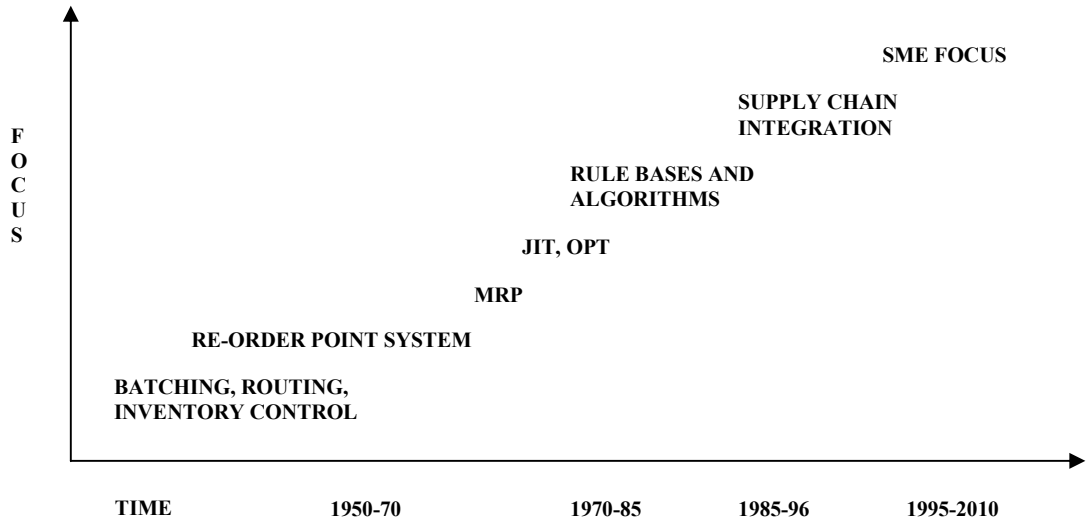


Figure 2.7 Development of Planning with Thrust Areas over Years

The different stages of the evolution of production planning systems are illustrated in figure 2.7. Starting from re-order point systems, the environment specific systems such as MRP, MRP II, and JIT evolved. ROP systems which are suitable only for simple systems are not preferred in a dynamic environment manufacturing systems. Wilson (1994); Lau *et al*. (2002) and Petroni *et al.* (2002) observed that the adoption of the MRP resulted in improved PPC, short lead times, better quality and easy scheduling. MRP required computer assistance and is not preferred by SMEs. In the SMEs intuitive

methods are commonly used. According to Schonberger (1983) the ROP is the least efficient systems, among the ROP, the MRP and the Kanban systems.

2.7.1. Production Planning and Manufacturing Environment

Jonsson *et al.* (2003) explained the fit between the manufacturing environment and the PPC methods. The study also revealed the mismatch in the use of PPC methods between those stated in theory and those that were practiced. Different planning environments are classified in table 2.4.

The successful users of the ROP reported the success factors as small product variety, steady state of demand and process type layout. Kanban users indicate their success factors as the use of the cellular manufacturing concepts and the less complexity in production. Batch process, volatility in demand and product variety are the characteristics of the OPT systems (Fransoo *et al.* 1994). Many firms using the OPT report poor performance due to their inability to manage the large product variety and the high demand variability.

Table 2.4 Classification of Planning Environments

Nature of environment	Reviewed by
Mass production	Jonsson *et al.* (2003), Newman *et al.* (1996) , Hill (1991)
Batch production	Kale *et al.* 2010, Stevenson *et al.* 2005, Howard *et al.*(2002), Fransoo *et al.* (1994),
Configure to order production	Stevenson *et al.* 2011, Doom *et al.* 2010, Shishir Bhatt 2010, Perona *et al.* 2009, Lecompte 2000, Suresh *et al.* (1999)
Complex customer products (versatile)	Kalinic & Forza 2012, Bonomyong *et al.* 2010, Carneiro *et al.* 2010, Deshmukh *et al.* (2005), Lecompte *et al.* (2000)

In a predictable and stable demand condition, simple ROP system or MRP performed well. Table 2.5 lists the literature review of the different types of planning methods and the tools used. The strategic application fields of the PPC methods show that the practices vary among environments. The literature review provides adequate information about the planning environment suitable for the respective type of production. But the study suffers from the criticism that the most of them are reported in the large firm context. Small firms are reluctant to adapt to high level knowledge and modern techniques, but it is required to acquire global competencies (Fransoo *et al.* 1994). More research focus in the SME context is required in this field.

Table 2.5 Different Types of Planning Methods

Materials planning: Re-order point ROP, Run out time planning, MRP, Kanban, Order based planning, individual planning by owner/proprietor	Banomyang *et al.* 2011, Doom *et al.* 2010, Stevenson *et al.* 2005, Jonsson *et al.* (2003), Newman(1996), Bonney (1994)
Capacity planning: Based on overall factors/ Contingencies, capacity bills, Resource profiles, CRP	Govinda Sharma, 2011, Stevenson *et al.* 2011, Flores *et al.*, 2007, Vollman (1992)
Shop floor control methods: Scheduling :-Finite capacity scheduling, Infinite capacity scheduling, Input/output control	Perona et al., 2009, Jonsson *et al.* (2003), Bergamaschi *et al.* (1997), Newman (1996)
Sequencing: By owner/manager/foremen, Priority rules Dispatch rules.	Sharma *et al.* 2011, Fogerty *et al.* (1999), Hill (1991)

2.7.2. Review of the Usage of PPC by the Firms

Manufacturing, planning and control methods are beyond generalization. In the production planning of the complex customer order products, the products are featured by smaller volumes, less standard and high level of variability. In the case of configure-to-order products, items manufactured are of less complexity and the assembly is made in batches (Everett & Ebert 1989). Lesser lead times and shorter throughput time are the features of this type of production. Mass production is characterized by the large production volumes of identical products in repeated productive operations.

Table 2.6 The sector wise Studies of PPC Reviewed

Industry sector	Researcher	Focus
Versatile manufacturing	Carneiro *et al.*, 2010, Persona *et al.* (2004)	PPC for complex production
Batch production	Stevenson *et al.* 2010, Perona *et al.*, 2009, Fransoo (1994)	PPC for batch production
Cellular Manufacturing	Doom *et al.* 2010, Shishir Bhatt, Schonsleben	PPC for cellular manufacturing
FMS	Nallan Suresh (1999)	PPC framework for FMS
Automation	Mathur *et al.* 2011, Monfared (2007)	PPC for automation
Construction	Naïf Turki *et al.* (2002)	Construction and manufacturing
Aircraft manufacturing	Ghober *et al.* (2004)	MRP implementation and issues
Textile industry	Karacapilidis (1996)	PPC issues in textile industry
Remanufacturing	Daniel *et al*(2000)	Review of PPC issues
Tool room	Mohanthy *et al*(1989)	Framework for tool room.
Inventory management	Flores *et al.*, 2007, Bonney (1994)	Inventory trends and issues
Humanitarian firms	Sheu *et al.* (1994)	PPC issues of non profit firms
Small firms	Kalinic & Forza 2012, Banomyong *et al.* 2011, Kale *et al.*, 2011, Sousa & Aspinwall, 2010, Waddel *et al.* (2007)	Issues of small firms
National	Sharma *et al.* 2012, Hvolby *et al.*, 2010, Kale *et al.* 2010,	Comparing PPC activities

Dincer *et al*. (2006) surveyed the planning process followed in Turkish firms and highlights the linkage between the firm's view on planning and the use of planning techniques. In a versatile manufacturing environment, the master production scheduling

is difficult due to the very complex customer orders and large number of variants of products. The issues in the VM context are listed below:

- The shop floor control systems are insensitive to sudden changes in assembly plans.
- The plan used to gather information from customers are mainly informal.
- The project planning and scheduling need effective integration with the supply planning to maintain delivery commitments.
- The knowledge repositories are to be maintained effectively.

The sector wise listing of the PPC research is given in table 2.6.

The literature review of the PPC in Textile industry (Karacapilidis 1996) reveals the mixed character of textile production which lies between job shop and flow shop. Re-manufacturing firms (Daniel 2000) use hybrid PPC systems including MRP, JIT, OPT and ROP system because of the complex characteristics they possess, like uncertainty in the timing and quality of return, balancing returns with the demand, disassembly, uncertainty in the materials recovered, reverse logistics, materials matching requirements, routing uncertainty and processing time uncertainty.

Research issues in the warehousing operations, planning and control include optimization algorithms and heuristics, trade off between productivity and emergency, to maximize the throughput and capacity planning to reduce the overall cost (Jeroen 1999). Niaf Turki & Homid (2003) revealed that the homogeneity and standardization of materials in construction are lower than that for manufacturing. The number of items involved in the construction is very large. In a project, the process variables are less controllable than in manufacturing. MRP is best suited for the project environment, where as JIT is suitable for production in a steady system.

Conclusions from the review of planning and controlling are listed below:

- Planning and controlling methods for SMEs are not much developed. The crude methods and the rule of thumb are practised in small firms.
- The planning efficiency of ERP systems and the computer based MRP practices are not up to the mark due to the lack of technical feedback.

- The work sophistication methods have progressed to a great extent in modern firms operating in specialised environments. The rule bases and the work flow models have evolved to the satisfactory level, but are situation specific.
- Unpredictable lead times and highly variable shop floor routings result in the limited usage of modern planning and control tools in SMEs.
- Informal way of performing operations, unpredictable demand and less management initiatives inhibit the small firms from using modern PPC methods.

2.8. Operational Differences between Small and Large Firms

SMEs are not smaller replica of large firms; they are very different type of organizations with their own peculiar problems. SMEs are defined and classified in different manner in different countries. It is accepted as a general practice that SMEs are owned by small owners or entrepreneurs, and are managed with smaller resources. They serve small market areas and are mostly indigenous systems. Large business firms are centrally organized and managed in a well-maintained and controlled fashion. Large firms use formal, bureaucratic and growth oriented approach. The management style in an SME is generally, autocratic, egocentric, impulsive and unpredictable (Saini 2008). Table 2.7 gives a comparison of small and large firms.

Small firms are free from formal organizational structure and hence decision making is easier. The structural complexity and the bureaucracy of large firms reduce the timeliness of their actions. The cost advantage enjoyed by the SMEs is challenged by the competition from globalization and liberalization (Beaver 2002). Todd *et al*. (2007) discussed the consequences of this aspect in the context of internationalization of the Indian SMEs. Doom & Milis (2010) studied the SMEs operating in Belgium and observed that the factors, such as a clear scope definition and a standardized infrastructure can not be considered as critical success factors for SMEs because SMEs rely on the input of consultants, who they use as a source of knowledge and experience.

Table 2.7 Comparison of SME and Large Firm

SMEs	Large Firms
1) Started by single entrepreneur or a small group.	1) Corporate ownership.
2) Organization structure is generally flat.	2) More wide, vertical and balanced.
3) Do not have many layers. Owner is at the core.	3) Have multiple and detailed layers.
4) More power distance.	4) Less power distance.
5) More flexibility.	5) Less flexible.
6) Entrepreneurs derive advantage by undertaking operations in terms of flexibility, informality, sustainability and structural adaptability.	6) More formalization and regulatory framework.
7) Focus on operational aspects, neglects people	7) More stable and democratic.
8) Low economies of scale.	8) Higher economies of scale.
9) Exposure, funding, decision-making, strategic allies etc are more critical.	9) More confidant and stable in terms of exposure, funds, decision-making etc.
10) Because of labor-intensive technologies, labor cost affects productivity.	10) Technology management is more efficient because of global and multinational strategies and hence betters productivity.

SMEs failed to deploy formal planning strategies due to the presence of certain barriers. O'Regan (2002) categorized the barriers of the small firms as follows:

1) Inadequate communication between the owner/manager and the workers.
2) Lack of management initiative and co-ordination.
3) Shortfall in employee capabilities and increased employee turn over.
4) Lack of understanding of overall goals and strategies.
5) Longer time for the implementation.
6) Resistance to change.
7) Unanticipated external problems.

Stonehouse & Pemberton (2002) observed the better use of formal planning and use of planning instruments in large firms. In manufacturing SMEs, most of the functional managers are given the charges of other functions and it results in conflicting interests and reduction in the effectiveness of control (Huin *et al*. 2002). Huin reports that more than 85 percent of the firms covered in his study are not producing the items as per the forecast (within an accuracy limit of 5 percent).

The globalization increased the attention to the application of IT (Information Technology) and IS (Information Systems) in business. Knowledge management, innovation and learning are also important for a firm to be competitive. IT is used extensively in areas such as sales and marketing, purchase, accounting, costing, production planning, control and information processing. The practice of both IT and IS are common in large firms due to the presence of adequate infrastructural facilities and management support (Seyal 2000).

Gurmeet Singh *et al*. (2001) reported that the lack of expertise, time, fund and managerial/ technical support influenced the performance of the SMEs. Effective demand forecasting and expensive software for ERP systems are not affordable for the SMEs. Singh *et al* (2010) opined that the flat organization structures resulted in easy decision making for the key person. But the finding suffers from the criticism that the flat structure created frustration among the employees because they are unable to realize their short and mid-term career goals. Islam & Karim (2011) compared the Malaysian small firms and large industries. The government support in getting the infrastructure and being aligned with the social fabric helped the Malaysian small firms to make the advantage over large firms. The orientation around a small group of satisfied customers, the leadership in developing a quality culture and the less formal interpersonal relationship are attributed to this advance by the small firms.

This section reveals the literature reviews differentiating the manufacturing practices of small firms and large firms. Positive aspects of small firms and growth areas, where research can contribute more can be understood form this review.

2.9. SMEs : An Overview

Definition of SMEs by European Union is given as, "The category of micro, small and medium sized enterprises (SMEs) employing fewer than 250 persons and annual turnover not exceeding 50 million Euros and/or annual balance shall total not exceeding 43 million Euro (EC, 2005). Small firms employ less than 50 persons with less than 7 million Euro turnover and less than 5 million Euro total assets, while medium firms employ 50 to 250 workers with 5 to 27 million euro assets and 7 to 40 million euro turnover (Daily & Dollinger (1991); Cromie *et al* (1995); European Commission 2005). Indian Parliament enacted the Micro, Small and Medium Enterprise

Development Act in 2006 (Saini *et al*. 2008). As per the Act, the medium manufacturing or production enterprises are those, which have an investment in plant and machinery between Rupees 50 and 100 million. The micro enterprises are limited to spend an investment within 2.5 million rupees and the small enterprises come with the investment limits between 2.5 and 50 million rupees. Table 2.8 gives a vivid account of SME classification in different countries.

Table 2.8 SME Classification in Different Countries

Category	Country	Category of industry	Criteria
Developed economies	Australia	Manufacturing	< 100 employees
	Germany	SME	< 500 employees
	Japan	Manufacturing	< 200 employees
	USA	SME	20 - 500employees
Developing economies	China	SME	< 100 employees
	Indonesia	SME	< 100 employees
	India	SME	< Rs 200 million in plant and machinery

SMEs are considered as an important business sector because of their role in generating employment, capability to penetrate markets, strong industry links and earning from the export markets (Islam & Karim 2011). Out of 28,335 manufacturing SMEs registered in Malaysia in 1988, 92.6 percent are SMIs and have created 40.2 percent of job opportunities of the whole industry. Yeh (2007) reported that SMEs in Taiwan accounted for 97.8 percent of the business establishments. According to Singh *et al* (2010) in India, SMEs accounted for 95 percent of the total industrial units and contributed 40 percent value addition in the manufacturing sector and contributed 6.29 percent to Indian gross domestic product. SMEs take a very good role in supporting the economy. Table 2.9 lists the contribution of the SMEs to different nation's economy.

Worldwide challenges faced by the SMEs include the need for developing effective strategies to face the global competition. Firms are compelled to increase the performance standards such as quality, productivity, delivery conditions, cost, operations, management and information processing (Singh *et al*. 2008, 2010). SMEs often face the pressures such as maintenance of low defect rates, cost reduction and

competitive pricing, capacity utilization, production performance and conformance to quality (Julien 1995). SMEs must acquire the capacity to make continuous improvement in business and production process for ensuring competitiveness in the long run (Dean & Snell 1996). The worldwide contribution of the SMEs is illustrated in table 2.10.

Table 2.9 SMEs Contribution to the Economy

Country	SME' contribution	Source/Reference
World wide	SMEs make up 25 to 35% of world export, and one-fifth of manufacturing SMEs earn 10 to 40% of sales from export.	OECD 2000, Wen – Chi *et al.* (2008)
India	Indian SMEs account for 95 percent of the total industrial units and contribute 40 percent value addition in the manufacturing sector and contribute 6.29 percent to Indian gross domestic product.	Singh *et al.* (2007, 2010)
Pakistan	68.4 percent of the SMEs are of single person ownership type.	Bhutta *et al.* (2008)
UK	SMEs in UK has increased by 50 percent for the last 25 years and contributing 35 percent of the GDP	Baever, European Commission 2005
US	99.7 percent of business accounts for SMEs. In the year 2000, there are 18.6 million SMEs accounting 58 percent employment contribution and 40 per cent of GDP	Zoysa & Herath (2006)
Ghana	SME sector accounts for the 15.5 percent of employment and 6 percent of the GDP	Boohane *et al.* (2008)
Taiwan	SMEs in Taiwan account 97.8 percent of the business establishments.	Yeh (2007)
Singapore	Manufacturing contribute 25 percent of the GDP of Singapore. More than 100000 SMEs operating in Singapore.	Huin (2002)
Malaysia	Manufacturing contribute 35 percent of the GDP of Malaysia. More than 500000 SMEs operating in Malaysia	Huin (2002)
Brazil	44.6 percent of the jobs are informal with 14.3 being in informal micro and medium sized firms.	ILO Report 2003, Rivera (2007)
Mexico	41.8 percent of the jobs are informal with 17.9 being in informal micro and medium sized firms.	ILO Report 2003, Rivera (2007)
Fiji	37 percent of working population earns from SMEs.	Gurmeet Singh *et al.* (2008)
Turkey	SMEs contribute 99 percent of business and 53 percent of workers in the manufacturing sector	Demirbag *et al.* (2007)

Functioning of SMEs in different countries and the role of SMEs are clarified from the review of SME research literature. In the scenario of globalization, banks and governments are realizing the role of SMEs as the back bone of a nation's economy. The subsequent improvement of the PPC tools of the SMEs can improve their operational performance.

Table 2.10 SME Contribution Worldwide

Country	Share of Total			Criteria for Recognition
	Output %	Employment %	Export %	
India	40	45	35	Fixed assets
USA	--	53	--	Employment
Japan	52	72	13	Employment & assets
Taiwan	81	79	48	Paid up capital & assets
Singapore	32	58	16	Employment & assets
Korea	33	51	40	Employment
Malaysia	13	17	15	Share fund & employment
Indonesia	36	45	15	Employment

2.9.1. Characteristics of SMEs

SMEs are characterized by the limited customer base, operating in competitive and turbulent markets, (Garengo *et al.* 2005), the less control or influence over the markets and the scarcity of resources (Singh *et al.* 2008). Workers and the owner/managers are less trained or skilled, and this resulted in the poor business planning (Pansiri & Temtime 2008; Singh *et al.* 2008). Despite these weaknesses, SMEs attract the research focus because of their smooth and flexible operations, faster decision making and flexible organization structure (Garengo *et al.* 2005).

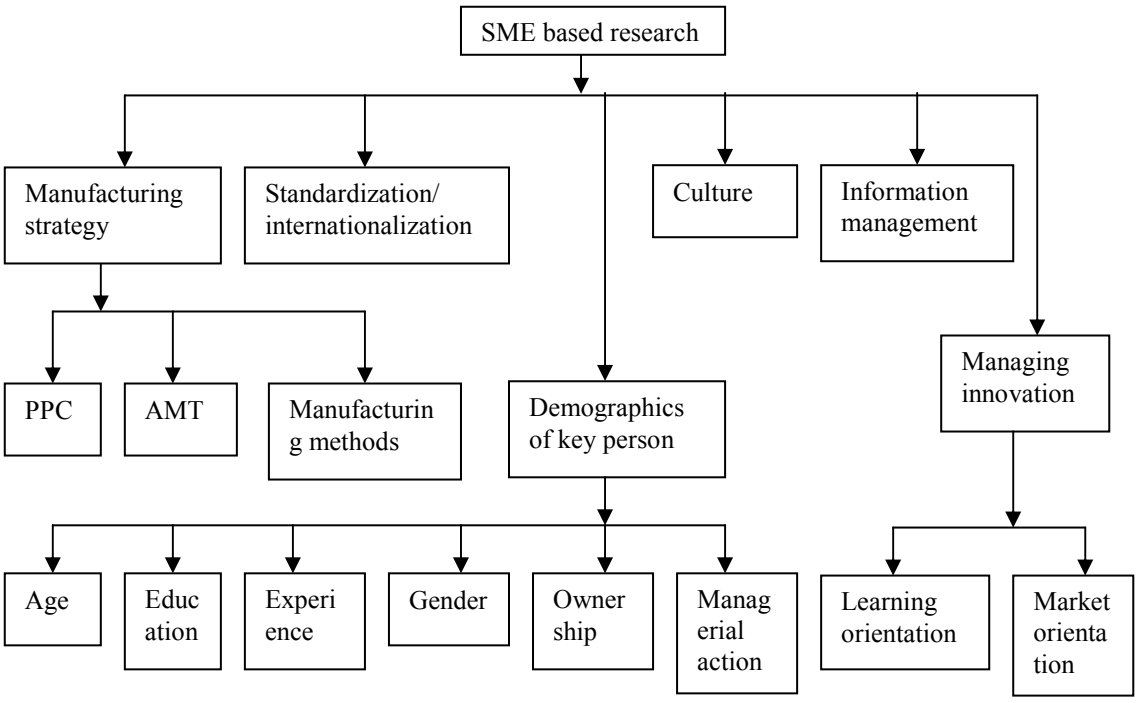


Figure 2.8 The Research areas linked with SME Performance.

The factors influencing the production planning and control and the manufacturing strategy in SMEs are listed as follows (Dangayach & Deshmukh 2001):

1) The sources of power and the influence on individuals and groups.
2) The impact of business and management education of managers.
3) The background and the experience of powerful individual managers.
4) The nature of decision-making process.
5) The external interaction and learning.

SMEs have gained more attention in the modern business environment due to the following reasons: (Breaker 1986; Dangayach & Deshmukh 2001)

1) They contribute to make changes in social and attitudinal engineering.
2) They took part in conforming and legitimizing self- employment.
3) They promote new venture creation and entrepreneurship

The strengths and the weaknesses of the SMEs are represented by the SWOT findings shown in table 2.11.

Table 2.11 SME's Strengths and Weaknesses (Ref: Singh *et al.* 2007; Kalpande 2011)

STRENGTHS	WEAKNESSES
▪ Flexibility: Capacity to absorb new technology, design and processes ▪ Good capital output ratio: Low level of capital investment per unit. ▪ Co-operation: Direct involvement of key persons result co-operation ▪ Quick decisions: Less bureaucracy so easy decision making	▪ Low technical competence. ▪ Lacking infrastructure. ▪ Lacking financial strength. ▪ Resistance to change. ▪ Low management initiative for modernization and standardization. ▪ Lower economies of scale.
OPPERTUNITIES	**THREATS**
▪ Can act as ancillary units of large firms. ▪ Globalization imparts export chances. ▪ More help by banks and government.	▪ Acquisition and merging by large firms result in uncertainty ▪ Open policies increase competition. Survival of the fittest may increase threats.

2.9.2. Working of SMEs in India

In India, the growth pattern of agriculture due to the developments in irrigation reported a rise in labour intensive industries in the past, but now there is a decline in labour requirements because of the increase in capital intensive technologies (Kalpande

et al. 2010). The population growth and the success of educational facilities result in the growth of large surplus labour in the rural area. The increased labour force is absorbed and effectively utilized to a great extent by SMEs (Saini *et al*. 2008).

The classification of the SMEs is based on the number of employees in the respective firms in the rest of the world while in India, the classification is based on the amount invested in plant and machinery (Saini *et al.* 2008). The statistics shows that (Source: Annual Economic Surveys, Govt. of India, different years) the total output contributed by the SSIs have grown up from Rs 1787 billion in 1991-1992 to Rs 4187 billion in 2004-2005. The employment in SSI has gone up from 13 million in 1991-92 to 28.3 million in 2004-2005. SMEs in the component manufacturing sector are of make to order type and not of the engineer to order type (Singh *et al*. 2010). The firms operating in the IT and the IS sector and the technical consultancy follow the engineer to order approach.

The following observations made by Saini *et al.* (2008) are very much relevant for the present day SMEs functioning in India:

1. The success of Indian SMEs depend on the enthusiasm and the competency of a single person (owner/ manager/ entrepreneur), around whom the firm revolves.
2. The people of Indian SMEs believe that informal practices help them minimize cost and provide the necessary in–built flexibility in their operations.
3. The SME entrepreneurs are lacking the vision and the capacity building to grow exponentially.
4. The employee involvement in running the business is not a common practice.
5. No formal performance appraisal system is followed by the firm.
6. The usage of the Information Systems and Technology in forecasting, production planning and control are not adequate.

The country specific challenges faced by Indian SMEs include inadequate e-readiness to share information, lower rate of economic growth, less popularity of e-commerce and poor technological infrastructure (Todd *et al*. 2007). The most important industry specific challenge faced by the manufacturing SME is the increased competition resulted from the withdrawal of protective measures, as part of economic

reforms. The firm specific challenges are related to the accessibility of funding, learning, training and R&D facilities. Dangayach & Deshmukh (2001) revealed that the Indian SME key personnel give priority to the quality over the flexibility. Kale *et al*. (2010) observed that the Indian SMEs have started implementing ERP to integrate the existing information system and found ERP implementation is found beneficial in inventory reduction, improving customer services and communications. Top management support, user involvement and active participation are found to be the reasons of ERP success. The Indian SMEs show a slow and steady growth in export business (as shown in table 2.14, Source: The office of the Development Commissioner (SSI), www.smallindustryindia. com /ssiindia/statistics/export_gr.htm).

The constraints and the pressures of Indian SMEs are presented in table 2.12. Chief issues leading to low performance of Indian SMEs are summarized in table 2.13.

Table 2.12 The Issues of Indian SMEs

Pressures	Constraints
1) Competition has shortened the Product Life Cycle. 2) Product complexity is increased due to new technical breakthroughs. 3) Market and customer uncertainty is more.	1) Owners of SMEs do not have specialist executives to manage internal operations. 2) Limited funding. 3) Less exports. 4) Limited external data gathering. 5) Low Govt. support. 6) Lack of growth conducive environment. 7) Poor training facilities. 8) Underutilized capacity.

Source: Dangayach & Deshmukh 2001

Table 2.13 The Issues Leading to Low Performance of Indian SMEs

1. Indian SMEs lack growth conducive environment and proper Govt. support.
2. The cost, the quality and the delivery time are the main pressures of Indian SMEs.
3. The improvement in process capability, maintenance, product design and reduction of rejection/rework are main strategies to be adopted for cost and quality.
4. Market research and automation are the main priorities to be adopted.
5. Use of information, customer awareness, market changes and optimize decision for defining quality standards are to be improved.

The high-tech boom in the IT sector and the manufacturing sector motivates the Indian SMEs to participate in the international business (Todd *et al* 2007). Liberalization policies have promoted the Government funding and encouraged the exports. At the same time, the agreements such as GATT and ASEAN welcome foreign investment and competition from outside countries. Unlike the giant multinational corporations, SMEs have limitations to enter globally. The IT enabled production planning and control and the e-learning assisted information processing are needed to acquire global competence.

Table 2.14 Growth of SMEs in India

Year	Total SSI units (in millions)	Employment (millions)	Total exports (Billion $)	SSI export (Billion $)	Percentage share
1991-1992	7063	16599	9047	2051	31.5
1992-1993	7351	17484	11024	3652	33.1
1993-1994	7649	18264	14280	5197	36.4
1994-1995	7960	19140	16976	5969	35.1
1995-1996	8284	19793	21838	7489	34.2
1996-1997	8621	20586	24398	8059	33.4
1997-1998	8971	21316	25931	9126	35.2
1998-1999	9336	22055	29076	10057	34.6
1999-2000	9715	22910	32764	11129	34.0
2000-2001	10110	23909	41583	14332	34.5
2001-2002	10521	24909	42658	14629	34.3
2002-2003	10949	26013	51908	17662	34.0
2003-2004	11395	27136	-	-	-

2.9.3. Review of the Working of SMEs Abroad

Malaysian SMEs (Islam & Karim 2010) perform well because of their orientation around satisfied customers, flexibility, leadership qualities, government support and awareness of customer requirements. Land & Gaalman (2009) conducted empirical studies on the selected manufacturing SMEs in the Netherlands. The two common problems of make to order type SMEs identified in the Netherlands are: 1) The inadequate planning overviews for sales decisions and 2) The uncontrolled delays in order driven process planning and procurement. Planning overviews can be improved further by paying more attention by the SME management in the pre-production phase, where there is potential to make significant improvements.

Beaver & Prince (2002) reported that the number of SMEs in UK has increased by 50 percent during the last 25 years and they are contributing 35 percent of the GDP. The United States Small Business Administration (USSBA) reported that over 50 percent of the employees and 45 percent of the wages in the USA are from the SMEs. Singapore accounted for a concentration of more than 100000 SMEs. About 500000 SMEs in Malaysia and three million SMEs in Japan are actively functioning. More than 80 percent of the business transactions and 29 percent of GDP in Singapore are from the SMEs. More than 60 percent of the SMEs in the ASEAN group are managing without any sophisticated planning tools such as ERP (Huin 2002). A study from the Syrian SMEs indicates that SME owner/manager's training is very much correlated with the firm performance (Alasadi 2008).

Perez & Durendez (2007) report that certain differences exist between the family owned and the non family owned firms. The family owned firms give less importance to planning and controlling activities compared to the non family firms. The importance given to learning and training by the family owned firms is also not up to the mark. Based on the experience of SMEs in Ghana, Boohene (2008) comments that the family owners put less effort on planning and less investment is put back in business. Hitt & Tyler (2002) reveal that the educated CEOs generate creative solutions to the SMEs.

In contradiction to the findings about Indian SMEs by Saini *et al.* (2008), Dodgson (1993) studied the European SMEs and indicates that small firms use the innovation efficiently because of their flexibility and speed of response. Yeh (2007) surveyed the SMEs in Taiwan and found that 80 percent of the firms use some sort of innovation. The SMEs of Taiwan ranked fourth globally in the number of US patents received because of their innovative practices. Kalinic & Forza (2012) empirically analyzed the rapid internationalization of traditional SMEs and observed that the SMEs are capable enough for internationalization by means of their specific strategic focus, as opposed to knowledge-intensity, international network, and international experience.

2.10. Improving SME Performance

Compared with the large firms, the SMEs have limited resources and are prone to get affected by external decisions. They also depend on the key person guiding the firm. Even though the SMEs are working under such limitations, many of them are

doing well. The attempts to improve the SME performance have resulted in the following benefits (Cocca & Alberti 2010):

1) More productivity.
2) More employment opportunities.
3) Satisfaction of local needs and balanced regional development.
4) More returns to the economy.
5) Increased export trade.
6) Better linking with the social fabric and customer satisfaction.

To improve the performance, it is required to know the current reality. A wide collection of performance measures are available from business management literature. Linking the SME performance with other variables (such as demographic, cultural, technological etc) indicates the domains for improvement. Qualities of firm performance measures as stated by Cocca & Alberti (2010) are the following:

- It should be derived from the strategy.
- It should be able to link operation with strategic goals.
- It should be simple to understand and use.
- It should be clearly defined.
- It should be relevant and easy to maintain.

Quantitative (performance characteristics directly measurable in numeric terms) and qualitative (performance characteristics measurable in comparative basis) performance measures are commonly used to step up the performance. More systematic and recorded, quantitative measures are reported from the research conducted in large firms (Hall 1982; Cochran 1984; Daily 1992; Greenly 1995; Zahru *et al.* 2000; Wiklund 2005). The SMEs use subjective measures as they are easy to use and are easy to gather (Bhutta *et al.* 2008.) Such studies, however suffer from reduced accuracy (Rosa *et al*. 1996). The informal methods are largely intuitive and depend on individual experiences, but are used when there is insufficient time or data (Karami *et al*. 2008; Smith *et al.* 1996). The sales growth index was used by Zahru *et al.* (2000) and the income growth rate by Saddler *et al.* (2001); Wiklund *et al.* (2005) and Wolff *et al.* (2005) however such measures are often kept secret.

Wijewardhana & Tibbits (1999) observe that the older firms record poor performance than the new firms. Lussier (1995) hypothesized that the firm performance depends on the formal planning, the use of professional consultants, the manager's education level, the standardization followed and the firm size. Grey *et al.* (2002) used the self reported past annual growth, the employment statistics, the actual difference in sales turnover and the total employment as entrepreneurial performance indicators. Operational performance indicators such as the productivity, the product and service quality, the production costs, the flexibility and the integration of the production system are used frequently (Kim *et al.* 1993; Forza 1995; Ariss *et al.* 2000; Swamidas *et al.* 2000 and Cagliano *et al.* 2001). The sales growth, the net margins increase, the share value growth, the sales turnover growth and the increase in productivity and employment were used as the performance indicators by Daily *et al.* (1992).

2.11. Review of the Studies Linking SME Performance

As a small firm revolves round the key person, the demographics of the CEO are the main subject matter for finding out the gaps for improving performance. The key person's age, education, experience, gender, communication, decision making style, power distance, learning, training and computer usage – all these are studied by researchers. The family business, the subsidiary firm and the partnership business - all are studied separately using the relevant theories and are suitably linked with the respective SME environment. However the studies indicated contradictory findings.

2.11.1. Forecasting and Firm Performance

Kan *et al.* (2003) established the negative impact of the forecast error on the business performance. Annastiina *et al.* (2009) analyzed the planning, the capacity and the inventory impacts due to the wrong forecast. Organizations need to improve their judgment in forecasting, for which the knowledge about the source of errors is necessary. Study of the effect of forecast inaccuracy on the inventory cost (Ritzman *et al.* 1993) stressed the need for reducing the effect of forecast error on the managerial decisions and the firm performance.

2.11.2. Planning and Control and Firm Performance

Many of the SMEs plan intuitively and their planning is rarely supported by the planning instruments (Stonehouse & Pemberton 2002). The formal planners are better

performers than the informal planners (Lyles *et al.* 1993 and O'Regan & Ghobadian 2003). The SMEs use lesser amount of written documentation (Robinson & Pearce 1983). They use simple measures of planning intensity. Peel & Bridge (1998) observed that the SME profitability and the goal accomplishment are positively related with the planning detail and the formal budgeting techniques. Research has indicated the positive relationship between the planning and the firm performance (Orpen 1985; Braker & Pearson 1986; Ibrahim 1998). Stevenson *et al*. (2011) commented on the applicability of Work Load Control (WLC) as an effective PPC tool for SMEs and suggested the need for more research input in this area.

The research on SMEs in Ireland, US, UK, Pakistan, Australia, Ghana, Ethiopia, India, Germany and Korea reveal that the entrepreneurs or the CEO's characteristics such as cultural differences, race, gender, age, experience, longevity etc influenced the managerial decision making and there by influence the usage and the quality of PPC activities (Rauch *et al*. 2000; Beaver 2002; Boohene *et al*. 2008; Bhutta *et al.* 2008). Karami (2006) observed that the age, experience and education of the CEO influence the planning decisions. Variyam & Kraybill (1993) observed the lack of strategic planning in independently owned SMEs.

2.11.3. Key person related Variables influencing the Firm Performance

1) Age of the Key Person

The age is inversely proportional to the risk taking (Hombrick & Manson 1984). The younger owner/managers are better educated and more informed so that the current technical knowledge is better utilized by them (Bantel & Jackson 1992). The young managers are characterized by more risk tolerance than the older ones (Roux 1987). However, age and firm performance are interpreted by contradictory findings.

2) Professional Experience of the Key Person

The linkage between the experience of the key person and the firm performance is contradictory in nature. Chan & Foster (2001) highlights the CEO's influence on the firm performance. Piercy *et al.* (1998) confirmed the positive relationship between the experience and the sales growth. Omerzel & Antoncic (2007) studied the Slovanian SMEs and observe that experience enhance critical/analytical thinking, knowledge of

company management and leadership abilities. But Karami *et al.* (2008) have said that there is no significant influence of the key person's experience on the firm performance.

3) Formal and Professional Education of the Key Person

The educated CEOs (formal and professional) are more knowledgeable and are prepared to break away from the traditional knowledge barriers, so that better firm performance is anticipated (Karami *et al.* 2008). Younger CEOs are of less experience but are educated well (Norburn & Birley 1988; Hitt & Tyler 1991). Both the entrepreneurship and management theories suggest that the younger CEOs develop effective strategic plans in SMEs by means of more innovation and interaction (Karami *et al.* 2008). Bhutta *et al.* (2008) surveyed the SMEs in Pakistan and observed that the education influences the production planning, the decision making and the risk taking.

2.11.4. Usage of Information Technology (IT) and Information System (IS)

Bhutta *et al.* 2008 observed a positive correlation between the computer usage and the firm performance. Blili & Raymonds (1997) highlight the importance and usefulness of the Information System Strategies in SMEs. Sharma *et al*. (2006) and Seyal *et al.* (2000) suggested that IT is beneficial to the SME and the IT should be used to support business functions and operational functions. The IS usage is related to the computing environment. The proficiency in both IS and IT usage is a must in the competitive business environment (Seyal 2000). Singh *et al.* (2010) confirmed the positive impact of the IT on the business performance. Sharma *et al*. (2006) commented that only two percent of the firms covered in his study used the computers for demand forecasting.

2.11.5. Usage of Learning

Both the learning orientation and the market orientation are subsets of innovativeness (Keskin 2006). Zhang (1995) observed that learning is required to promote the small firm business but a formalized learning function has not existed in the SMEs. The researchers established the positive correlation between the learning orientation and the firm performance (Aharoni 1994; Saddler & Smith 2001; Keskin 2006).

2.11.6. Usage of Training

Perez & Durendez (2008) observe that the managers of the family firms paid less attention to training as a competitiveness factor than non-family firms. The SMEs lack a

deep knowledge of the accounting principles and they have fewer levels of financial controls (Tabone & Baidacchino 2003). Singh *et al.* (2010) studied the Indian automobile component sector and indicated the significant correlation between the employee training and firm performance. Alasadi *et al.* (2008) observe that, when the SME key personnel became trained, their business performance is improved.

2.11.7. Usage of Standardization

Literature indicates that the standardization procedures improve the firm performance. Street & Fernie (1993) observe that firms go for certification due to customer demand and the competitive pressures. Wenmoth & Dobbin (1994) suggested that the need for a regulatory environment and the internal forces induced the firms to seek the certification. The survey by Reynor & Porter (1991) among the SMEs in the UK indicated that the customer pressure is the driving force for implementing the ISO 9000. SME's experience on the standardization practices resulted in the better quality and the management control (Brown *et al.* 1998).

2.11.8. Characteristics of Entrepreneur Influencing Firm Performance

The entrepreneurs are the first generation owners. They differ from the second generation owners in some respects. The entrepreneurs are characterized by autonomy and independence as the principal motivation for the business management (Beaver & Prince 2002). Small firms exhibit informal and particularistic management style, while large firms are more formal and bureaucratic. Though there is cultural difference among different countries, these findings agree with the working of the Indian firms.

2.11.9. Critical review of the studies linking the use of PPC with SME performance

I. Studies focusing the appropriateness of current forecasting methods are very limited, rather abundant literature focus on the mathematical and technical side. In SMEs, simplicity, ease of use and understandability are vital.

II. Planning and control area is very vast and studies conducted in different countries vary according to the cultural, economic, production and demand aspects. Generalization of the studies is difficult and in certain aspects it is meaningless. Use of vague and unclear firm performance indicators in many studies resulted in ambiguities and contradictory findings.

III. Age, education, experience and culture of the SMEs and ownership style vary among different countries. Though the studies conducted in different countries are leading to clear observation and findings, most of them are beyond generalization.

IV. The use of qualitative data and indicators, especially in the field of SME research often seems to be a limitation to the authenticity of the findings.

V. Use of IT, IS, learning, training etc are found beneficial to the PPC system implementation, but the articles dealing with the detailed discussion of the applicability (ways of implementing them in small firms) are very less.

2.12. Performance Measures and Indicators used in various Research Works

Taticchi *et al.* (2010) reviewed the extensive collection of performance measurement literature concerned to the SMEs and large firms and commented on the lack of adequate performance measurement based literature dealing with the SMEs. Bhutta *et al.* (2008), used the sales per employee as a measure of the firm efficiency and the sales increase or the decrease as a measure of the firm growth. His study also revealed that the characteristics of the key person significantly influenced the firm performance. Rosa (1996) used the profitability index (Mc Kinsey index equal to the ratio between gross profit and net sales revenue) for measuring the performance of SMEs. Such measures are very rarely disclosed by the owners. The sales growth index is used by Zahra *et al.* (2000) and the income growth rate by Woof *et al.* (2005). Getting the quantitative measures such as return on equity, return on assets and return on investment are difficult because such facts are kept secret.

Kraus (2006) related the time period, the degree of formalization and the use of strategic planning instruments with the firm performance. Grey *et al.* (2002) used the self reported past annual growth, the employment statistics, the actual difference in sales turnover and the total employment as entrepreneurial performance indicators. Operational performance indicators such as productivity, product quality, production costs, flexibility and integration of the production system are used by Forza (1995) and Swamidas *et al.* (2000). Table 2.15 lists various firm performance indicators.

Because of the difficulty in getting quantitative measures such as return on investment (ROI) and return on assets (ROA), etc from the SMEs, researchers use qualitative methods for measuring firm performance. Excessive reliance on self reported rating methodology reduced the accuracy of many research findings. The questionnaire

surveys and the schedules suffer from the difficulty to get a positive response for the objective performance norms. SME researchers, instead manage with less efficient subjective norms. This drawback is more predominant in the case of the SMEs, as owner/ manager/ entrepreneurs use their own rule of thumb or intuitive methods.

Table 2.15 Firm Performance Indicators Used by Researchers

Indicators / focus on	Researcher
Sales / employee, Sales increase / decrease	Bhutta *et al.* (2008)
Profitability index, gross profit / net sales, Mc Kenzie Index	Daily (1992)
Self reported performance of sales, Return on equity, Assets, investments (ROE, ROA, ROI)	Winterton *et al.* (2002)
Market share, sales volume, degree of owner/ manager Satisfaction, profitability, returns on investment firm reputation	Cochran, (1984), Hall (1982), Ibrahim (1998), Howard 1992, Saddler (2001) *Neever (1990)*
Sales growth index, Income growth rate	Zahru *et al* (2000), Wiklund (2005), Greenly 1995.
Self reported past annual sales performance, Annual Employment, actual difference in sales turnover, total employment.	Chen – Huang (2008) Grey (1998), White (1996)
Productivity (resource utilization, throughput) Product and service quality, costs, Flexibility	Swamidas 2000, Forza (1995), Ariss (2000), Cagliano (2000)
Integration of the production system	Kim (1993)
Profit growth, cash flow, earning, net earnings per assts, Capital productivity, capital output ratio, rate of return on investment	Kent (1994), Thomas (1981), Chowdhury (1993), Kean (1998) Smallborne (2000).
Ability to meet business, ability to meet domestic needs	Rosa (1996)
Owner/managers age, experience, education, age of the firm	Alasadi. (2008)
Planning, level of education, size of the firm, type of ownership.	Doris *et al.* (2008)

2.13. Conclusion

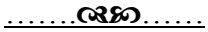
A review of literature indicates the progress in refinement of PPC problems and development of methods to solve them. Though so much is available in research journals but practice of PPC in SMEs is lagging behind and does not use much from the published research. PPC has become widely used by large manufacturing firms but it is not used widely and effectively by the SMEs. Mathematical models for PPC are used mostly through algorithms in software packages. The use of such software package is more in large firms and only managers in large firms are trained to use them effectively. There could be different reasons for poor practice of PPC in SMEs. These reasons need to be explored. Clear division of Forecasting, planning and control, which is seen in many large business is absent in most SMEs, where all these form a single unit.

Literature review resulted in the identification of the following knowledge gaps:

- SMEs do not use PPC effectively, and reasons for low usage are to be explored.
- Role of PPC for improved SME performance need to be studied.
- SMEs are dominated by the key person/persons. Key performance factors linking the attributes of the key person with the use of PPC and SME performance is to be identified.
- The organizational factors influencing PPC and performance are to be studied.
- The key success factors, which promote the use of PPC and firm performance needs to be explored. Also the factors inhibit the performance are to be identified.
- To help estimate the benefits (improved firm performance) to be had from PPC.
- Filling the knowledge gaps will help in developing methods of teaching SME to improve key success factors (by the improved use of PPC) and will help restrict the factors inhibiting the use of PPC. Firm performance can be improved through the betterment of PPC.

The importance of the demographics of key person and organizational factors (such as size of the firm, standardization etc) to improve PPC use, and the firm performance has been realized from the literature review. Benefits of improved PPC usage, revealed from the literature review justified the research problem and its objectives. Also literature provided adequate information to frame the model and to select the research methodology.

Literature review revealed the difficulties associated with the data collection and the analysis in the context of the SMEs. Appropriateness of the self reported rating scales, the use of qualitative data and the convenience cum cluster sampling in SME research (which are used in this research) are revealed from the past research works. Review of the literature has contributed to select the suitable instruments for measuring the PPC usage and tools for analyzing the data.



Chapter 3

LINKING THE USE OF FORECASTING WITH THE SME PERFORMANCE

Contents

This chapter presents the results of the study linking the use of forecasting in the SMEs with the firm performance. Initially the research model and framework are presented. The research design and hypotheses formed are discussed then. Details of the diagnostic tool development are described thereafter. The description of the variables is given in the next section. The exploratory factor analysis and various types of validity tests are described then. Hypotheses test results are discussed thereafter. The chapter concludes with the listing of the ways of improving the use of forecasting in the SMEs and thereby improving the firm performance.

3.1. Introduction

Sanders (1994) pointed out that the unstable business environment increased the complexity of business forecasting. Modern forecasting practices emphasize on statistical methods, still judgmental methods are commonly used (Dalrymple 1987; Mentzer 1995). Informal forecasting methods are prone to bias and errors, but informal methods are frequently used in industries (Hogarth *et al*. 1981; Armstrong 1984). Market based forecasts help plan production, finance and other corporate activities (Herbig *et al*. 1994).

Developments in the economic and business conditions changed the focus of the forecasting methods from the conventional methods (convenience, judgmental and salesmen types) to the quantitative methods. Many SMEs prefer the convenience

forecasting because of the ease of use of such methods and their ignorance of using the higher level techniques (Smith *et al.* 1996). Statistical forecasting methods are least used in SMEs, as they demand basic knowledge, training, confidence and management initiative (Sanders 1994). Use of the forecasting method is rated using the measures of improved production performance, delivery commitments, accuracy, satisfaction and ease of use (Herbig 1994; Makridakis 1995 and Annastiina 2010).

3.2. Description of the Research Model and Framework

In this research work, the linkage between the use of forecasting, planning and controlling with firm performance are studied. Figures 3.1(a) and 3.1 (b) explain the research models used in this study. The firm performance is chosen as the dependent variable. The use of forecasting, standardization, use of training, learning and the demographic characteristics of the key person (such as age, education and experience) are the independent variables linking with the firm performance.

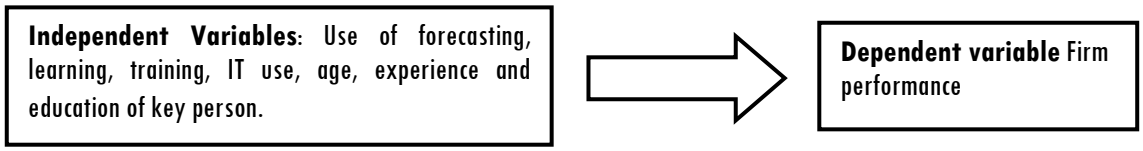


Figure 3.1(a) Model linking Firm Performance with the Independent Variables

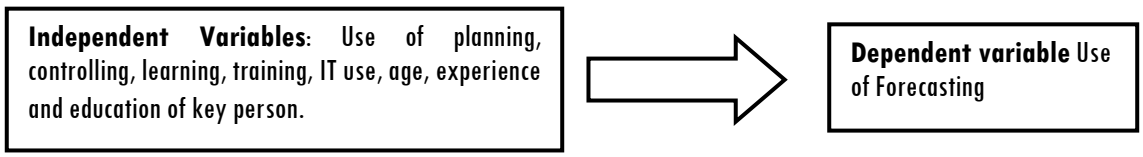


Figure 3.1(b) The Model linking Use of Forecasting with the Independent Variables

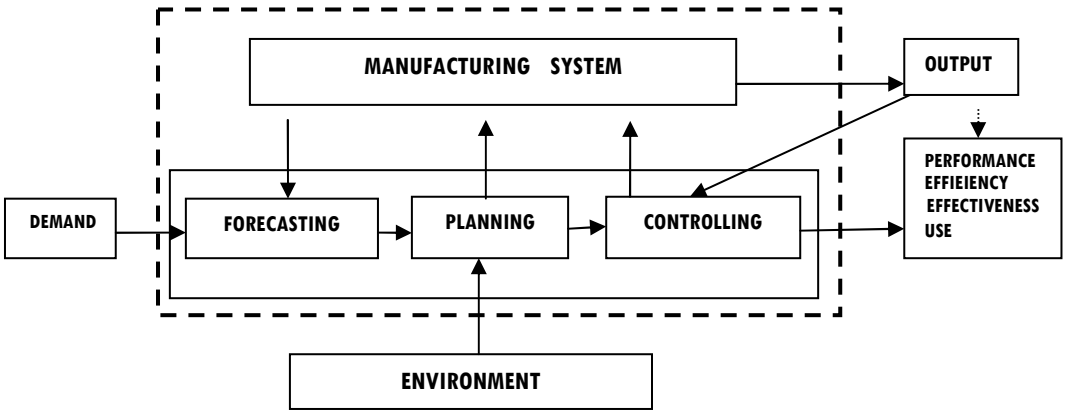


Figure 3.2 The framework link PPC with Firm Performance

A framework linking the PPC functions with firm performance is shown in figure 3.2. Forecast demand is the basis for production and materials planning. Deploying the resources within the capacity and meeting the fluctuating demand needs special skills. The lack of formal PPC knowledge and short term view of the key person results in low firm performance. In this study, the gaps among the forecast, planned and produced quantities have been examined and linked with firm performance. This chapter deals with the linkage between the 'use of forecasting' and firm performance.

The term "Use of forecasting" indicates the forecast choice by the firm. Forecasting models are grouped into two according to the order of complexity. The first group includes the lower order models. Judgmental, convenience and salesmen forecasts are less complex and highly subjective and are grouped as lower order models. The second group includes higher order forecast models in which subjectivity is less and complexity is more. Statistical forecasting methods are grouped as higher order models. The "Usefulness of forecasting" is measured by estimating the parameters such as efficiency, effectiveness and ease of use of forecasting technique. The indicators used by Herbig *et al*. (1994) and Smith *et al*. (1996) namely simplicity, understandability, effectiveness, comprehensiveness, timeliness; accuracy and overall satisfaction are selected as indicators for measuring the usefulness of forecasting, in this research. A structural model used to test the hypotheses is shown in Figure 3.3.

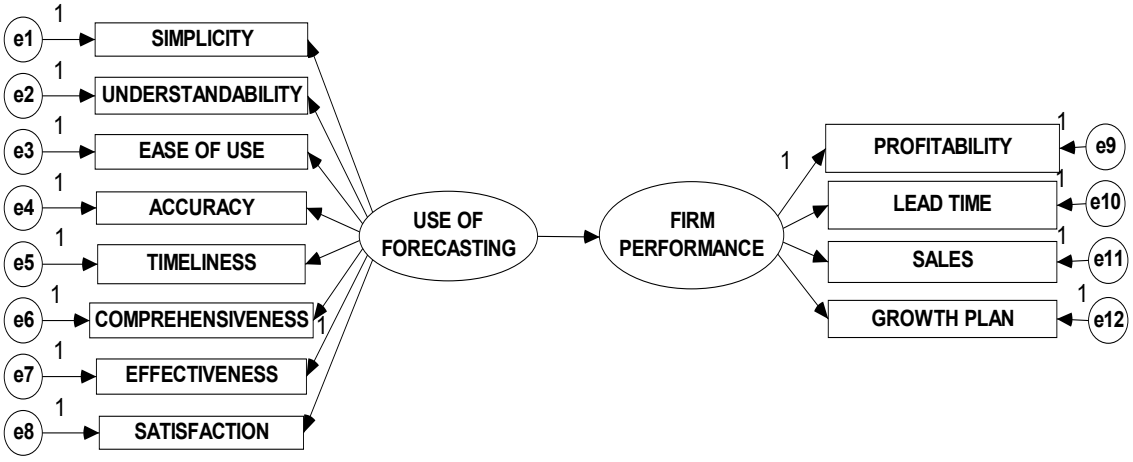


Figure 3.3 The Structural Model for testing the Use of Forecasting

This chapter addresses the following research questions:

- What are the determinant factors, which influence the use of forecasting in the SMEs?
- How do the above factors (as viewed by the CEOs / the owners / the entrepreneurs of SME) influence the use of forecasting and firm performance?
- What conclusions/ generalizations/ steps can be taken to increase the use of forecasting in the SME to improve the firm performance?

3.3. Research Design and the Sampling Design

An exploratory research design was used to link the use of PPC with the firm performance. Propositions linking the dependent and the independent variables were made in the form of hypotheses to be tested (discussed in the next section). Indicators of the variables were selected from the previous research works (explained in section 3.8). A schedule was used to collect responses from the firms selected according to the sampling plan. Detailed description of the validity and reliability tests are given in section 3.9.5. The characteristics of the SMEs included in the survey are given in table 3.1.

Table 3.1 The characteristics of the SMEs Surveyed

Firm size		Age of key person		Experience of key person	
Micro (n ≤ 10)	62	Young	43	< 5 years	113
Small (n 10 to 100)	276	Medium	266	5 – 10 years	178
Medium (n ≥ 100)	44	Old	73	> 10 years	91
Run by owners	124	Education Level : School	173	Production : Make to order	181
Run by managers	188	Pre university & graduate	179	Make to stock	182
Run by entrepreneurs	70	Professional (B Tech, MBA)	30	Assemble to order	19
ISO firms	149	Demand : Dependent	120	Total no. of firms	382
Non ISO firms	233	Independent	262		

The data base of the Small and Medium Enterprises Association of Kerala State was selected as the sampling frame. After reviewing the works of other researchers, (Bhutta *et al*. 2008; Islam & Karim 2010) it was decided to approach the key persons directly. A random sample selection and survey was attempted, but it failed due to very

poor response. Initially the questionnaires were sent, but the response was very poor (about 5 per cent), that too with many items related response missing. The investigation showed that the respondents lacked the knowledge to read, understand and give their responses. Hence it was decided to personally administer the questionnaire among the respondents. Many of the SMEs selected on random basis refused to participate in the survey and therefore a cluster cum convenience sampling had to be used. In respondents so selected an introduction was available with the key person, resulting in their co-operation.

The industrial estates in the seven districts of Kerala State (which contributed major share of manufacturing industries) were selected for the survey. A few firms not located in the industrial estates were also included. Sample size determination is discussed in detail in Appendix V. Letters of introduction from the Rubber Board, the Small Industries Development Corporation (SIDCO), the State Industries Department, the district chapters of Small and Medium Enterprise Association Kerala (SMEA) and the administrative offices of the respective industrial estates were utilized to gain introduction for data collection.

3.3.1. Convenience cum Cluster Sampling

Convenience cum cluster sampling is used as an alternative to collect data in exploratory studies, when the sample size is large and random sampling is no more applicable. In this study, some of the reputed industrial estates, where a large number of SMEs present are selected as clusters and complete enumeration (to the possible extent) was carried out. Also some of the individual SMEs, which operate outside the industrial estate was also included in the study. The use of such type of data collection is more common in SME research (Bhutta *et al*., 2008, Boohene *et al*., 2008).

Sampling frame include the active SMEs registered in the Small and Medium Enterprises Association of the Kerala State. In a particular district, approximately 5000 members are present, of which 3000 active members are present. Among the 30000 to 40000 active members in the state, random sampling is no more applicable because of the uncertainty to cooperate with the study as well as the difficulty in approaching the firm. After knowing the limitations of data collection using the internet or mail data was

collected using questionnaire schedule. Calculation of the sample size is described in Appendix V.

3.4. Research Hypotheses Formed

The studies indicated that the age of the key person is inversely related to the risk taking (Bhutta *et al.* 2008; Karami *et al.* 2008). As the flexibility decreases with increase in age, rigidity and resistance to change increases and so risk taking decreases with age (Karami *et al.* 2008). Higher education levels of key person results in more exposure to learning opportunities and better decision making (Omerzel & Antoncic 2008). The CEOs with high educational background used formal strategic plans (Hendry *et al.* 1998*)*. Kraus *et al* (2008) argue that better contact, guidance and the application of systematic decision making by the educated key person result in better firm performance. Karami *et al*. (2008) observed that experienced key persons managed the firm in a better way. Based on the demographics of the owner/ the manager/ the entrepreneur (hereafter called "key person"), the following hypotheses were proposed in the null form:

H_{01a} : Firm performance is not influenced by the age of the key person.

H_{01b} : Firm performance is not influenced by the education of the key person.

H_{01c} : Firm performance is not influenced by the experience of the key person.

H_{01d} : There is no difference in the firm performance between the ISO 9000 certified and the non ISO certified firms.

H_{01e} : There is no difference in the firm performance between the firms run by the entrepreneurs and the second generation owner/managers.

Singh *et al.* (2010) observed the positive correlation between the employee training and the firm performance. The training given to SME key personnel resulted in the firm growth and the better performance (Alasadi *et al*. 2008). Peterson (1988); Gibb (1997) and Anderson & Boocock (2002) observed that the self-directed, work based and informal learning styles of the SME key personnel resulted in less formal and less structured learning. Use of Information Systems (IS) and Information Technology (IT) in PPC functions by Indian SMEs are reported to be poor (Dangayach *et al.* 2001; Sharma *et al.* 2006; Todd *et al.* 2007). Sharma *et al*. (2006) and Todd *et al.* (2007)

identified the lack of funds, education and awareness as the reason for the low use of computer hardware and software packages. The following hypotheses were proposed to explore the use of training, learning and IT practices in the SMEs.

H_{01f} : Firm performance is not influenced by the firm's training orientation.

H_{01g} : Firm performance is not influenced by the firm's learning orientation.

H_{01h} : Firm performance is not influenced by the IT practices followed in the firm.

H_{01i} : No difference in the firm performance between the firms with less employees and the firms with more employees.

H_{01j} : Firm performance is not influenced by the "type of forecasting".

Large firms used more people to prepare the forecasts and used more effective methods. The SMEs paid little attention to forecasting due to the lower operating volumes, less competition and lack of knowledge (Smith *et al.* 1996). The research indicated that the use of computers for preparing forecasts is less than five percent (Sharma *et al*. 2006). More resistance to change was observed for switching over to formal/statistical forecasting methods by small firms (Sanders 1995). The lack of management support, relevant data and knowledge base are identified as the reasons for the unfit forecasting practice (Smith *et al*. 1996). To evaluate the use of forecasting, following hypotheses were formulated:

H_{02a} : Firm performance is not influenced by the "use of forecasting" by the firm.

H_{02b} : There is no difference in the use of forecasting between the firms run by the entrepreneurs and the firms run by the conventional owner/managers.

H_{02c} : "Use of forecasting" is not influenced by the age of the key person.

H_{02d} : "Use of forecasting" is not influenced by the education of the key person.

H_{02e} : "Use of forecasting" is not influenced by the experience of the key person.

H_{02f} : No difference in the use of forecasting between the ISO and the non ISO firms.

3.5. Questionnaire Development and Pre-testing the Instrument

The questionnaire used in this research consists of five sections. The first section deals with the firm's demographic indicators and measures of the firm performance (there are 12 main questions and 12 sub questions). The second section collects response regarding the awareness of modern PPC techniques (there are 4 main questions and 4 sub questions). The third section deals with the use of forecasting by the firm (there are 6 main questions and 10 sub questions). The fourth section of the questionnaire is devoted to measure the use of planning (there are 7 main and 8 sub questions). Similarly the fifth section measures the use of controlling (there are 13 main and 20 sub questions). The questionnaire schedule is given in Appendix I.

Firm performance is measured using six indicators namely, the sales performance (Daily 1992; Bhutta *et al.* 2008), the growth plan by the firm (Greenly 1995; Bhutta *et al*. 2008), the target achievement (Rosa 1996; White 1999; Singh *et al*. 2010), the profit levels met by the firm (Sadler *et al.* 2001; Wiklund *et al.* 2005), the delivery promptness (Singh *et al*. 2007), the lead time reduction (Daily *et al.*1992). The indicators are measured using a five point Likert's type scale.

Sales performance is selected because it is the drive for operating the firm. The SMEs manage the working capital by re circulating the money returned. Rosa *et al*. (1996); White (1999), Singh *et al*. (2007) and Saini *et al*. (2008) have commented on the importance of the sales performance. The growth orientation reflects the next year's plan for expansion and possibility of future development (Boohene 2007; Todd *et al.* 2007; Bhutta *et al*. 2008). Target achievement reflects the firm's ability to implement the production planning effectively. Profit levels indicate the firms overall performance in the competitive environment. Lead time reduction indicates the firm's ability to plan and act. The indicators collectively measure the overall SME performance.

The second part of the questionnaire reveals the firm's awareness of the use of modern PPC tools. This part of the questionnaire links the intentions of SME key persons with the perceived usage of modern PPC techniques. The third part of the questionnaire collects response about the use of forecasting. For measuring the use of forecasting, eight indicators, namely simplicity, understandability, ease of use, comprehensiveness, effectiveness, timeliness, accuracy and overall satisfaction are used.

Herbig *et al.* (1994) and Smith *et al.* (1996) used the above indicators for measuring the use of forecasting in the industries.

The demographics of the key persons such as age, education, professional experience, type of key person, IT proficiency and learning are used as control variables for the analysis. Size of the organization (the number of employees), production type, product type, demand type etc were also used as control variables and were measured using suitable indicators. Firms were classified into manufacturing, food processing, electrical, electronics and rubber/plastic. The firms were grouped on the basis of manufacturing into make to stock, make to order and assemble to order. The firms were also grouped on the basis of ownership into proprietary, joint stock, new venture, co - operative and government sector. The key persons were grouped into five age groups (less than 30 years in the lowest level to more than 60 years in the highest level). The key person's education was grouped into five (below secondary school at the lower end to professional degree such as the engineering degree or the MBA in the higher end). Most of the questions were of five point Likert type. Such classifications are frequently used in SME research (Karami *et al*. 2006; Singh *et al*. 2006).

The fourth and fifth sections of the questionnaire (for measuring the use of planning and controlling) are discussed in chapters 4 and 5 respectively. The questionnaire was pre-tested with three experts from the university, and three experts from the industry (one industrial consultant, one member of the SME owners association and one advisor of the State Industries Department respectively). After pre-testing with a pilot sample of 50, three questions were dropped and two were modified.

3.6. Data Collection

Data was collected using administered questionnaire schedule. The key persons (the owner/ the manager / the entrepreneurs) were approached to complete the questionnaire. The data collection for the survey was carried between March 2010 and July 2010. A total of 420 responses were obtained. After the full survey and the data entry, it was found that there were 382 completed, usable responses. The same was used for testing the validity and the reliability, which were found to be acceptable, and hence analysis was carried out.

3.7. Analysis of the Data

The preliminary statistical requirements (normality, linearity, colliniarity etc) were tested using SPSS 19. The non parametric correlation between the variables is found significant (except for the respondent's age and experience). The scatter plots, the box plots and the non parametric correlation showed the suitability of the data, for testing the hypotheses (Blaikie 2003). Exploratory Factor Analysis was used to test the suitability of the indicators to measure the latent constructs used in the study such as "Firm Performance", "Use of Forecasting", "Use of Planning", "Use of Controlling", "IT Usage" and "Learning". The adequacy of the sample was checked using Kaiser-Meyer – Olkin criterion and Bartlett's test of sphericity. The communality values and factor loading scores were checked and some indicators were dropped due to non conformity.

Content validity, unidimensionality, reliability, internal consistency, construct validity and convergent validity of the indicators were tested. Satisfactory values of Cronbach's Alpha showed construct reliability. Discriminant validity was ensured by comparing the correlation scores with other scales (Hair *et al.* 2011). A split factor analysis conducted with type of key person as the control variable validated the applicability of the constructs at different levels of control variable. A detailed discussion of the analysis is given in section 3.9.

3.8. Description of the Variables in the study

Particulars of the variables included in the study are discussed below:

3.8.1. Demographics of the Key Person

The age, education and experience of key person were measured on a five point Likert's scale. The key person's age is grouped into five levels. The age less than 30 is indicated by the code 1. Similarly the age ranging from 31-40 is coded 2, the age from 41-50 is coded 3, the age from 51-60 is coded 4 and the age above 60 is coded 5 respectively. The descriptive statistics of the key person's age, education and experience is shown in figures 3.4 to 3.6.

Education of key person has been measured on a five point ordinal scale. No formal education by the key person is coded with a value of 1 and the professional

education was coded with the highest score of 5. Professional experience less than 3 years is coded with a value of 1 and experience more than 20 years is coded with a highest score of 5. A code of 1 was given to the firms with employees equal to or less than 10. Employees between 11 and 50 is coded 2, between 51 and 100 is coded 3 and more than 100 is coded 4. Testing of normality is illustrated in table 3.2. Kolmogorov – Smirnov Z statistic indicated deviation of data distribution from normal distribution.

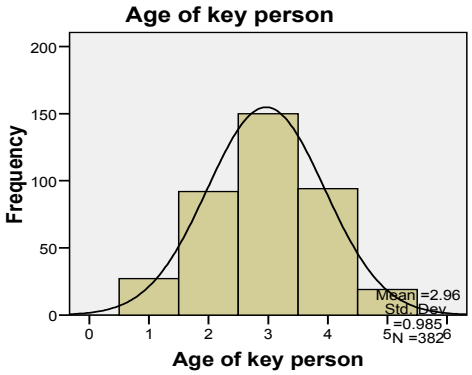


Figure 3.4 Distribution of the Age of Key Person

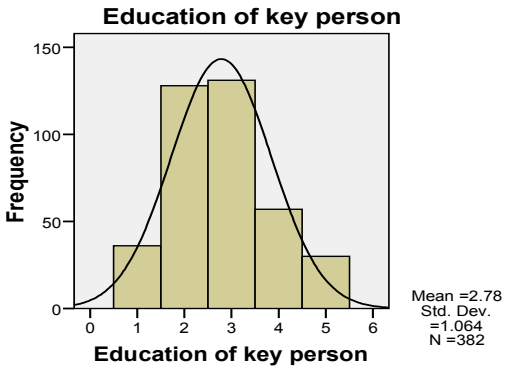


Figure 3.5 Distribution of the Education of Key Person

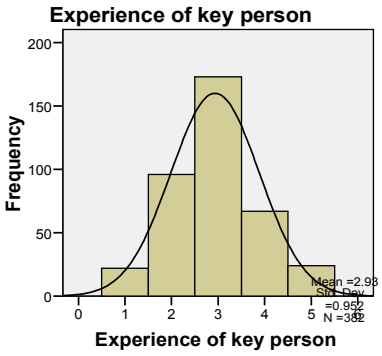


Figure 3.6 Distribution of the Experience of Key Person

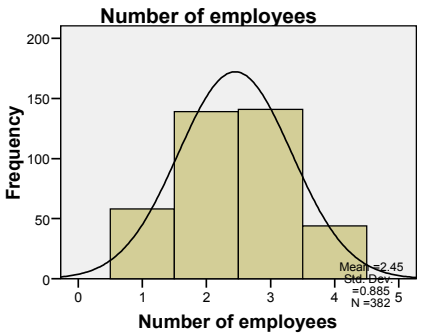


Figure 3.7 Distribution of the Number of Employees

Table 3.2 The Results of Kolmogorov – Smirnov Test for Normality

Indicator		Number of employees	Age of key person	Education of key person	Experience of key person
N		382	382	382	382
Normal Parameters	Mean	2.45	2.96	2.78	2.93
	Standard Deviation	.885	.985	1.064	.952
Most Extreme Differences	Absolute	.218	.203	.198	.234
	Positive	.209	.189	.198	.234
	Negative	-.218	-.203	-.152	-.219
Kolmogorov-Smirnov Z		4.261	3.974	3.878	4.581
Asymp. Sig. (2-tailed)		.000	.000	.000	.000

3.8.2. Indicators of the Firm Performance

There were six indicators of Firm performance as discussed in section 3.5. Descriptive statistics of firm performance is illustrated in table 3.3.

Table 3.3 The Firm Performance Statistics

Indicator	Mean	Standard Deviation	Skewness	Kurtosis
Sales performance	3.65	0.59	-0.47	0.15
Growth plan by the firm	3.41	1.15	-0.42	-0.61
Target achievement	3.6	0.68	-0.07	0.11
Profit levels met by the firm	3.67	0.65	-0.16	-0.05
Delivery promptness	3.68	0.62	-0.29	0.11
Lead time reduction	3.65	0.60	-0.29	0.00
Firm performance index	3.66	0.49	-0.26	0.13

All the firm performance indicators were measured on a five point Likert Scale. Distribution of the overall firm performance is shown in figure 3.8.

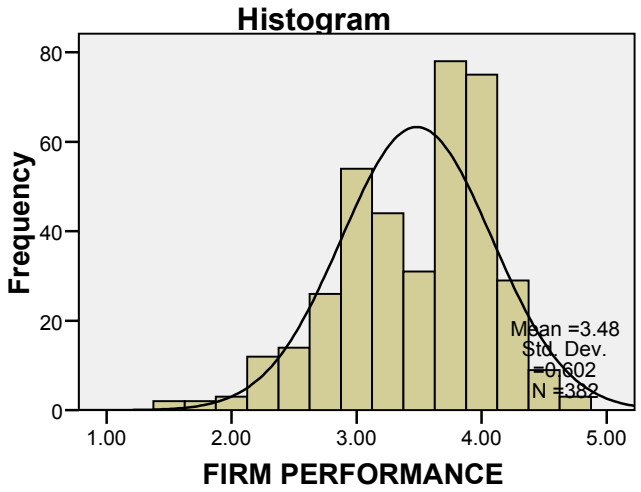


Figure 3.8 Histogram of Mean Firm Performance

3.8.3. Indicators of the Use of Forecasting

The Use of forecasting was measured with eight indicators (Herbig *et al*. 1994; Smith *et al*. 1996). The descriptive statistics is illustrated in table 3.4. The comprehensiveness records a mean score of 3.16 and the mean scores of all other measures range between 3.54 and 3.83.

Table 3.4 Descriptive Statistics of Use of Forecasting

Indicator	Mean	Standard Deviation	Skewness	Kurtosis
Simplicity	3.83	0.55	-0.53	1.11
Understandability	3.78	0.64	-0.39	0.83
Ease of use	3.79	0.62	0.02	-0.27
Effectiveness	3.54	0.76	0.23	-0.39
Comprehensiveness	3.16	0.82	3.83	-0.53
Timeliness	3.64	0.64	3.78	-0.39
Accuracy	3.57	0.65	-0.54	0.36
Overall satisfaction	3.66	0.55	-0.09	-0.64
Use of forecasting	3.64	0.43	-0.06	0.44

3.8.4. Indicators of IT Usage and Learning

The IT usage and the learning orientation were measured using three indicators respectively. The descriptive statistics is shown in tables 3.5. Distribution of the IT use and the learning deviates from the normal distribution. K-S Test results of normality is shown in table 3.6.

Table 3.5 The Descriptive Statistics of Use of Information Technology

Indicator	Mean	Std. Deviation	Skewness	Kurtosis
Extend of use of computers	2.88	1.18	0.13	-0.81
Number of computers used	2.51	0.91	2.88	0.13
Computer proficiency	2.61	1.03	0.48	-0.25
Score of IT Usage	2.73	0.98	0.15	-0.56

Table 3.6 Testing of Normality using Kolmogorov – Smirnov Test

Indicators		Firm performance	Use of forecast rating	Score of IT usage	Score of learning
Normal Parameters(a,b)	Mean	3.4	3.60	2.74	3.54
	Std. Deviation	.60	.50	.93	.54
	Positive	.087	.077	.117	.139
	Negative	-.180	-.101	-.094	-.167
Kolmogorov-Smirnov Z		3.518	1.981	2.283	3.274
Asymp. Sig. (2-tailed)		.000	.001	.000	.000

3.8.5. Nature of Association between the Variables.

The scatter plots and the box plots were used to test the nature of association between the variables and the presence of specific trends and relationships. Figure 3.9 shows the association between the firm performance and the use of learning. Figure 3.10 and 3.11 show the scatter plots of the firm performance with the use of forecasting and the IT usage respectively. Figures 3.12, 3.13, 3.14, 3.15, 3.16 and 3.18 illustrate the variation of the firm performance with different ranges of age, education, experience, standardization, IT usage and learning.

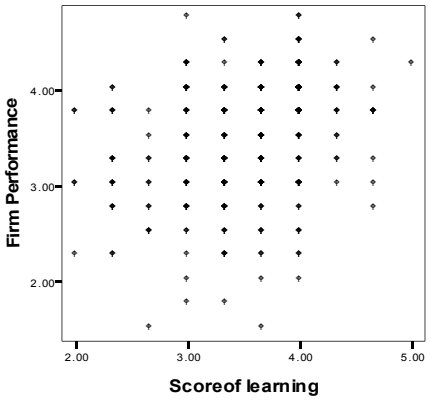


Figure 3.9 Scatter Plot between the Use of Learning and Firm Performance

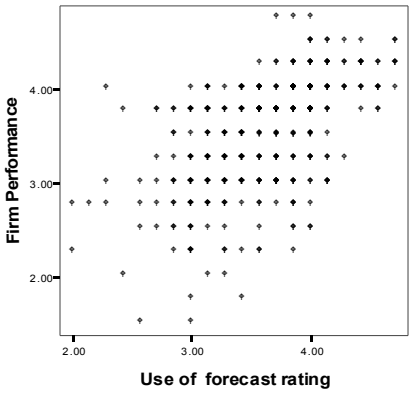


Figure 3.10 Scatter Plot between the Use of Forecasting and Firm Performance

Figures 3.19, 3.20, 3.21, 3.22 and 3.23 show the variation of use of forecasting with standardization, education, IT, learning and the ownership type. No difference in the firm performance is observed for the firms managed by the next generation owners and the entrepreneurs. Better performance is reported from the firms run by the professional managers. The figure 3.10 (scatter plot) and the figure 3.19 (box plot) indicates positive association between the use of forecasting and the firm performance. The firm performance is not influenced by the age and the experience of the key person (figure 3.12). As the education of the key person increases, the firm performance also increases (figure 3.13).

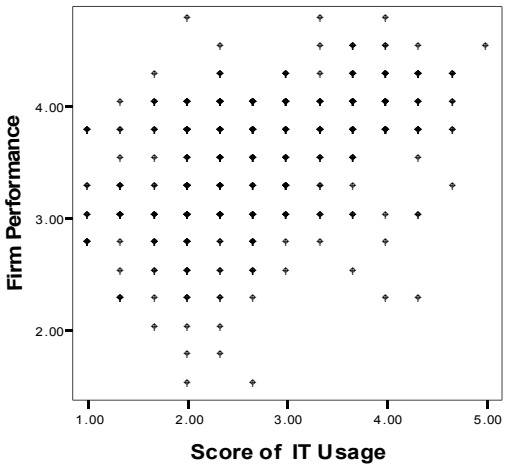


Figure 3.11 Scatter Plot between the Use of IT and Firm performance

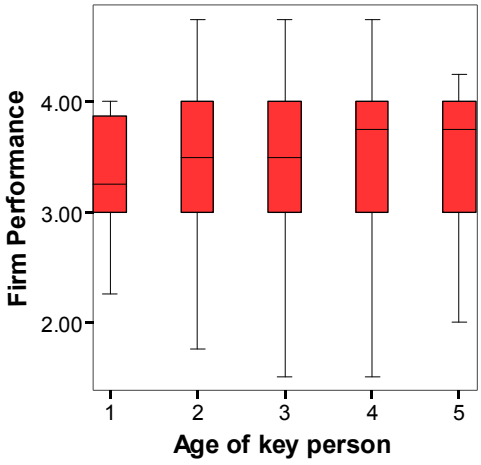


Figure 3.12 Box Plot between the Age of Key Person and Firm Performance

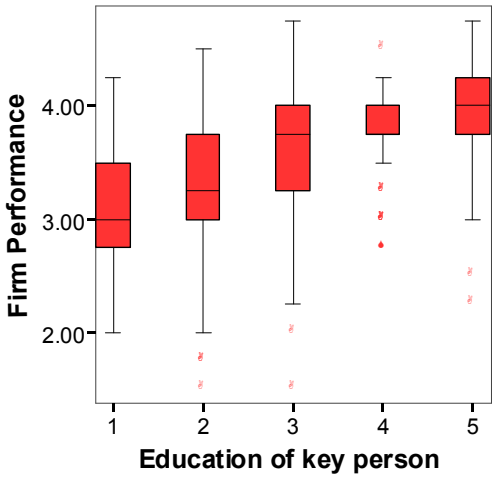


Figure 3.13 Box Plot between Education of Key Person and Firm Performance

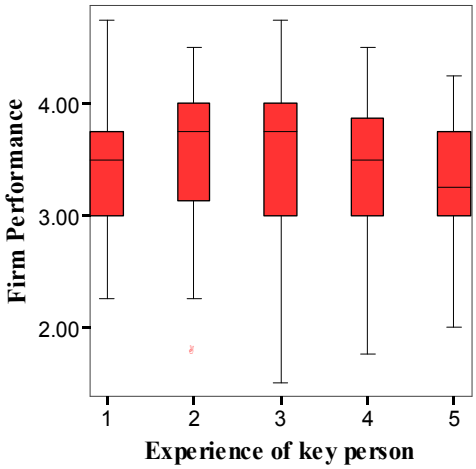


Figure 3.14 Box Plot between Experience and Firm performance

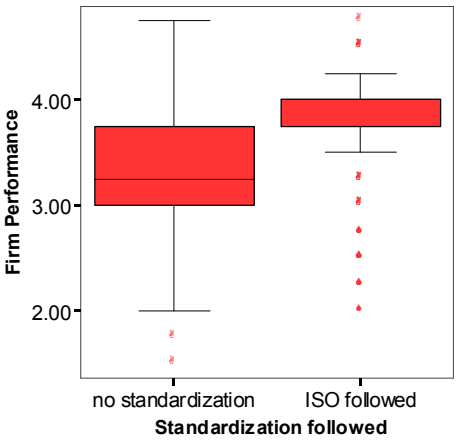


Figure 3.15 Box Plot between Standardization and Firm Performance

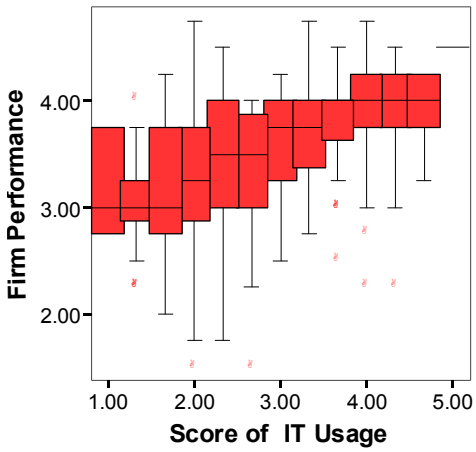


Figure 3.16 Box Plot between IT Usage and Firm performance

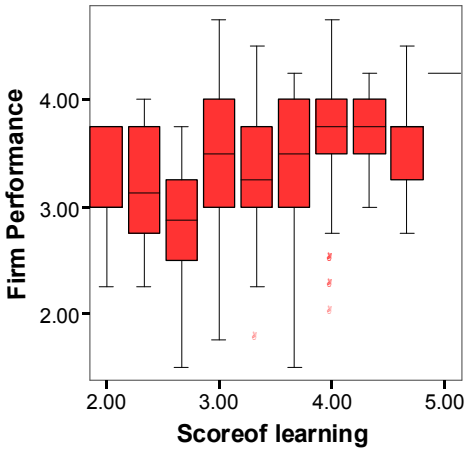


Figure 3.17 Box Plot between Learning and Firm performance

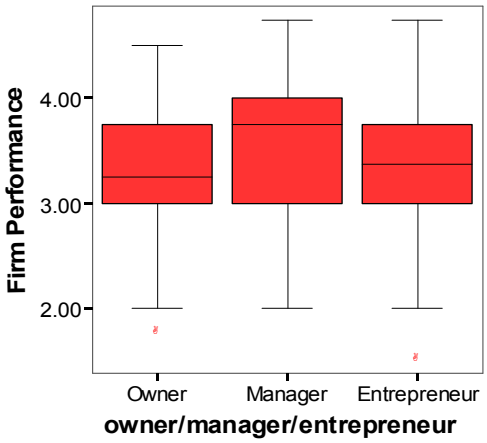


Figure 3.18 Box Plot between Type of Ownership and Firm performance

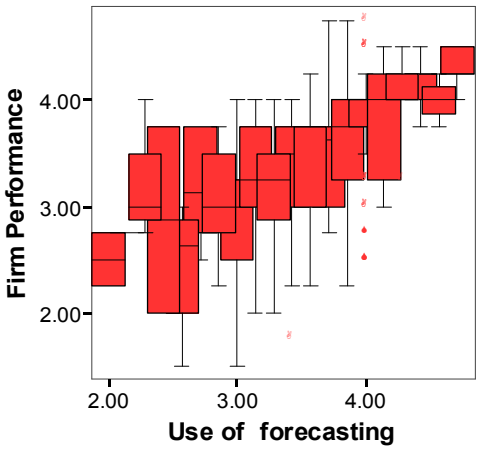


Figure 3.19 Box Plot between use of Forecasting and Firm Performance

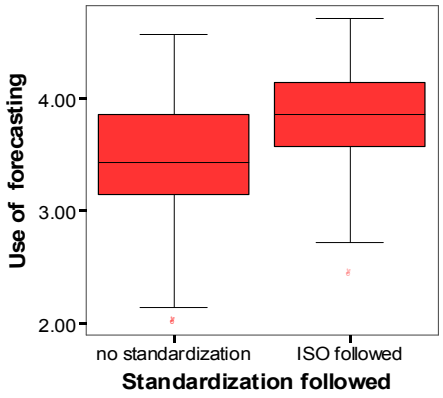


Figure 3.20 Box Plot between Use of Forecasting and Standardization

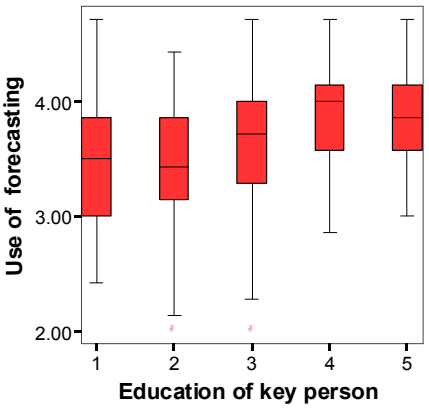


Figure 3.21 Box Plot between Use of Forecasting and education of key person

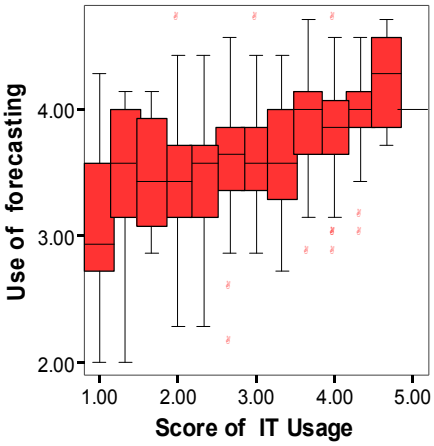


Figure 3.22 Box Plot between Use of Forecasting and IT Usage

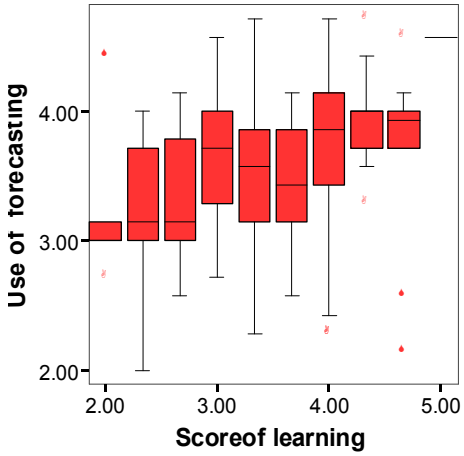


Figure 3.23 Box Plot between Use of Forecasting and Learning Orientation

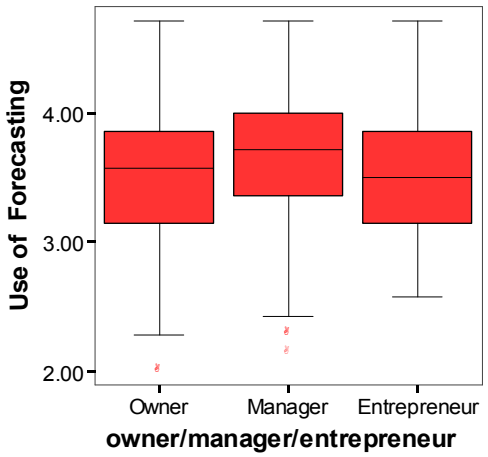


Figure 3.24 Box Plot between Use of Forecasting and Type of Ownership

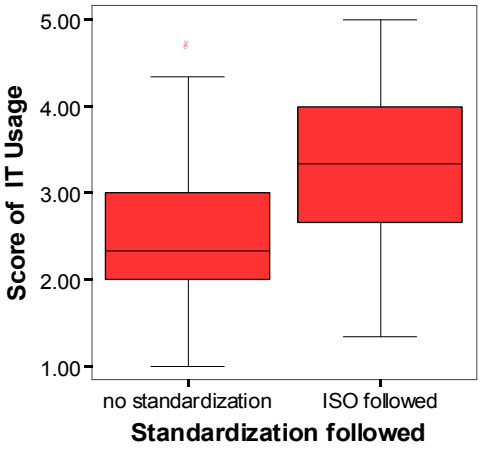


Figure 3.25 Box Plot between Standardization and IT Usage

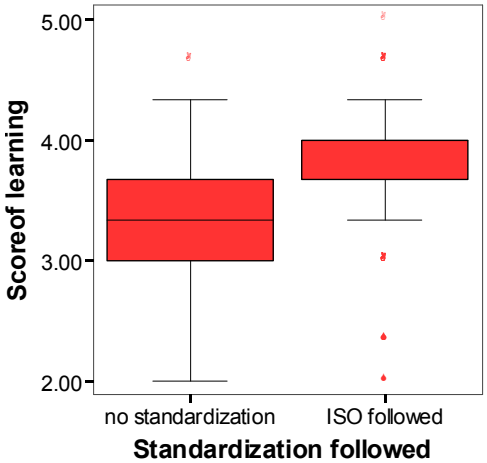


Figure 3.26 Box Plot between Learning Orientation and Standardization

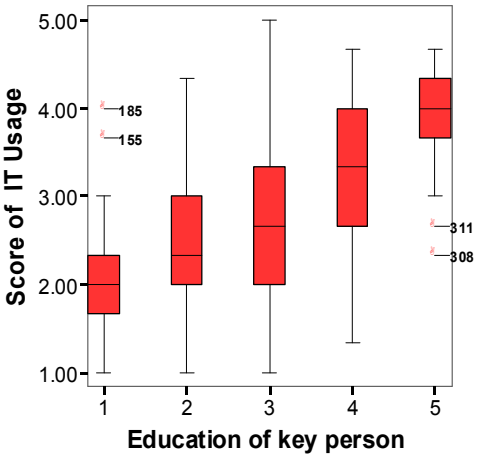


Figure 3.27 Box Plot between IT Usage and Education of Key person

Better use of forecasting and IT usage is reported from the ISO certified firms (Figure 3.22). Learning and IT usage are positively associated with the use of

forecasting. The professional managers are found as better users of forecasting than the owners and the entrepreneurs. The ISO certified firms show better learning orientation (Figure 3.26). Professional managers are better at using IT than the owners and the entrepreneurs. The key person's education influences IT usage (Figure 3.27). More detailed discussion of the relationships is discussed under the section 3.10.

Result of the non parametric correlation between the variables is given in table 3.7. From the table 3.7, it is seen that there is significant correlation among the variables included in the study (except for the key person's age and the experience). The scatter plots, the box plots and the non parametric correlation results prove the suitability of the data for testing the hypotheses.

Table 3.7 Non Parametric Correlation between the Variables

Variable	Firm performance	Use of forecasting	Learning	IT usage	Age	Education	Experience
Firm Performance	1						
Use of	.512**	1					
Learning	.410**	.339**	1				
IT usage	.376**	.424**	.598**	1			
Age	.057	.109*	.149**	.126*	1		
Education	.235**	.295**	.387**	.571**	.112*	1	
Experience	.084	.047	.108*	.083	.619**	-.011	1
Note: All variables were measured on five-point Likert's scale, *p< 0.05, ** p< 0.01							

]

3.9. Exploratory Factor Analysis for factor reduction

The factor analysis is an interdependence technique used to define the underlying structure among the variables used in the analysis. In the factor analysis the information contained in a number of original variables is condensed (summarized) into a smaller set of composite dimensions or variates, termed as factors.

In this study, the exploratory factor analysis (EFA) has been used to fulfill the following objectives:

- To identify the structure of the relationships among the indicator variables (firm performance, use of forecasting, IT usage and learning) selected in this study.
- To check the role and the contribution by each indicator variable to form the factor construct and to reduce variables into limited factor constructs without distortion.

The firm performance, use of forecasting, IT usage and learning are the latent variables. Control variables such as, age, education and experience of the key person, ownership type and standardization were used for the cross validation. Description of indicators is given below:

3.9.1. Firm Performance

Six, self reported type, qualitative measures (adapted from theory and previous research) were used as the indicators for measuring the firm performance. Better performance is indicated with higher values on the scale and it caused subsequent influence (reflection) on the corresponding indicators. Conceptually it is believed that the better performing firms invest more, enjoy more satisfaction, report prompt delivery, take lesser lead times, achieve targets and perform good sales. The conceptual definition of the firm performance and its six indicators are proven and established by the works of Rosa *et al*. 1996; O'Regan *et al.* 2002; Karami *et al*. 2006; Bhutta *et al*. 2008 and Saini *et al.* 2008 (explained in detail in the section 3.5.1.).

A sample size of 382 is found adequate. It is more than the rough estimate of the 15:1 ratio requirement for EFA (between samples and variables) suggested by Hair *et al*. (2011). All correlations are significant at 0.01 level (table 3.8), which confirmed enough multicolleniarity for conducting factor analysis.

Table 3.8 Inter-item Correlation Matrix of Firm Performance Indicators

	Sales performance	Growth plan by the firm	Target achieved	Profit levels met	Delivery promptness	Lead time reduction
Sales performance	1.000					
Growth plan by the firm	.386**	1.000				
Target achievement	.552**	.420**	1.000			
Profit levels met by the	.549**	.307**	.512**	1.000		
Delivery promptness	.436**	.268**	.529**	.561**	1.00	
Lead time reduction	.392**	.272**	.490**	.485**	.575**	1.00
** p is significant at .01 level, *p is significant at .05 level						

Sample adequacy was tested using K-M-O criterion (Kaiser-Meyer – Olkin criterion) and Bartlett's test of sphericity. MSA value more than 0.5 (in this case more than .82) indicates the presence of non- zero correlations between the variables. The Bartlett's test of sphericity (significant at .0001 level) verified the presence of none zero correlations. Thus the combined results of the MSA and the Bartlett's test indicated the

suitability of the data for conducting the factor analysis (Hair *et al*. 2011). The MSA values are shown in table 3.9. A principal component analysis is performed, which resulted in the extraction of components as shown in table 3.10.

Table 3.9 KMO and Bartlett's Test Results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.820
Bartlett's Test of Sphericity	Approx. Chi-Square	627.251
	df	6
	Sig.	.000

Table 3.10 Initial Communality Values

Indicators	Initial	Extraction
Sales performance	1.000	.629
Growth plan by the firm	1.000	.554
Target achievement	1.000	.667
Profit levels met by the firm	1.000	.663
Delivery promptness	1.000	.522
Lead time reduction	1.000	**.414**

The indicator "Lead time reduction" with low communality (0.414) is deleted. The acceptable communality value is above 0.5 (Hair *et al*. 2011). New communality values after deleting the indicator the "lead time reduction" are shown in table 3.11.

Table 3.11 The Communality values after dropping the Factor, "Lead Time Reduction"

	Initial	Extraction
Sales performance	1.000	.660
Growth plan by the firm	1.000	.604
Target achievement	1.000	.708
Profit levels met by the firm	1.000	.693
Delivery promptness	1.000	**.453**

The item delivery promptness is deleted from the analysis, because of the low communality. Communality values after deleting the delivery promptness is shown in table 3.12.

All indicator variables were reduced to a single factor construct (Table 3.13). A satisfactory level of loading (greater than 0.8) was obtained. Factor constructs with

eigen values greater than one were selected. The Scree plot is shown in figure 3.28. Table 3.14 gives the total variance explained by the factor construct.

Table 3.12 The Communality values after dropping the Factor, "Delivery Promptness"

Indicators	Initial	Extraction
Sales performance	1.000	.686
Growth plan by the firm	1.000	.649
Target achievement	1.000	.738
Profit levels met by the firm	1.000	.686

Table 3.13 Factor Component Matrix of the Variable "Firm Performance"

Indicator	Component
	1
Sales performance	.828
Growth plan by the firm	.806
Target achievement	.859
Profit levels met by the firm	.828
Extraction Method: Principal Component Analysis. One component is extracted	

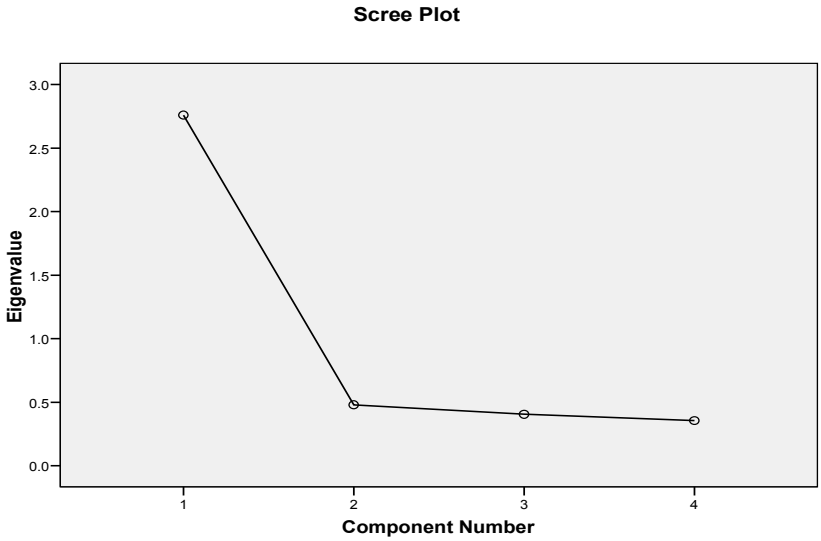


Figure 3.28 Scree Plot of Firm Performance

About 69 percentage of the variability is explained by a single construct. An analysis of the validity and the reliability is given in section 3.9.6.

Table 3.14 Percentage Variance Explained in Factor Analysis

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.759	68.978	68.978	2.759	68.978	68.978
2	.479	11.977	80.956			
3	.406	10.145	91.101			
4	.356	8.899	100.000			
Extraction: Principal component analysis						

3.9.2. The Usefulness of Forecasting

The "Usefulness of forecasting" is defined as the extent by which the forecast used by the SME fits for the purpose. The eight indicators were used to measure the usefulness of forecasting. It is assumed that the more useful forecast scored high and it resulted in subsequent positive influence (reflection) on the corresponding indicators. The descriptive statistics of the indicators of the "use of forecasting" is shown in table 3.15. Inter item correlation indicates that all correlations are significant at .01 level (Table 3.16).

Table 3.15 Descriptive Statistics of the Use of Forecasting

Indicators	Mean	Std. Deviation	Analysis N
Simplicity	3.71	.606	382
Understandability	3.67	.665	382
Ease of use	3.67	.670	382
Effectiveness	3.53	.745	382
Comprehensiveness	3.13	.774	382
Timeliness	3.59	.629	382
Accuracy	3.49	.626	382
Overall satisfaction	3.56	.640	382

Table 3.16 Inter-item Correlation of the Indicators of the Use of Forecasting

Indicators	Simplicity	Understand ability	Ease of use	Effectiveness	Comprehensi veness	Timeliness	Accuracy	Overall satisfaction
Simplicity	1.000							
Understandability	.580	1.000						
Ease of use	.522	.602	1.000					
Effectiveness	.502	.505	.562	1.000				
Comprehensiveness	.351	.341	.360	.432	1.000			
Timeliness	.447	.508	.533	.533	.372	1.000		
Accuracy	.477	.506	.525	.498	.402	.554	1.000	
Overall satisfaction	.483	.555	.542	.512	.419	.502	.541	1.000

The MSA and the Bartlett's test indicate the suitability of the data for factor analysis. MSA values are shown in table 3.17.

Table 3.17 KMO and Bartlett's Test Results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.917
Bartlett's Test of Sphericity	Approx. Chi-Square	1173.770
	df	21
	Sig.	.000

The Principal Component Analysis was used to eliminate the indicators with cross loading. Except for the indicator "comprehensiveness", all the initial communality values are above 0.5 and the indicator variable "comprehensiveness" was dropped. After deleting the comprehensiveness, the factor analysis was again conducted and all the communality values were found acceptable (shown in table 3.18).

Table 3.18 The Communality values after deleting the item "Comprehensiveness"

Indicators	Initial	Extraction
Simplicity	1.000	.551
Understandability	1.000	.629
Ease of use	1.000	.640
Effectiveness	1.000	.583
Timeliness	1.000	.571
Accuracy	1.000	.578
Overall satisfaction	1.000	.590

Table 3.19 shows the total variance explained. About 59.18 per cent of the variance is explained by the first component and is therefore acceptable.

Table 3.19 Total Variance Explained by the Components

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.142	59.176	59.176	4.142	59.176	59.176
2	.610	8.711	67.887			
3	.519	7.409	75.296			
4	.483	6.905	82.201			
5	.460	6.566	88.767			
6	.421	6.020	94.787			
7	.365	5.213	100.000			
Extraction method: Principal Component Analysis						

The factor loading is explained in table 3.20. All factor loadings are above 0.7 (squared factor loading should preferably be above 0.5).

Table 3.20 Factor Component Loading Matrix Extracted

	Component
Indicator	1
Simplicity	.742
Understandability	.793
Ease of use	.800
Effectiveness	.763
Timeliness	.756
Accuracy	.761
Overall satisfaction	.768
Extraction Method: Principal Component Analysis.	

3.9.3. Use of Information Technology (IT) and Information System (IS)

IT Usage is defined as the extent by which the Information Technology and Information Systems are used by the SME. The conceptual definition of the use of IT and its three indicators are proven and established by the works of Blili & Raymonds (1997); Seyal *et al.* (2000) and Bhutta *et al.* (2008). The descriptive statistics of the indicators are shown in table 3.21. Inter-item correlation matrix is shown in table 3.22 and K-M-O and Bartlett's test results are shown in table 3.23. The results indicate the suitability of the data for the factor analysis.

Table 3.21 The Descriptive Statistics of IT Usage

Indicators	Mean	Std. Deviation	Analysis N
Extent of use of computers	2.94	1.090	382
Number of computers used	2.66	.953	382
Computer proficiency	2.64	1.050	382

Table 3.22 Inter-item Correlation Results of IT usage

	Extent of use of computers	Number of computers used	Computer proficiency
Extent of use of computers	1.000	.798	.708
Number of computers used in the firm	.798	1.000	.732
Computer proficiency	.708	.732	1.000
All correlations are significant at .01 level			

Table 3.23 K-M-O and Bartlett's Test Results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.742
Bartlett's Test of Sphericity	Approx. Chi-Square	710.833
	df	3
	Sig.	.000

Table 3.24 The Total Variance Explained by the Components of the IT Usage

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.492	83.077	83.077	2.492	83.077	83.077
2	.308	10.254	93.331			
3	.200	6.669	100.000			
Extraction Method: Principal Component Analysis						

The extraction method using the principal component analysis resulted in the acceptable communality values. About 83 per cent of the variance is explained by the first component (shown in table 3.24). Table 3.25 explains the particulars of the factor loadings.

Table 3.25 Factor Component Loading Matrix Extracted

	Component
Indicators	1
Extent of use of computers	.917
Number of computers used in the firm	.927
Computer proficiency	.890
Extraction Method: Principal Component Analysis. One component is extracted.	

3.9.4. Use of Learning

The learning orientation is defined as the readiness to extract experience and adapt newer knowledge areas (internally and externally) for the improvement in the production performance. The conceptual definition of the learning orientation and its three indicators are established by Anderson & Boocock (2002); Keskin (2006) and Karami (2008). The descriptive statistics of learning orientation is shown in table 3.26. Acceptable inter-item correlation and communality values indicate the suitability of the data for further analysis.

Table 3.26 The Descriptive statistics of Learning Orientation

Indicator	Mean	Std. Deviation	Analysis N
Learning is beneficial	3.72	.622	382
Enough learning opportunities	3.57	.631	382
Outside Learning provided	3.36	.706	382

3.9.5. Validity and the Reliability of the EFA

The content validity, the face validity, the convergent validity and the reliability were tested by the standard methods. Following sections illustrate the details of the respective tests.

3.9.5.1. Testing the Validity and the Reliability of the Use of Forecasting

a) **Content Validity**: It is the assessment of the correspondence of the variables in a summated scale and its conceptual definition. The face validity of the construct was tested from the works by Herbig *et al*. (1994) and Smith *et al.* (1996). The forecasting theory by Sanders (1995); Makridakis (1999) and Wacker *et al.* (2006) provided theoretical evidence for the indicators, for measuring the use of forecasting.

b) **Unidimensionality:** The unidimensionality means the items are strongly associated with one another and collectively represent a single concept. Unidimensionality was confirmed by high loading of items to a single latent construct. All the indicators of the use of forecasting have been reduced to the single factor construct, without any cross loading.

c) **Reliability:** Reliability is the degree of consistency among the multiple items of a factor construct. The reliability was ensured from the Internal Consistency and the Cronbach's alpha.

d) **Internal Consistency**: The internal consistency refers to the consistency among the variables on a summated scale. The item to item correlation values above 0.3 and item to total correlation above 0.5 indicate adequate internal consistency. Table 3.27 explains the internal consistency of items.

Table 3.27 The Correlation data explaining Internal Consistency of Items

	Simplicity	Understand ability	Ease of use	Effectiveness	Timeliness	Accuracy	Overall satisfaction	Total use of forecasting
Simplicity	1	.553**	.506**	.489**	.456**	.470**	.459**	.719**
Understandability		1	.583**	.514**	.505**	.497**	.516**	.760**
Ease of use			1	.542**	.515**	.514**	.527**	.786**
Effectiveness				1	.540**	.497**	.501**	.781**
Timeliness					1	.528**	.474**	.738**
Accuracy						1	.508**	.723**
Overall							1	.742**
** correlation is significant at .01 level of significance								

All correlations are significant and inter- item correlations are found greater than 0.3. The items to total correlations are greater than 0.7. This indicates adequate internal consistency.

1) **Cronbach's Alpha:** It is the reliability coefficient that assesses the consistency of the entire scale. Its value ranged from 0 to 1. Alpha value of 0.6 to 0.7 is considered as the lower limits of acceptability. Table 3.28 shows the alpha values of all indicators. All values are well above the acceptable limit.

Table 3.28 Cronbach's Alpha values of the Items

Indicators	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Simplicity	21.51	9.636	.644	.432	.871
Understandability	21.55	9.161	.701	.513	.864
Ease of use	21.55	9.103	.711	.511	.862
Effectiveness	21.70	8.905	.667	.452	.869
Timeliness	21.64	9.476	.660	.448	.869
Accuracy	21.73	9.474	.664	.452	.869
Overall satisfaction	21.66	9.380	.673	.457	.867

e) **Convergent Validity:** This term is used to assess the degree to which two measures of the same concept are related. The convergent validity is ensured by observing, whether the scale correlates with the other like scales. All indicators of the use of forecasting are well correlated with one another (0.01level of significance) and the good items to total correlations are observed. These findings do establish the convergent validity.

Table 3.29 Testing the Convergent Validity

Measure - Mean	Mean scores Group1(N=124)	Mean scores Group2(N=88)	Mean scores Group3(N=70)	F-value	Significance
Summated scale "Use of forecasting"	3.51	3.70	3.52	6.584	.002
Surrogate variable "Ease of use"	3.56	3.77	3.57	4.529	.011
Correlation between item and summated scale			.836**		

To establish the convergent validity, the summated scale can be compared with a surrogate variable. The t-tests were used to check the similarity of the patterns. The surrogate variable is an individual item (item which loaded with high value) taken in isolation for comparison with the factor construct. The testing of the convergent validity is shown in table 3.29. The mean scores of the use of forecasting and the surrogate variable, "ease of use" were compared among the three groups (firms run by owner, manager and entrepreneur respectively). The original variable and the surrogate variable followed the same pattern of distribution, as evident from ANOVA table.

f) **Discriminant Validity:** The discriminant validity is the degree to which two conceptually similar concepts are distinct. To establish discriminant validity, the "Use of forecasting" scale was correlated with the "firm performance scale". The correlations are positive, but value less than 0.3 establish discriminant validity.

Similarly, the validity and reliability tests for the variables, namely Firm Performance, IT Usage, Learning and Training were conducted and acceptable results were observed. The table 3.30 shows the basis of the content validity of the indicators selected.

Table 3.30 Content Validity of the Variables

Construct	Bases of Content validity
Firm Performance	The face validity is ensured from the works of O'Regan *et al.* (2002); Deshmukh *et al.* (2005); Karami *et al.* (2006) and Bhutta *et al.* (2008). Smith *et al.* (1996); White (1999) and Singh *et al.* (2006, 2007, and 2010), provided empirical evidence for the indicators.
IT Usage	The face validity of the IT usage is tested by Seyal *et al.* (2000) and Bhutta *et al.* (2008). Blili & Raymonds (1997) established the theoretical evidence for the indicators for measuring the use of the IT. The face validity of the learning orientation is tested by Anderson & Boocock (2002) and Keskin (2006).
Learning	The face validity of the learning orientation is tested by Anderson & Boocock (2002) and Keskin (2006).

Table 3.31 illustrates the establishment of the convergent validity of the construct "Firm Performance". Summated scale and the surrogate variable show the

same pattern of relationship, as established by the ANOVA Test. Good correlation between the item and the summated scale is also observed. Internal consistency of the items of the construct "Firm Performance" is established by the high values of the inter item correlation scores and item – total correlation scores (shown in table 3.32).

Table 3.31 The illustration of the Convergent Validity of the construct Firm Performance

Measure	Mean scores Group1(N=124)	Mean scores Group2(N=88)	Mean scores Group3(N=70)	F-value	Significance
Summated scale "Firm Performance"	3.361	3.5997	3.379	7.581	.000
Surrogate variable "Target Achievement"	3.39	3.56	3.330	3.548	.000
Correlation between item and summated scale			.836**		

Table 3.32 Correlation data explaining the Internal Consistency of Items of Firm Performance

Indicators	Sales performance	Growth plan by the firm	Target achievement	Profit levels met by the firm	Total FP
Sales performance	1	.542**	.598**	.602**	.803**
Growth plan by the firm		1	.607**	.534**	.824**
Target achievement			1	.601**	.836**
Profit levels met by the firm				1	.812**
** correlation is significant at .01 level of significance					

3.9.6. Split Factor Analysis and Validation of the EFA Model

To define the underlying structure among the variables and to know whether any similarity or major differences exist among them, the split sample observations were compared. Using the control variables, the "ownership type" and the "education of the key person", split factor analysis was conducted. The objectives of the split factor analysis are described below:

- To test the validity of the factor constructs under the influence of the control variables.
- To identify the difference in the loading pattern due to the influence of the control variables.

3.9.6.1. Split Factor Analysis of the Use of Forecasting

The factor loadings and the communalities for the seven perceptions of the "use of forecasting" were examined with the control variable, the "ownership type". The first group include the firms headed by the professional managers and the entrepreneurs (N = 258). The second group consist of the firms headed by the conventional owners (N = 124).

Both groups showed the same pattern of factor loadings. The items were loaded on a single factor construct in both cases, which supported the theoretical proposition that the indicators correspond to the factor construct, the "Use of Forecasting". A comparative statistics of the factor loadings and the communalities are shown in table 3.33.

The interpretation of Split Factor Analysis: The indicators namely, "Simplicity", "Understandability", "Ease of use" and "Timeliness" are loaded better in sample 2 i.e. the firms run by the owners than sample 1 i.e. the firms run by the managers/ entrepreneurs. It is inferred that the users of sample 1 gave more orientation to the "Usefulness" perspective of forecasting than users of the sample 2. The items including "Effectiveness", "Accuracy" and "Overall satisfaction" are loaded better in sample 2, than those that are in sample 1. Thus the users of sample 2 are more oriented to the "fitness to purpose" perspective (the finding agreed with the findings of Smith *et al.*, 1996). More education and formal practices are attributed for the preference on the "effectiveness of forecasts" by the professional managers than the conventional owners.

Table 3.33 Split Factor Analysis of the Use of Forecasting

SPLIT SAMPLE 1(N = 258)			SPLIT SAMPLE 2 (N= 124)	
Item	Component factor loading	Communality	Component factor loading	Communality
Simplicity	.720	.518	.782	.612
Understandability	.761	.580	.856	.733
Ease of use	.775	.601	.782	.704
Effectiveness	.777	.604	.724	.524
Timeliness	.715	.512	.822	.676
Accuracy	.779	.607	.718	.515
Overall satisfaction	.773	.598	.753	.566
*Sample 1- Firms run by Managers/Entrepreneurs, Sample 2 – Firms run by owners				

3.9.6.2.Split Factor Analysis of the Firm Performance

Using the ownership type as a control variable, the split factor analysis was conducted. Factor loadings and the communalities for the four perceptions of the "Firm Performance" were compared. Comparative statistics of the factor loadings is shown in table 3.34.

Table 3.34 The Split Factor Analysis of Firm Performance

SPLIT SAMPLE 1			SPLIT SAMPLE 2	
Item	Component factor loading	Communality	Component factor loading	Communality
Sales performance	.827	.684	.823	.678
Growth plan by the firm	.797	.636	.814	.662
Target achievement	.850	.722	.882	.778
Profit levels met by the firm	.854	.729	.753	.567
*Sample 1- Firms run by Managers/Entrepreneurs, Sample 2 – Firms run by owners				

The interpretation of Split Factor Analysis: Items are loaded on a single construct in both cases, confirming that the indicators correspond to the factor construct "Firm performance". The "Profit levels met by the firm" is loaded well in sample 1 (firms run by the managers and the entrepreneurs) than those that are in sample 2 (firms run by the owners) which indicate that the users of sample 1 give more orientation to the "Systematic control" perspective than the users of sample 2.

3.9.6.3. Split Factor Analysis of the IT Usage.

Using the 'ownership type' as the control variable, the loadings and the communalities for the three perceptions of the "IT Usage" were compared. Items were loaded to a single construct, which support the theoretical assumption, stating that the indicators correspond to the construct "IT Usage". No specific differences were observed.

3.9.6.4. Split Factor Analysis of the Learning Orientation.

The loadings and the communalities for the three perceptions of learning orientation were compared. Comparative statistics are shown in table 3.35. Split factor analysis agreed with the theoretical proposition, stating that the indicators correspond to the factor construct "Learning Orientation". A better learning orientation is observed in the firms run by the managers and the entrepreneurs than the firms run by the owners.

The findings from this study agree with Saini *et al.* (2008) who stated that the SMEs driven by the conventional owners put low priority to learning. Such firms are managing by means of autocratic/ egocentric styles and enforce their views/ perceptions on the firm.

Table 3.35 The Split Factor Analysis of Learning Orientation

SPLIT SAMPLE 1			SPLIT SAMPLE 2	
Item	**Component factor loading**	**Communality**	**Component factor loading**	**Communality**
Learning is beneficial	.826	.683	.819	.671
Enough learning opportunities	.856	.733	.812	.659
Outside Learning provided	.837	.700	.823	.677
*Sample 1- Firms run by Managers/Entrepreneurs, Sample 2 – Firms run by owners				

3.10. Kruskal – Wallis Test Results

The Kruskal –Wallis Chi square test is used to test the difference among groups not having normal distribution (Darren George 2008). The bivariate tests link one independent variable with one dependent variable at a time. The combined influence is studied under the title "multivariate tests" and is discussed under section 6.1. Before conducting the Kruskal –Wallis Chi square test, the correlation between variables is observed. The non parametric correlation (Spearman's correlation) between the variables is shown in table 3.36. Most of the correlation values except a few (related to the demographics of the key person) is significant at .01 and .05 level respectively.

Table 3.36 Spearman Correlation between Variables

Variable	Firm performance	Use of forecasting	Learning	Training	IT usage	Age	Education	Experience
Firm Performance	1							
Use of Forecasting	.512**	1						
Learning	.410**	.339**	1					
IT usage	.376**	.424**	.598**	.257**	1			
Age	.057	.109*	.149**	.135*	.126*	1		
Education	.235**	.295**	.387**	.207**	.571**	.112*	1	
Experience	.084	.047	.108*	.147*	.083	.619**	-.011	1

3.10.1. Results of the Tests Linking with the Firm Performance

Kruskal –Wallis Chi square test was used to test the hypotheses mentioned in section 3.4. The difference among the scores of the dependent variable (use of

forecasting) is compared among the two groups, namely the low and the high level users. In order to define the low and the high level users, the control variables such as the type of the owner, the number of employees, the demographics of key person, the IT usage, the standardization followed and the training orientation were used. The test results are summarized in table 3.37.

No significant difference in the firm performance was found between firms run by the younger and the older key persons and hence the hypothesis H_{01a} is accepted. Karami (2006) argued that the lower age of the key person result in the increase in the firm performance. Such a finding is not observed in this study. A χ^2 value of 42.987 (significance at p = .0001) rejected the null hypothesis H_{01b} stating that there is no difference in the firm performance between the firms run by the educated and the less educated key persons. Education of the key person is positively associated to the firm performance. The findings do agree with the observations of Ahmed (1997); Karami *et al*. (2006) and Bhutta *et al*. (2008).

The null hypothesis H_{01c}, stating that there is no difference in the firm performance between the firms run by the more experienced and less the experienced key persons was accepted. No significant correlation between the 'experience of key person' and the 'firm performance' was observed. This finding differs from the findings of Reid (1983); Piercy *et al.* **(**1998) and Singh *et al*. (2008), who linked the key persons experience with the firm performance. The null hypothesis H_{01d} stating no significant difference in firm performance between ISO and non ISO certified firms is rejected. Better performance was reported from ISO 9000 certified firms.

Table 3.37 The results of the Hypothesis Tests linking with the SME Performance

Difference in the use of Firm Performance (Dependent Variable)				
Independent Variable	**Kruskal -Wallis Chi square**	**Significance**	**Influencing dependent variable**	**Type of relationship**
Age: Young < 40 years, Aged > 40 years	2.816	.093 (NS)	NO	No relation
Education: Low (Pre university and below), Higher level (Graduate and professional)	42.987	.000	YES	Positive
Experience: Less experienced < 8 years, More experienced > 8 years	.304	.581(NS)	NO	No relation
Below and above level users of Standardization.	72.302	.000**	YES	Positive
Between Owner/Manager/Entrepreneurs	14.492	.001**	YES	Positive
Below and above level users of training			YES	Positive
Below and above performers of "Use of Learning".	13.667	.000**	YES	Positive
Below and above performers of "Use of IT".	60.774	.000**	YES	Positive
Number of employees	65.439	.000**	YES	Positive
Below and above level "Use of forecasting"	35.35	.01	YES	Positive
Note: Kruskal –Wallis Test - variables measured on Likert's five-point scale (1 – low score; 5 high score; scores 3 and less were considered below level and more than 3 were considered above level); mean value; SD- standard deviation. *: $p<0.05$; **: $p<0.01$.NS-Not statistically significant.				

The test conducted among the firms headed by the conventional owners /managers / entrepreneurs resulted in a χ^2 value of 14.492 (p = .001) and thereby rejected the null hypothesis H_{01e}. Better firm performance was reported by the firms managed by the professional managers than the firms managed by the owners and the entrepreneurs. A χ^2 value of 13.667 (p = .001) rejected the null hypothesis H_{01g}, stating no difference in firm performance between the firms with more and less learning orientation. Positive association between the learning orientation and the firm performance was observed. Positive association between the IT usage and the firm performance was observed and the null hypothesis, H_{01h} was rejected.

The test conducted among the firms with different number of employees (three groups) resulted in a χ^2 value of 65.439 (p = .001), thereby rejecting the null hypothesis H_{01i}. Better firm performance is reported by the firms having more employees.

The null hypothesis H_{01j} (means that there is no difference in the firm performance among different types of forecasting used) is rejected. The firms using higher order forecasting methods reported better firm performance than the firms using the lower order forecasting methods.

3.10.2. Results of the Tests Linking with the Use of Forecasting

The results of hypotheses tests linking with the use of forecasting is listed in table 3.38.

Table 3.38 Results of Hypothesis Tests linking with the Use of Forecasting

Difference in the Use of Forecasting (Dependent Variable)				
Independent Variable	**Kruskal - Wallis Chi square**	**Significance**	**Influencing the dependent variable**	**Type of relationship**
Below and above level performers of "Use of forecasting"	9.813	.001	YES	Positive
Between Owner/Manager/Entrepreneurs	14.492	.001**	YES	Positive
Age: Young < 40 years, Aged > 40 years	11.107	.001**	YES	Positive
Education: Low (Pre university and below), Higher level (Graduate and professional)	36.662	.000**	YES	Positive
Experience: Less experienced < 8 years, More experienced > 8 years	.780	.377(NS)	NO	No relation
Below and above level users of Standardization.	48.562	.000**	YES	Positive
Below and above level "Use of IT Usage".	44.427	.000**	YES	Positive
Below and above level "Use of Learning".	41.698	.000**	YES	Positive
Number of employees	42.195	.000**	YES	Positive
Note: Kruskal –Wallis Test - variables measured on Likert's five-point scale (1 – low score; 5 high score); mean value; SD- standard deviation. *: p<0.05; **: p<0.01.NS-Not statistically significant.				

The hypothesis test conducted among the firms with the low and the high level users of forecasting resulted in a χ^2 value of 9.813 (p = .001). The null hypothesis H_{02a} stating no relationship between the use of forecasting and the firm performance is rejected. Thus the forecasting is found influencing the firm performance. The null hypothesis H_{02b} is rejected and observed that the type of the key person influenced the use of forecasting. Professional managers used the forecasting in a better way than the entrepreneurs and the next generation owners.

Better use of forecasting is reported by the younger key persons and the null hypothesis H_{02c} is rejected. Similarly the null hypothesis H_{02d} is rejected because more educated key persons reported better use of forecasting than the less educated key persons. With a χ^2 value of .780 (p = .377) it is not possible to reject the null hypothesis H2e, stating no difference in the use of forecasting between the firms run by the experienced and the less experienced key persons. It is concluded that the experience of key person is not influencing the use of forecasting.

Firms with the ISO certification resulted in better use of forecasting and hence the hypothesis H_{02f} is rejected. The null hypothesis H_{02g}, stating that there is no difference in the use of forecasting between the firms with more and less learning orientation is rejected. Positive association between the learning and use of forecasting is observed. Similarly, positive association between the use of IT and the use of forecasting is observed and the hypothesis H_{02h} is rejected.

The test conducted among the firms with different number of employees (three groups) resulted in a χ^2 value of 42.195 (p = .001), thereby rejecting the null hypothesis H_{02i} (stating that there is no difference in the use of forecasting between the firms with more and less number of employees). Better use of forecasting is reported in the firms having more number of employees.

3.11. Research Findings and Conclusion

Firms using higher level models of forecasting are seen to perform better than the users of the lower level models. The lower level forecast users record an average firm performance score of 3.2, while the higher level forecast user record 3.6. The split factor analysis revealed that the conventional owners preferred the usefulness aspect of forecasting (indicated by "Simplicity", "Understandability", "Ease of use" and

"Timeliness") while the professional managers and the entrepreneurs preferred fitness to purpose aspects of forecasting (indicated by the "Effectiveness", the "Accuracy" and the "Overall satisfaction").

Analysis of the firms headed by the different types of key persons indicates that the firms headed by professional managers have better firm performance. The professional managers are more oriented to education, IT usage and learning than the entrepreneurs and the owners. It is observed that the younger managers are more educated but there is no significant difference in the firm performance between firms with the young managers and the firms run with the old managers. These findings lead to the conclusion that being informal and following unstructured processes helped SMEs minimize the cost and provide the necessary in – built flexibility in their operations, as already reported by Saini (2008).

The firms headed by the professional managers as the key person record an average firm performance score of 3.6, while the firms headed by owners report an average performance score of 3.36 and those firms headed by the entrepreneurs report an average firm performance score of 3.38. Certification processes such as the ISO 9000 insist formal procedures, record keeping and collective decision making. The ISO certified forms reported better firm performance and usage of forecasting. This finding agrees with the observations of Brown *et al*. (1998). Certification is recommended to SMEs because it results in better awareness, exposure and the use of formal procedures.

The higher level users of IT record a firm performance score of 3.82, while the lower level users of IT record a performance score of 3.33. Similarly the firms with the high learning orientation report an average firm performance score of 3.55, while the firms with the low learning orientation report a score of 3.27. These findings indicate the need of giving more attention to impart e-literacy and IT usage to improve the PPC usage and firm performance.

The lowest firm performance score of 2.91 is reported from the firms with less than 10 employees, while it is 3.86 for the firms with more than 100 workers. The use of forecasting score is 3.4 in the case of firms with less than 10 employees, while it is 3.97 for the firms with more than 100 workers. These two findings indicate that the team work and knowledge sharing are more in the firms employing more workers. The

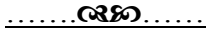
finding agrees with Karami *et al*. (1996) and Mahmoud *et al*. (1996) stating the more team work for the improved firm performance.

The analysis linking the type of product, process and demand with the firm performance and the use of forecasting are dropped from the analysis, as they are not yielding any interesting results.

3.11.1. The ways of Improving the Use of Forecasting and SME Performance

The ways of improving the use of forecasting in SMEs and thereby improving the firm performance are summarized below:

- Other than the individual and the convenience forecasting, the SME key persons should choose the statistical forecasting techniques. The higher order forecasting is more realistic and is contributing to the improved firm performance.
- The professional managers report better use of forecasting and produce improved firm performance. The professional managers are more educated and used more of the IT facilities. The entrepreneurs and the owners should learn and practice more of the advanced PPC techniques (IT enabled forecasting and other activities) for improving the performance.
- Since ISO certified firms have better firm performance, ISO certification is recommended for SMEs.
- Educating the key person and the employees to learn modern forecasting methods (suitable to the firm) is recommended.



Chapter 4

LINKING THE USE OF PLANNING WITH THE SME PERFORMANCE

Contents

This chapter presents the details of the research methodology and the results linking the use of planning with firm performance. The research model and methodology are presented in the beginning. The schedule used for data collection is discussed then. The Hypotheses formed are discussed thereafter. The indicators used in the study are described then. In the next section, the nature of association between variables is graphically analyzed. Steps of the exploratory factor analysis and the validity tests are explained then. The hypotheses test results are discussed thereafter. The chapter concludes with the listing of the ways of improving the use of planning and thereby improving firm performance.

4.1.Introduction

It is already seen in chapter 3, that the use of forecasting is positively influencing firm performance. As the production firm grows, professional planning is necessary for effective control because of the increase in environmental complexities (O'Regan & Ghobadian 2002). Braker *et al.* (1986) observed positive linkage between, production planning and firm performance. Subsidiary firms use planning in a better way because of their familiarity with resource management (Variyam & Kraybill 1993). The key person's characteristics - race, gender, education, age and experience - influence managerial decision making and the usage of the PPC (Beaver 2002; Bhutta *et al.*

2008). Peel & Bridge (1998) observed that SME profitability and goal accomplishment are influenced by the planning detail and the formal budgeting techniques. Poor planning and controlling in SMEs are attributed to the negligence of the owners and reliance on the rule of thumb (Singh *et al.* 2007; Saini *et al.* 2008).

4.2. Description of the Research Model, Framework and the Methodology

In this chapter, emphasis is given to link the characteristics of the SMEs with the use of planning and firm performance. "Use of planning" indicates the choice of the planning by the SMEs. Using this latent construct, the usefulness of planning to achieve firm performance was measured. Fourteen indicators were used to measure the latent construct "Use of Planning".

Following research questions were proposed with respect to the SMEs:

- What are the factors, which influence the use of planning in the SMEs?
- How do the above factors (as viewed by the key persons of the SME) influence the usage of planning to improve the firm performance?
- What conclusions/ generalizations can be drawn/ steps can be taken to increase the use of planning in the SME to improve the firm performance?

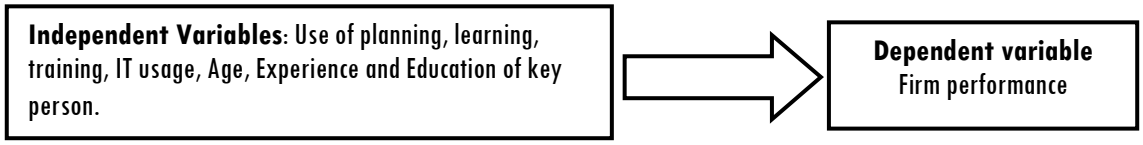


Figure 4.1(a) Model linking Firm Performance with independent variables

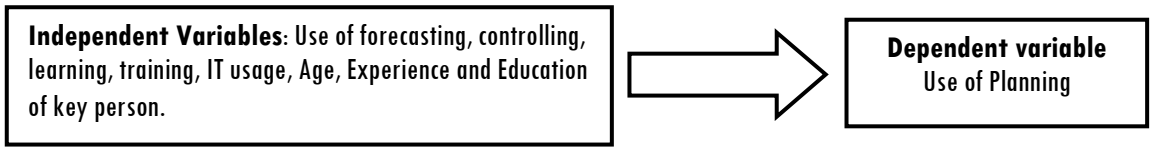


Figure 4.1(b) Model linking Use of Planning with Independent Variables

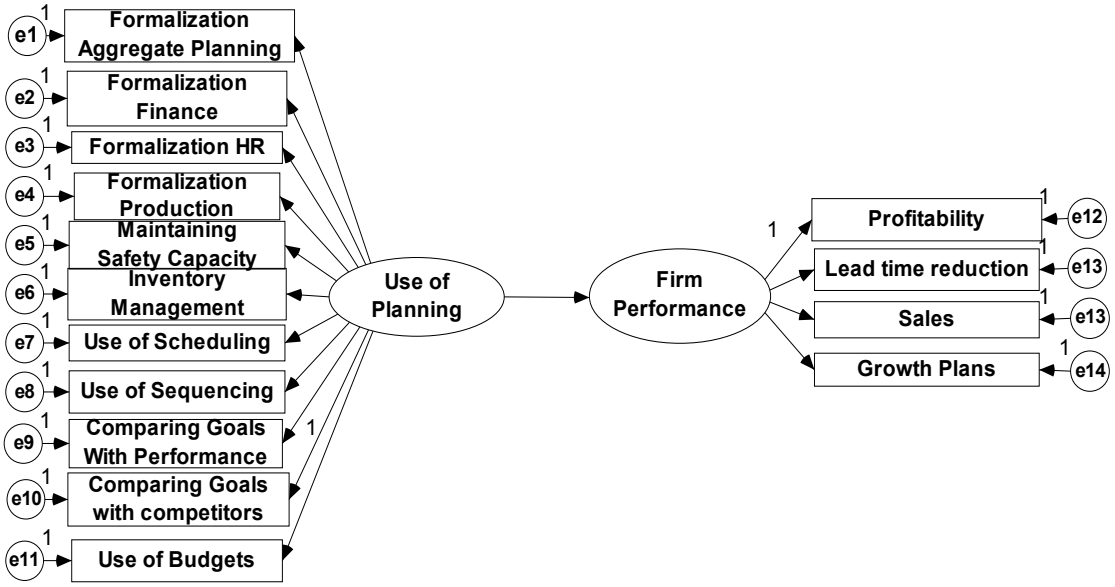


Figure 4.2 The Structural Model for testing the Use of Planning

The research model is depicted in Figures 4.1(a) and 4.1 (b) respectively. The dependent variable "Firm performance" is linked with the selected independent variables such as "use of planning", "controlling", "standardization", "learning orientation" and demographics such as age, education and experience of the owner/manager. A structural equation model has been used to test the hypotheses formed and shown in Figure 4.2.

4.3. Item Development for the "Planning" Section of the Questionnaire

Based on the previous research conducted in this area, a self reported type, enumerator assisted questionnaire schedule was prepared to measure the use of PPC and firm performance. The fourth section of the questionnaire deals with the measurement of the use of planning. The questionnaire is given in Appendix 1.

The relationship between firm performance and formal planning is a debatable issue because some researchers (Robinson 1983 and Braker *et al.* 1988) established a positive association between the two, while some other researchers (Orper 1985 and Shrader *et al.* 1989) are of the opinion that such a significant relationship does not exist. Poza *et al.* (2004) observed that the family owned firms avoid strategic planning due to the conflict between CEO and the rest of the family. Alasadi *et al*. (2008) studied the SMEs in Syria, and observed that formal planning in SME is positively related to the firm performance. Many SMEs planned intuitively and planning is rarely supported by

the planning instruments (Stonehouse & Pemberton 2002). Some researchers agreed with the perception, that the formal planners are better performing than the informal planners (Lyles *et al.* 1993; O'Regan & Ghobadian 2003). According to Robinson & Pearce (1983), the SMEs preferred informal procedures and lesser amount of written documentation.

The dimensions of the use of planning include five indicators of "Planning Formalization" (Perez *et al*. 2007; Alasadi *et al*. 2008; Kraus *et al.* 2008), three indicators of "Capacity Management" (O'Regan *et al*. 2002; Louis Raymond 2005) two indicators of "Goal Accomplishment" (Peel & Bridge1998; O'Regan *et al*. 2002; Kotey 2003) and four indicators of "Use of Planning Instruments" (Kraus *et al*. 2006; Bhutta *et al*. 2008). A five point Likert scale was used to collect the response.

Planning formalization was measured with the options such as no planning, informal planning or written plan in five functional areas (production, marketing, HR, finance and strategic planning). The use of planning instruments was rated from the perceived knowledge or use of MRP, Kanban, sequencing, scheduling and PERT/CPM. Inventory management was rated by asking questions about the maintenance of the safety stock, the management of final inventory and the management of the raw inventory. Goal accomplishment was measured from the firm's practice of comparison of goals with the performance and comparison of firm performance with the competitors.

IT and IS usage have measured with the questions such as "Number of computers used in the firm" (Bhutta *et al.* 2008), "Level of computer proficiency of workers" (Sharma *et al.* 2006; Bhutta *et al*. 2008), "Extent of use of computers/internet" (Sharma *et al.* 2006; Bhutta *et al.* 2008; Singh *et al*. 2010) and "Practice of computer enabled control" (Todd *et al.* 2007; Sharma *et al.* 2006; Singh *et al*. 2010). The practice of ISO 9000 was inferred from an open ended question. Learning orientation was measured by asking questions such as opinion on the worth of learning, level of in house and external learning opportunities (Anderson & Boocock 2002; Keskin 2006).

4.4. Research Hypotheses Formed

Organisational readiness, willingness to change, company culture and political landscape influence the planning and the controlling methods (Dangayach & Deshmukh 2001). Kraus *et al.* (2008) argued that the planning and the controlling methods for traditional small sector firms are not much developed. Ibrahim & Rue (1998) reported that crude methods and rule of thumb are followed by many SMEs. Karami 2006 observed that the CEO's age, experience and education influence the adoption of the planning decisions. Based on the conceptual arguments and empirical evidence, the following hypotheses were proposed in the null form (Krishnaswami *et al*. 2010):

H_{03a} : Firm performance is not influenced by the "use of planning" by the firm.

H_{03b} : There is no difference in the "use of planning" between the firms run by the entrepreneurs and the firms run by the conventional owner/ managers.

H_{03c} : "Use of planning" is not influenced by the number of employees.

H_{03d} : "Use of planning" is not influenced by the education of the key person.

H_{03e} : "Use of planning" is not influenced by the experience of the key person.

H_{03f} : "Use of planning" is not influenced by the age of the key person.

H_{03g} : "Use of planning" is not influenced by the IT usage.

H_{03h} : "Use of planning" is not influenced by the learning orientation.

H_{03i} : "Use of planning" is not influenced by the standardization.

4.5. Indicators of the Use of Planning

Use of planning has been measured with fourteen indicators. They are grouped into five dimensions. The first dimension is the planning formalization. This dimension includes five items. The planning formalization was measured on a five point scale ranging from no planning to the written planning. The responses were collected from the practicing areas such as the production, finance, materials, human resource and strategic planning. The statistics of the planning formalization is given in table 4.1 and figure 4.3.

Table 4.1 The Descriptive Statistics of Formalization in Planning

Indicator	Mean	Standard Deviation	Skewness	Kurtosis
Degree of formalization in aggregate planning Materials **P1**	3.70	.911	-0.786	.284
Degree of formalization in aggregate planning **P2**	3.73	.922	-0.659	-.184
Degree of formalization in aggregate planning **P3**	3.29	.981	-0.169	-0.292
Degree of formalization in aggregate planning **P4**	3.59	.972	-0.459	-0.175

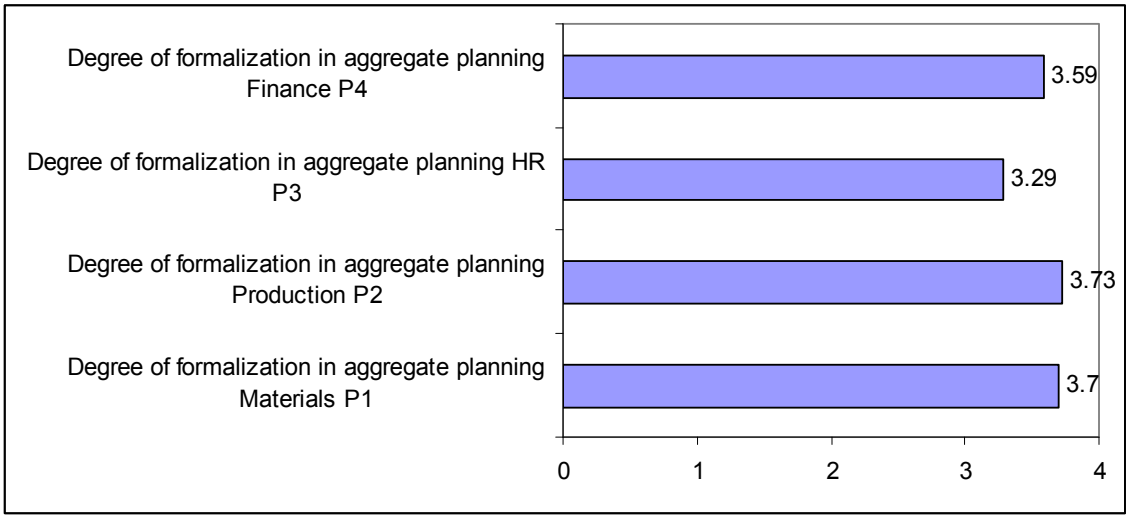


Figure 4.3 Mean scores of Planning Formalization

To measure the use of the planning instruments, the respondents were asked to express their awareness and the use of different planning tools such as MRP, Kanban, sequencing algorithms and scheduling. The descriptive statistics of use of planning formalization is illustrated in table 4.1. Figure 4.4 describes the mean scores of use of planning instruments.

The inventory management was measured by asking questions about the maintenance of safety capacity, safety stock of final inventory and safety stock of raw inventory. Figure 4.5 shows the mean scores of inventory management. The goal accomplishment was measured from the comparison of the goals with the performance and comparison of the performance with competitors. Average score of goal accomplishment is 3.62. Figure 4.6 shows the mean scores of the goal accomplishment. Histogram of the use of planning is shown in figure 4.7. The distribution is positively skewed and deviate from the normal.

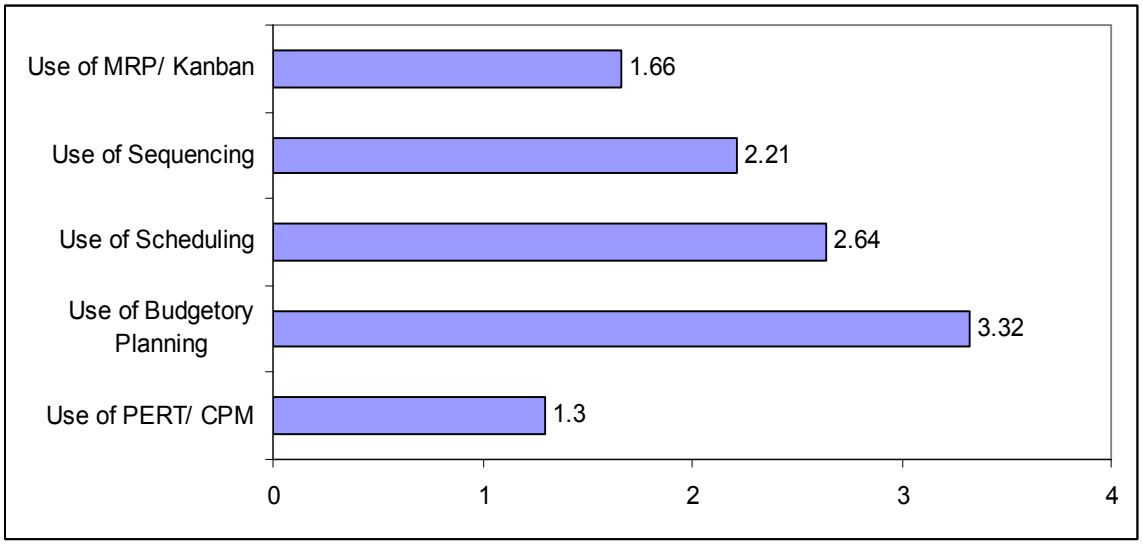


Figure 4.4 Mean scores of Use of Planning Instruments

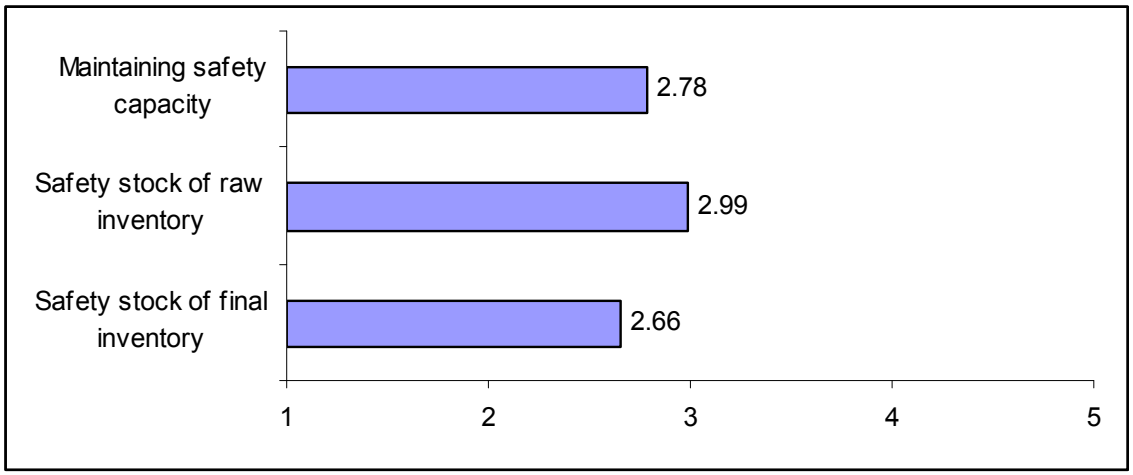


Figure 4.5 The Mean scores of Inventory Planning

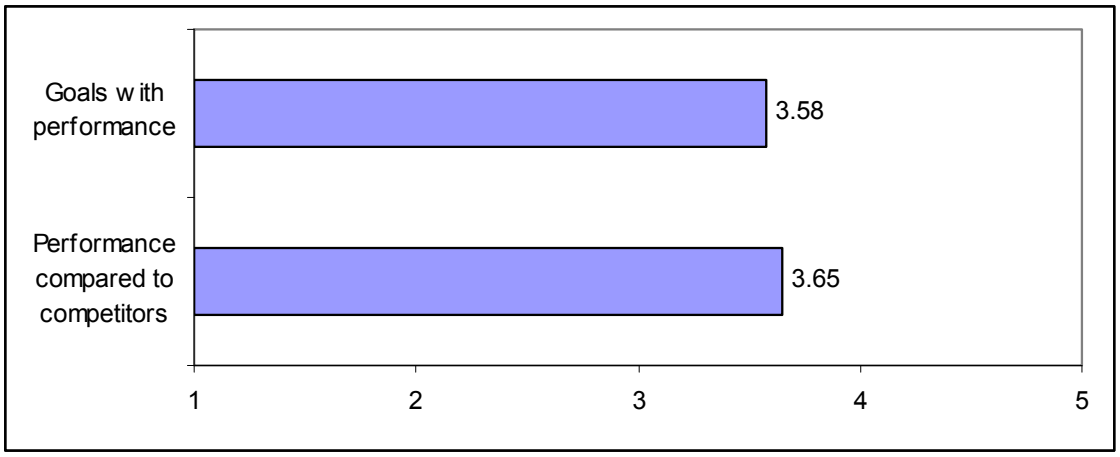


Figure 4.6 Mean scores of Goal Accomplishment

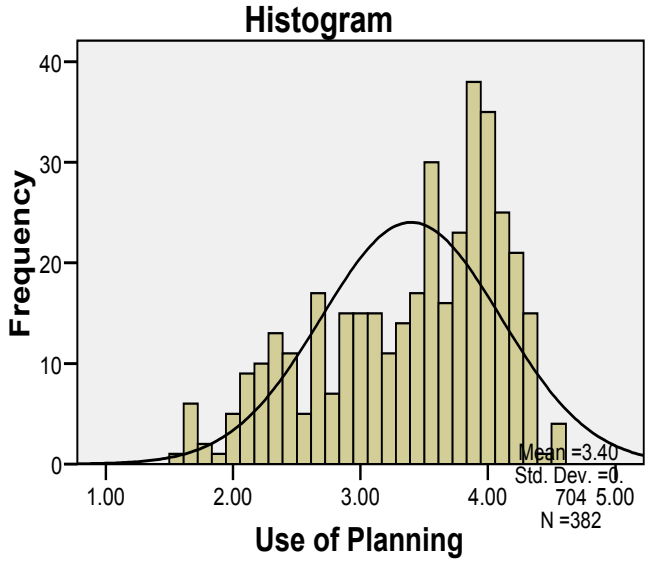


Figure 4.7 Histogram of the Use of Planning

The normality of data is checked by Kolmogorov-Smirnov test. The K–S Test of normality indicates the significant deviation from the normal distribution (Table 4.2).

Table 4.2 Details of Kolmogorov – Smirnov Tests

Indicators		Firm performance	Use of forecast rating	Use of Planning	Total control rating	Score of IT Usage	Score of learning
N		382	382	382	382	382	382
Normal Parameters	Mean	3.4817	3.6032	3.3973	31.0890	2.7408	3.5471
	Std. Deviation	.60183	.50357	.70437	5.78644	.93131	.54803
Most Extreme Differences	Absolute	.180	.101	.133	.082	.117	.167
	Positive	.087	.077	.079	.082	.117	.139
	Negative	-.180	-.101	-.133	-.043	-.094	-.167
Kolmogorov-Smirnov Z		3.518	1.981	2.607	1.605	2.283	3.274
Asymp. Sig. (2-tailed)		.000	.001	.000	.012	.000	.000

4.6. Nature of Association between the Variables.

It is hypothesized that the use of planning influences the firm performance. Before testing the hypotheses, nature of association between the variables has been studied. The scatter plots and the box plots were used to test the nature of association between the variables and the presence of specific trends and relationships.

The increasing trend in figure 4.8 indicates the positive association between the firm performance and the use of planning. Figures 4.9 to 4.14 illustrate the variation of

"Use of Planning" with "Firm Performance", age, education, experience, standardization, IT Usage, learning and ownership type. Use of planning is positively associated with the firm performance. Age and experience of key person are not associated with the use of planning. Education of the key person is associated with the use of planning. Detailed analysis is followed in section 4.6.

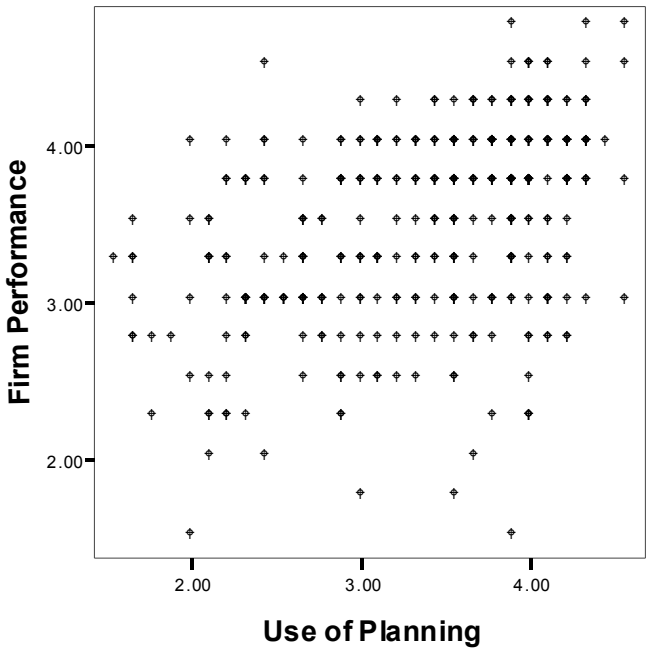


Figure 4.8 The Scatter Plot between the Use of Planning and the Firm Performance

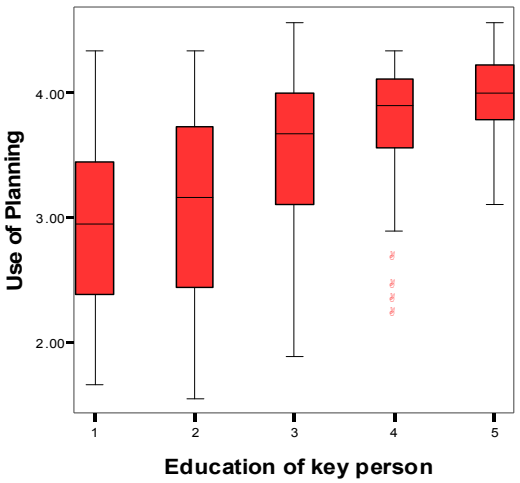


Figure 4.9 Box Plot between Use of Planning and Education of Key Person

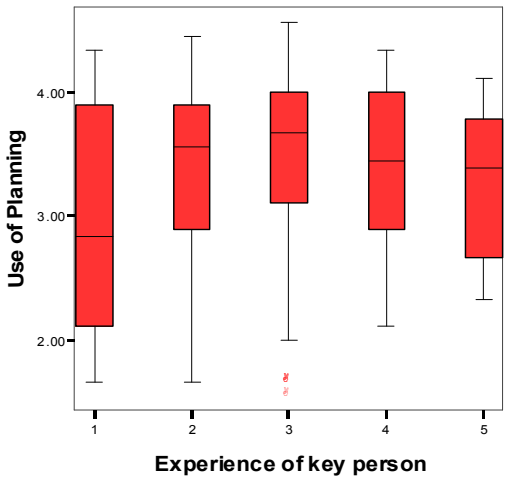


Figure 4.10 Box Plot between Use of Planning and Experience of Key Person

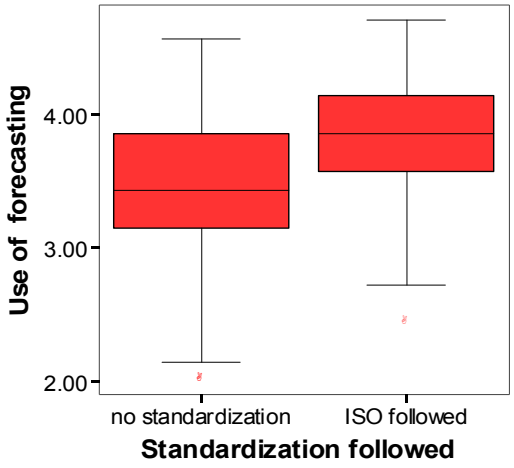


Figure 4.11 Box Plot between Use of Planning and Standardization

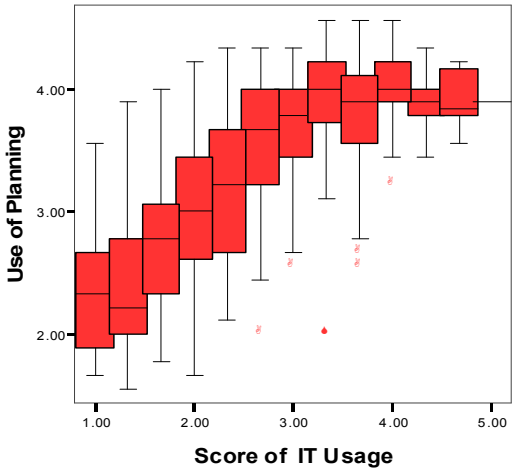


Figure 4.12 Box Plot linking Use of Planning and IT Usage

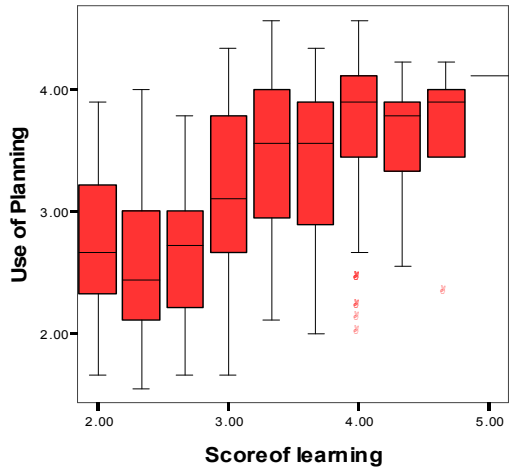


Figure 4.13 Box Plot linking Use of Planning and Learning orientation

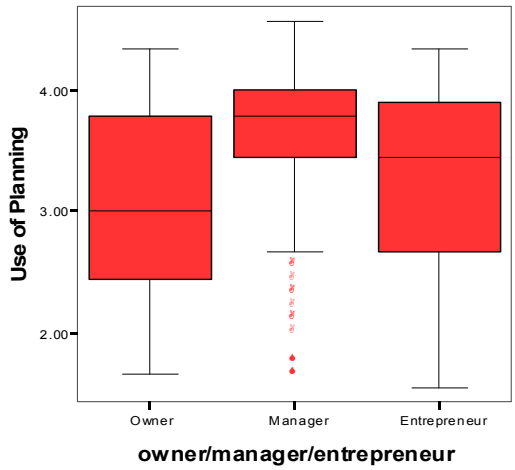


Figure 4.14 Box Plot between Use of Planning and type of Ownership

Standardization and IT usage are positively associated with the use of planning. The certification processes, such as ISO 9000 results in formal planning. 'Use of computers' is positively correlated with the 'use of planning'. 'Learning' is also positively associated with the 'use of planning'. It is observed that the professional managers are using the planning function in a better manner than the second generation owners and the entrepreneurs.

Table 4.3 illustrates the non parametric correlation between the variables. A significant correlation is observed between most of the variables except the key person's age and experience. The data show a sufficient amount of linearity, homoscedasticity and some multicolleniarity. Since the data was not normal non parametric tests had to be used.

Table 4.3 The Non Parametric Correlation between the Variables

Variable	Firm performance	Use of forecasting	Use of planning	Learning	IT usage	Age	Education	Experience
Firm Performance	1							
Use of Forecasting	.512**	1						
Use of planning	.294**	.400**	1					
Learning	.410**	.339**	.539**	1				
IT usage	.376**	.424**	.715**	.598**	1			
Age	.057	.109*	.120*	.149**	.126*	1		
Education	.235**	.295**	.563**	.387**	.571**	.112*	1	
Experience	.084	.047	.076	.108*	.083	.619*	-.011	1

4.7. Use of Exploratory Factor Analysis

In this study, Exploratory Factor Analysis (EFA) is used to fulfill the following objectives:

- To identify the structure of the relationships among the indicator variables.
- To represent the data in a much smaller number of concepts in the summarized form.
- To check the role and contribution by each indicator variable to form the factor construct and to reduce the variables into the limited constructs without much distortion of the data.

The indicator variables were selected from the previous research. The control variables such as age, education, experience, ownership type and standardization followed have been used for cross validation. Item wise description of the factor analysis performed is given below:

4.7.1. The Use of Planning

The use of planning reveals the choice of planning methods by the SMEs. Conceptually it is believed that formal planning, effective use of the planning instruments, better budgeting, sequencing, scheduling and inventory management indicate better use of planning.

The usefulness of planning was measured using fourteen items, which were grouped into five dimensions. Table 4.4 gives the descriptive statistics of the indicators.

The inter-item correlations are shown in table 4.5. All correlations are significant and some degree of multicolleniarity indicates the suitability of the factor analysis.

Table 4.4 The Descriptive Statistics of the Use of Planning

Indicators (N =382)	Mean	Std. Deviation
Degree of formalization in materials planning **P1**	3.70	.911
Degree of formalization in production planning **P2**	3.73	.922
Degree of formalization in HR planning HR- **P3**	3.29	.981
Degree of formalization in finance planning **P4**	3.59	.972
Maintaining safety capacity **P5**	3.23	.819
Safety stock of final inventory **P6**	3.08	.865
Safety stock of raw inventory **P7**	2.97	.878
Goals with performance **P8**	3.29	.772
Performance compared to competitors **P9**	3.37	.786
Use of MRP Kanban **P10**	1.66	1.052
Use of sequencing **P11**	2.21	1.297
Use of scheduling **P12**	2.63	1.477
Use of Budgetary planning **P13**	3.29	1.080
Use of PERT/CPM **P14**	1.30	.753

Table 4.5 The Inter-tem Correlation Matrix of the Use of Planning

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14
P1	1													
P2	.624	1												
P3	.624	.604	1											
P4	.600	.638	.638	1										
P5	.536	.546	.629	.593	1									
P6	.521	.525	.599	.577	.628	1								
P7	.310	.323	.355	.360	.382	.373	1							
P8	.509	.574	.571	.544	.540	.548	.316	1						
P9	.519	.559	.575	.558	.522	.525	.375	.545	1					
P10	.307	.306	.393	.374	.344	.369	.113	.353	.291	1				
P11	.331	.384	.456	.442	.401	.335	.195	.431	.402	.608	1			
P12	.406	.415	.480	.483	.473	.386	.212	.446	.440	.600	.742	1		
P13	.520	.543	.559	.580	.515	.482	.342	.528	.525	.391	.524	.589	1	
P14	.184	.164	.285	.178	.161	.191	.046	.206	.121	.523	.479	.370	.268	1

The measure of sample adequacy was tested using the K-M-O criterion (Kaiser-Meyer – Olkin criterion) and the Bartlett's test of sphericity. The results of the MSA and the Bartlett's test indicate the suitability of the data for conducting the factor analysis. The MSA values are shown in table 4.6.

Table 4.6 KMO and Bartlett's Test Results

K-M-O Measure of Sampling Adequacy.		.94
Bartlett's Test of Sphericity	Approx. Chi-Square	2887.74
	df	91
	Sig.	.000

A latent root criterion of the eigen value greater than one was selected. The Scree plot (Hair *et al*. 2011) is shown in figure 4.15. The initial communalities after conducting the principal component analysis are shown in table 4.7. Except for the indicator "Safety stock of raw inventory" all the communality values were above 0.5. Hence the indicator variable "Safety stock of raw inventory" was dropped from further analysis.

After eliminating the indicator item "Safety stock of raw inventory, the factor loading of the rotated component matrix is shown in table 4.8.

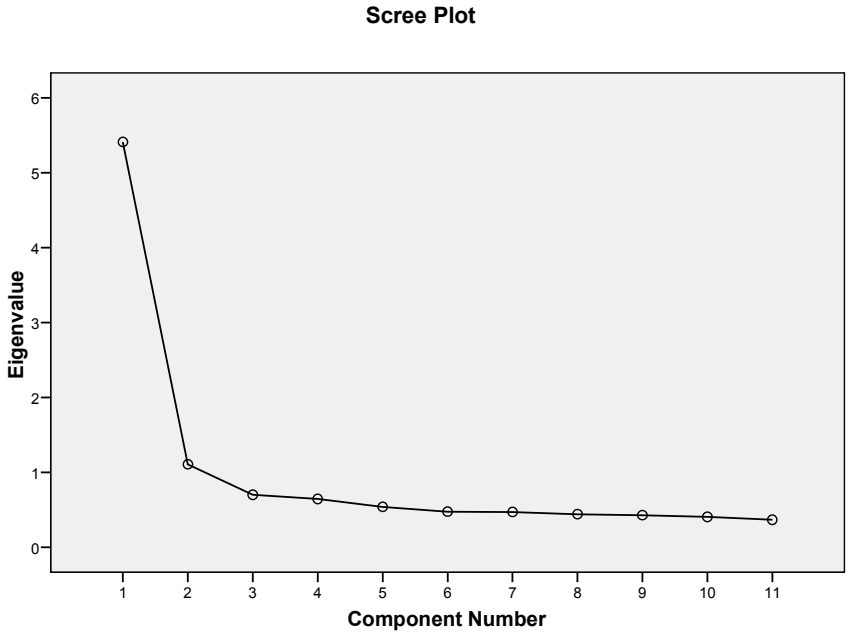


Figure 4.15 The Scree Plot of Use of Planning

Table 4.7 The Initial Communality Values

Indicators	Initial	Extraction
Degree of formalization in aggregate planning Materials	1.000	.583
Degree of formalization in aggregate planning P	1.000	.631
Degree of formalization in aggregate planning HR	1.000	.665
Degree of formalization in aggregate planning F	1.000	.662
Maintaining safety capacity	1.000	.620
Safety stock of final inventory	1.000	.589
Safety stock of raw inventory	1.000	.333
Goals with performance	1.000	.567
Performance compared to competitors	1.000	.582
Use of MRP Kanban etc	1.000	.696
Use of sequencing	1.000	.742
Use of scheduling	1.000	.698
Use of Budgetary planning	1.000	.587
Use of PERT/CPM etc	1.000	.590
Extraction Method: Principal Component Analysis.		

Two items, namely the "Use of sequencing" and the "Use of scheduling" cross loaded on the two factor constructs (table 4.8) and were dropped from the list. The factor analysis was conducted with the eleven items and no cross loading was found. Also the communality value was found acceptable. The new communalities and the factor loadings are shown in table 4.9 and table 4.10.

Table 4.8 Factor Loadings of the Use of Planning after eliminating "Safety stock of raw inventory"

	Component	
Indicators	1	2
Degree of formalization in aggregate planning Materials	.762	.141
Degree of formalization in aggregate planning P	.793	.146
Degree of formalization in aggregate planning HR	.766	.290
Degree of formalization in aggregate planning F	.786	.228
Maintaining safety capacity	.762	.199
Safety stock of final inventory	.748	.171
Goals with performance	.718	.244
Performance compared to competitors	.747	.157
Use of MRP Kanban etc	.231	.801
Use of sequencing	**.529**	**.800**
Use of scheduling	**.422**	**.721**
Use of Budgetary planning	.649	.206
Use of PERT/CPM etc	.005	.776
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 3 iterations.		

Table 4.9 The Communality values of the Use of Planning (with eleven items)

Indicators	Initial	Extraction
Degree of formalization in aggregate planning Materials	1.000	.597
Degree of formalization in aggregate planning P	1.000	.650
Degree of formalization in aggregate planning HR	1.000	.680
Degree of formalization in aggregate planning F	1.000	.671
Maintaining safety capacity	1.000	.618
Safety stock of final inventory	1.000	.591
Goals with performance	1.000	.578
Performance compared to competitors	1.000	.588
Use of MRP Kanban etc	1.000	.726
Use of Budgetary planning	1.000	.565
Use of PERT/CPM etc	1.000	.812

Table 4.10 The Factor Loading with eleven Indicators

Indicators	Component	
	1	2
Degree of formalization in aggregate planning Materials	.763	.120
Degree of formalization in aggregate planning P	.801	.092
Degree of formalization in aggregate planning HR	.781	.264
Degree of formalization in aggregate planning F	.804	.157
Maintaining safety capacity	.774	.135
Safety stock of final inventory	.747	.182
Goals with performance	.736	.188
Performance compared to competitors	.765	.056
Use of MRP Kanban etc	.296	.799
Use of Budgetary planning	.692	.294
Use of PERT/CPM etc	.051	.899

The reliability was ensured from the acceptable scores of Cronbach's alpha (Alpha value above 0.8). Two items, namely P11 and P15 were dropped from the analysis, as they have very low item to total correlation and low values of squared multiple correlation.

Table 4.11 The Reliability Test Results

Indicators	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Degree of formalization in aggregate planning Materials	29.83	42.150	.685	.510	.894
Degree of formalization in aggregate planning P	29.81	41.751	.712	.564	.893
Degree of formalization in aggregate planning HR	30.25	40.569	.765	.601	.889
Degree of formalization in aggregate planning F	29.94	40.884	.744	.587	.891
Maintaining safety capacity	30.30	42.884	.702	.542	.894
Safety stock of final inventory	30.45	42.526	.692	.521	.894
Goals with performance	30.24	43.501	.686	.489	.895
Performance compared to competitors	30.16	43.610	.660	.479	.896
Use of MRP Kanban etc **P11**	31.87	43.181	.491	**.288**	.906
Use of Budgetary planning	30.25	40.501	.685	.479	.895
Use of PERT/CPM etc **P15**	32.24	47.262	.314	**.304**	.911

Table 4.12 The Communality values of the Use of Planning (with nine indicators)

Indicators	Initial	Extraction
Degree of formalization in aggregate planning Materials	1.000	.594
Degree of formalization in aggregate planning P	1.000	.641
Degree of formalization in aggregate planning HR	1.000	.678
Degree of formalization in aggregate planning F	1.000	.669
Maintaining safety capacity	1.000	.616
Safety stock of final inventory	1.000	.591
Goals with performance	1.000	.579
Performance compared to competitors	1.000	.571
Use of Budgetary planning	1.000	.554

Table 4.13 Factor Loading with nine Indicators

	Component
Indicators	1
Degree of formalization in aggregate planning Materials **P1**	.771
Degree of formalization in aggregate planning **P2**	.801
Degree of formalization in aggregate planning **P3**	.823
Degree of formalization in aggregate planning **P4**	.818
Maintaining safety capacity **P5**	.785
Safety stock of final inventory **P6**	.769
Goals with performance **P8**	.761
Performance compared to competitors **P9**	.756
Use of Budgetary planning **P13**	.744

Table 4.14 illustrates the total variance explained by the factor constructs. Around 61 per cent of the variance is explained by the first component and is therefore acceptable.

Table 4.14 Total Variance Explained by the Components

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.492	61.024	61.024	5.492	61.024	61.024
2	.587	6.521	67.545			
3	.528	5.866	73.411			
4	.485	5.386	78.797			
5	.457	5.080	83.877			
6	.390	4.336	88.213			
7	.375	4.170	92.383			
8	.353	3.928	96.310			
9	.332	3.690	100.000			

4.7.2. Validity and Reliability of the EFA

The content validity, the face validity, the convergent validity and the reliability tests were conducted. Details of testing the validity and the reliability are explained below:

4.7.2.1.Testing the Validity and Reliability of the Use of Planning

a) **Content Validity**: The face validity is tested from the works of Bracker *et al.* (1986); Bonney (1994); O'Regan *et al*. (2002); Deshmukh *et al*. (2005) and Alasadi *et al.* (2008).

b) **Unidimensionality:** The unidimensionality is ensured by the high loading of items to a single latent construct. All indicators of the use of planning were reduced to the single factor construct, without any cross loading (shown in table 4.14).

c) **Reliability:** The reliability is ensured by: i) Internal Consistency ii) Cronbach's alpha.

   a. **Internal Consistency**: The internal consistency refers to the consistency among the variables in a summated scale. The item to item correlation for all the indicators with the value more than 0.3 and item to total correlation above 0.5 indicated adequate internal consistency (Hair et al. 2008). The internal consistency of items is evident from table 4.15.

Table 4.15 The Correlation Data for explaining Internal Consistency of Items

	P1	P2	P3	P4	P5	P6	P8	P9	P13
P1	1								
P2	.579**	1							
P3	.414**	.550**	1						
P4	.539**	.528**	.534**	1					
P5	.120*	.202**	.323**	.357**	1				
P6	.200	.164**	.295**	.340**	.612**	1			
P8	.241**	.315**	.335**	.376**	.212**	.130*	1		
P9	.324**	.414**	.482**	.454**	.206**	.192**	.545**	1	
P13	.485**	.517**	.525**	.538**	.307**	.252**	.412**	.480**	1
Total	.631**	.704**	.765**	.754**	.676**	.616**	.693**	.777**	.813**

All the correlations are significant and inter- item correlations are greater than 0.3. All items to total correlations are nearing 0.7. This indicates a sufficient level of internal consistency.

b. Cronbach's Alpha: Table 4.16 shows the alpha values of all indicators. All values are more than 0.8 (which is acceptable). Thus reliability is ensured.

Table 4.16 The Cronbach's Alpha values of the Items

Indicators	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
P1	26.56	27.507	.520	.440	.825
P2	26.63	26.359	.611	.486	.815
P3	27.41	25.371	.651	.459	.810
P4	26.97	25.472	.696	.506	.805
P5	27.75	27.202	.463	.538	.832
P6	27.87	27.552	.412	.523	.838
P8	26.95	29.740	.456	.357	.832
P9	26.88	29.028	.564	.448	.825
P13	27.20	23.885	.655	.463	.810

d) Convergent Validity:

The convergent validity is ensured by observing, whether the scale correlates with the other like scales. The testing of the convergent validity is shown in table 4.17. Mean scores of the use of planning and surrogate variable "formalization in aggregate planning" were compared among three groups (the firms run by the owner / manager / entrepreneur respectively). The original variable and the surrogate variable followed the

same pattern of distribution. Significant correlation (greater than 0.7) is observed among the variables. Thus the convergent validity is established.

Table 4.17 Testing the Convergent Validity

Measure	Mean scores Group1(N=124)	Mean scores Group2(N=88)	Mean scores Group3(N=70)	F-value	Significance
Summated scale "use of planning"	3.079	3.668	3.233	33.34	.000
Indicator item - Formalization in aggregate planning	3.38	4.02	3.54	21.964	.000
Correlation between item and summated scale			.765**		

a. **Discriminant Validity:** The discriminant validity is the degree to which two conceptually similar concepts are distinct. The use of planning scale was correlated with the firm performance scale. Positive correlation values of the order less than 0.3 have established the discriminant validity.

4.7.3. Split Factor Analysis of the Use of Planning

The factor loadings and the communalities for the nine perceptions of the "use of planning" were compared with a control variable "ownership type". The first group includes the firms headed by the professional managers and the entrepreneurs (N = 258). The second group consists of the firms headed by the conventional owners (N = 124). The factor loadings and the communalities are compared in table 4.18.

Table 4.18 Split Factor analysis of the Use of Planning

Indicator item	SPLIT SAMPLE 1(N= 258) Managers and Entrepreneurs		SPLIT SAMPLE 2(N 124) Conventional Owners	
	Component factor loading	Communality	Component factor loading	Communality
Degree of formalization in aggregate planning Materials	.778	.605	.713	.508
Degree of formalization in aggregate planning Production	.776	.602	.802	.643
Maintaining safety capacity	.818	.670	.796	.634
Safety stock of final inventory	.805	.647	.810	.656
Goals with performance	.756	.571	.787	.619
Performance compared to competitors	.749	.561	.785	.616
Use of Budgetary planning	.751	.564	.734	.539

4.7.4. Interpretation of the Split Factor Analysis

Items were loaded to a single construct in both cases and the indicators correspond to the factor construct the "Use of Planning". The indicators including "Formalization in the aggregate planning", "Safety stock of inventory", "Comparing

goals with performance" and "Comparison of performance with competitors" are loaded better in sample 2 (the firms managed by the second generation owners) than sample 1 (the firms run by the managers and the entrepreneurs). It is found that the users of the sample 1 give more orientation to the "Planning for safe performance" perspective than users of the sample 2. Items including the "Formalization in planning of materials", the "Maintaining safety stock" and the "Budgetary planning" are loaded better in sample 2 than sample 1. This indicates that the users of sample 2 (the firms run by the second generation Owners) are more oriented to the "Growth" perspective (the findings are in agreement with Gray *et al*. 2002 and O'Regan *et al*. 2002).

4.8. Kruskal – Wallis Test Results

The Kruskal –Wallis Chi square Test was used to test the hypotheses framed in section 4.3. This test is specifically used to test the difference in the groups having non normal distribution (Darren George 2008). The difference in the scores of use of planning is compared between two groups, namely the low and high level users. In order to define the low and high level users, the control variables - type of the owner, number of employees, demographics of the key person, IT usage, standardization followed, training - were used. The test results are summarized in table 4.19.

Table 4.19 The Results of Hypothesis Tests linking with the Use of Planning

Difference in the Use of Planning (Dependent Variable)				
Independent Variable	**Kruskal -Wallis Chi square**	**Significance**	**Influencing dependent variable**	**Type of relationship**
Between Owner/Manager/Entrepreneurs	54.721	.001**	YES	Positive
Firms with Less and More employees (N<10 to N >150)	129.195	.000**	YES	Positive
Education: Low (Pre university and below), Higher level	78.636	.000**	YES	Positive
Experience: Less experienced < 8 years, More experienced > 8 years	2.350	.125(NS)	NO	No relation
Age: Young < 40 years, Aged > 40 years	6.323	.012*	YES	Positive
Low and high level "Use of IT".	135.473	.000**	YES	Positive
Low and high level "Use of Learning".	63.010	.000**	YES	Positive
Low and high users of Standardization.	92.310	.000**	YES	Positive
Note: Kruskal –Wallis Test - variables measured on Likert's five-point scale (1 – low score; 5 high score); mean value; SD-standard deviation. *: p<0.05; **: p<0.01.NS-Not statistically significant.				

The significant difference in the firm performance is observed among the low and the high level users of planning (χ^2 value of 60.04 with significance value of p = .0007). The null hypothesis H_{03a} stating no influence by the use of planning on the firm

performance is rejected. Positive orientation towards the high level users of the planning (alternate hypothesis) indicates that the use of planning is positively associated with firm performance.

The null hypothesis H_{03b} stating no influence by the type of the owner/ manager/ entrepreneur on the use of planning is rejected. The firms run by the professional managers indicated better scores of planning. The null hypothesis H_{03c} stating no influence by the number of employees on the use of planning is also rejected. The positive association between the number of employees and the use of planning supported the alternate hypothesis, that the use of planning is influenced by the number of employees.

The null hypothesis H_{03d} stating no difference in the use of planning between the firms run by the educated and those that are run by the less educated key persons is rejected. The positive association between the education and use of planning supported the alternate hypothesis. The test was not able to reject the null hypothesis H_{03e}, stating no difference in the use of planning between the firms run by experienced and those that are run by the less experienced key persons. Thus it is concluded that the experience of the key person is not influencing the use of planning.

It is observed that the use of planning is influenced by the age of the key person and so the null hypothesis H_{03f} is rejected. The younger key persons exercise a better planning. A χ^2 value of 135.5 ($p = .0001$) rejected the null hypothesis H_{03g}. The positive association concluded that the use of planning is influenced by the IT usage. Similarly the null hypothesis H_{03h}, stating no linkage between the planning and the learning orientation is rejected and the alternate hypothesis indicates that the use of planning is influenced by the learning orientation. The significant difference in the use of planning scores observed among ISO 9000 non ISO firms and the positive orientation of the scores towards the users of ISO 9000 rejected the null hypothesis H_{03i}. It is concluded that standardization positively influences the use of planning.

From hypotheses tests aforementioned, it is observed that all independent variables except the experience of the key person are positively influencing the use of planning. The null hypotheses are rejected and the alternative hypotheses are accepted in each case (except for the experience of key person).

4.9. Research Findings and Conclusion

The bivariate tests (linking one dependent variable and one independent variable at a time) lead to the following observations. The firms headed by the professional manager record an average score of 3.69 for the use of planning, while the firms headed by the owners report a planning score of 3.08 and that of entrepreneurs is 3.23. It is observed that the key persons, categorized as the second generation owners and the entrepreneurs had shown a close resemblance in terms of education and IT usage. The analysis of the firms headed by the owner/ manager/ entrepreneur, indicated that the professional managers are contributing to the improved firm performance.

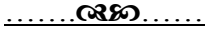
The high level users of the IT record a "Use of Planning score" of 3.82, while low level users of the IT record a performance score of 2.82. Similarly the firms with high level learning orientation report an average use of planning score of 3.62, while the firms with the low level learning orientation report a score of 3.09. The lowest use of planning score is reported from the firms with less than 10 employees (2.67), while it is 3.93 for the firms with more than 100 workers. The use of forecasting score is 3.4 in the case of the firms with less than 10 employees, while it is 3.97 for firms with more than 100 workers. It is seen that with the increase in the size of the firm, the forecasting and the planning tend to become more formal and systematic (agrees with the findings of Alasadi 2008). Team work and knowledge sharing is more in firms employing more workers. More team work result in improved firm performance (agreed with the findings of Karami *et al*. 1996; Mahmoud *et al*. 1996; Bhutta *et al*. 2006).

4.9.1. The Ways of Improving the Use of Planning in the SMEs

The ways of improving the use of planning in SMEs are summarized as below:

- Professional managers contribute much to the firm by means of formal methods, better learning, IT practices and team work. SMEs can improve the use of planning and the firm performance by availing the service of the professional managers to the extent possible.
- Positive correlation between the use of computers and the firm performance indicate the positive contribution by the IT and the IS on the planning.

- Learning and training orientation result in better scores of the firm performance and the use of planning. So attempts for providing learning and training are to be promoted.
- Education of the key person is very important to improve the firm performance and for improving the use of planning.
- Standardization, such as ISO 9000 is positively associated with formal planning and production performance. SMEs should learn and practice the standard procedures of forecasting, planning and control to improve the performance.
- SMEs with limited resources should train their key persons and workforce should acquire the specific learning and IT competencies to overcome their limitations to use PPC techniques effectively.



Chapter 5

LINKING THE USE OF CONTROLLING WITH THE SME PERFORMANCE

Contents

This chapter presents the details of the research framework used and the results linking the use of controlling in SMEs with the firm performance. The research model and details of the item development are discussed in the beginning. The hypotheses formed are discussed then. The indicators used in the study are explained thereafter. Nature of association between variables is graphically presented in the next section. The procedures of the exploratory factor analysis and the validity tests are explained then. Hypotheses test results are discussed thereafter. The chapter concludes with the listing of the ways of improving the use of controlling in SMEs and the firm performance.

5.1. Introduction

The positive influence of the forecasting and the planning on the SME performance has already been discussed in chapters 3 and 4 respectively. In the small firms, the activities are headed by a few persons, with more general abilities and the less of operations management domain skills. The effectiveness of such firms is reported to be poor (Saini *et al.* 2008). In such firms, the shop floor control for make to stock (MTS) production is not difficult since planned items need to be produced and pushed in the market. Controlling of the make to order (MTO) production is difficult because of the unpredictable lead times, the highly variable shop floor routings, the product complexities and the pressure of early delivery. A quick and accurate feedback information processing in the shop floor level is absent in most of the SMEs. Inadequate

training of the SME personnel imparted with results in the ill-informed decisions and the deviation from the plans set (Garengo *et al*. 2009).

5.2. Description of the Research Model and the Framework

"Use of controlling" indicates the choice of controlling by the SME. The selected indicators of this construct represent various dimensions of the "Use of controlling". Under the latent construct "Use of controlling", the usefulness of controlling to achieve the firm performance was measured. Better use of controlling is indicated by the use of accurate and reliable methods of operational and strategic control and the use of the right type of controlling instruments.

In figures 5.1(a) and 5.1 (b), the research models used in this study are explained. The firm performance is the dependent variable and the use of forecasting, planning, standardization, training orientation, learning orientation and demographic characteristics such as age, education and experience of the respondent are the independent variables.

The following research questions were proposed with respect to the SMEs:

- What are the factors which influence the use of controlling in the SMEs?
- How do the above factors, as viewed by the key persons of the firms influence the usage of controlling to improve its performance?
- What conclusions/ steps/ generalizations can be taken to increase the use of controlling in the SMEs to improve the firm performance?

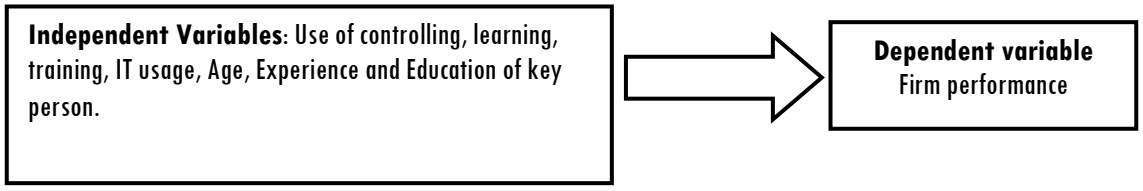


Figure 5.1(a) Model linking Firm Performance with Independent Variables

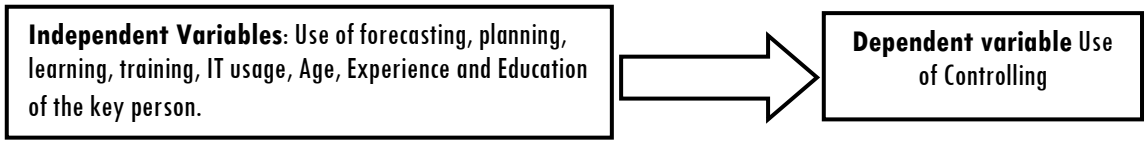


Figure 5.1(b) The Model linking the Use of Controlling with Independent Variables

A structural model used to test the hypotheses is shown in Figure 5.2, as below:

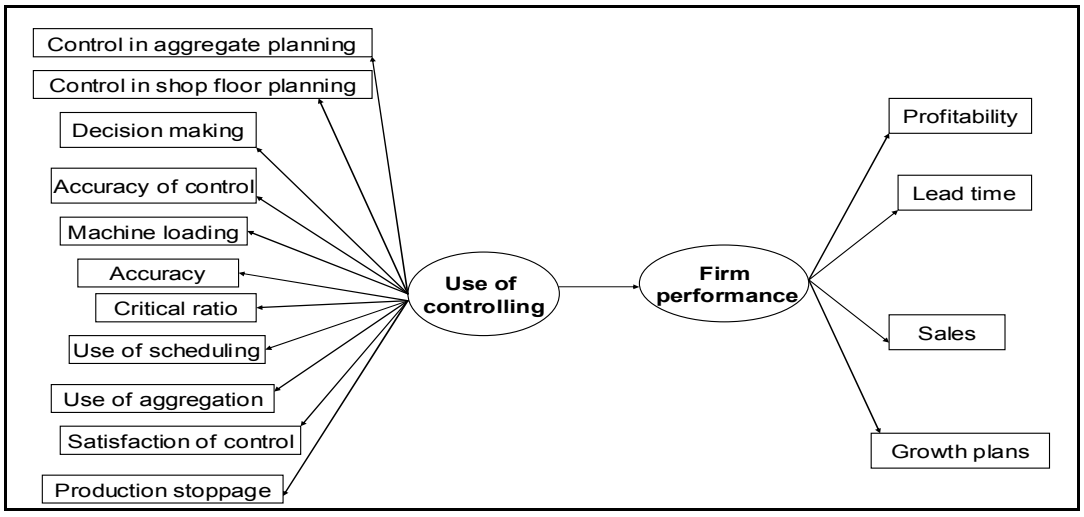


Figure 5.2 A Structural Model to Test the Use of Controlling

5.3. Item Development for the Controlling Section of the Questionnaire

The section five of the questionnaire deals with the use of controlling in the SMEs. Thomson (1999) has reported that the planning and controlling methods support the goal accomplishment. Violation of the production schedules and poor decision making negatively influences the SME performance (Alasadi *et al.* 2008). "Use of control in SMEs" was measured with three indicators of "schedule conformity" (Howard *et al*. 2002; Jonsson *et al*. 2006), four indicators of "Control system effectiveness" (Singh *et al.* 2010) and four indicator of "successful implementation of decisions" (O'Regan *et al*. 2002). The questionnaire was pre-tested by the academic experts from the university, and the experts from industry as discussed in section 3.5.1.

5.4. Research Hypotheses Formed

The entrepreneur's motivation, intuition and personal judgment influence the planning and the control followed (Gibb *et al.* 1997). The following hypotheses (in the null form) were proposed to test the use of control and to link the same with firm performance and other variables.

H_{04a} : Firm performance is not influenced by the "use of controlling".

H_{04b} : There is no difference in the "use of control" between the firms managed by the first generation entrepreneurs and the next generation owners /professional managers.

H_{04c} : There is no difference in the "use of controlling" between the ISO and non ISO firms.

H_{04d} : "Use of controlling" is not related to the number of employees in the firm.

H_{04e} : "Use of controlling" is independent of the education of the key person.

H_{04f} : "Use of controlling" is independent the experience of the key person.

H_{04g} : "Use of controlling" is independent of the age of the key person.

H_{04h} : "Use of controlling" is not related to the IT usage.

H_{04i} : "Use of controlling" is not related to the learning orientation.

5.5. Description of the Indicators of the Use of Controlling

The use of control has been measured with eleven indicators. These eleven indicators are grouped under three heads. The "Efficiency of control" is a construct including three indicators, namely the percentage of time production stopped, the critical ratio and the extent of violation of production schedules (Alasadi *et al.* 2008). Production stoppages result from poor management of demand, production techniques and inventory. Poor delivery commitments and the violation of production schedules indicate the lack of controlling. The critical ratio is the ratio between the demanded time and the supply lead time. The critical ratio less than unity indicates the need for postponement. Frequent /continuous record of critical ratio less than one and the violations of production schedules reflect the ill-health of the firm and the lack of proper control (Alasadi *et al*. 2008).

The control system effectiveness was measured using four indicators, namely "Degree of control in aggregate and shop floor planning", and "Accuracy and satisfaction of control" (Howard *et al*. 2002; Jonsson *et al*. 2006). The effectiveness or the fitness to purpose is often inferred judgmentally, as there are no other methods to quantify the measure (Jonsson *et al*. 2006; Howard *et al*. 2002). The construct "Depth of Control" included four indicators, namely "Use of aggregate planning", "Use of scheduling", "Machine loading" and "Decision making style" (Singh *et al.* 2007, 2010). The depth of control indicates the knowledge, awareness and practice of the control by the firms. The descriptive statistics of the "Use of Control" is given in table 5.1 to 5.3 and figures 5.3 to 5.5.

Table 5.1 The Descriptive Statistics of Efficiency of Control

Indicator	Mean	Standard Deviation	Skewness	Kurtosis
Percentage of time production stopped	3.44	.706	-0.505	-.079
Critical Ratio usage	3.58	.647	-0.431	.344
Violation of Production Schedules	3.40	.588	-0.300	-0.648

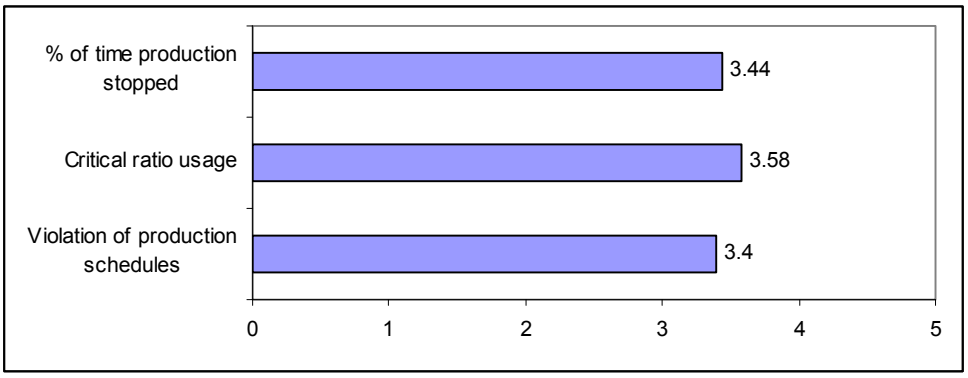


Figure 5.3 Mean Scores of Efficiency of Control

The accuracy of control and the satisfaction of controlling were measured on a five point ordinal scale with options varying from the very low level to the very high level. Though the perceived use of control is very subjective, such measures are used in SME research (Rosa 1996, Islam & Karim 2011) because of non availability of quantitative data.

Table 5.2 Descriptive Statistics of the Effectiveness of Control

Indicator	Mean	Standard Deviation	Skewness	Kurtosis
Degree of control Aggregate planning	3.48	.647	-.819	.424
Degree of control shop floor planning	3.60	.512	-.407	-1.228
Accuracy of control	3.36	.575	.194	-.299
Overall satisfaction of control	3.36	.647	-.211	-.419

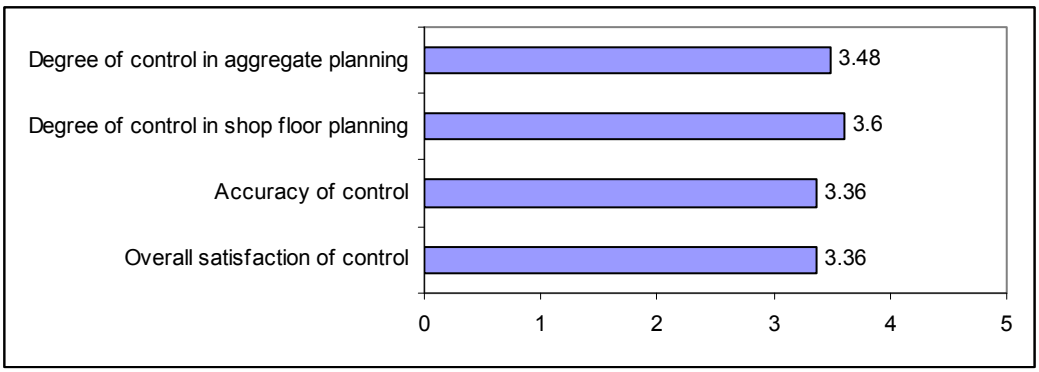


Figure 5.4 Mean Scores of the Effectiveness of Control

The third construct, depth of control was measured by asking questions about the use of aggregate planning, scheduling methods, basis of machine loading and decision making style. Figure 5.5 shows the mean scores of the indicators of the depth of control.

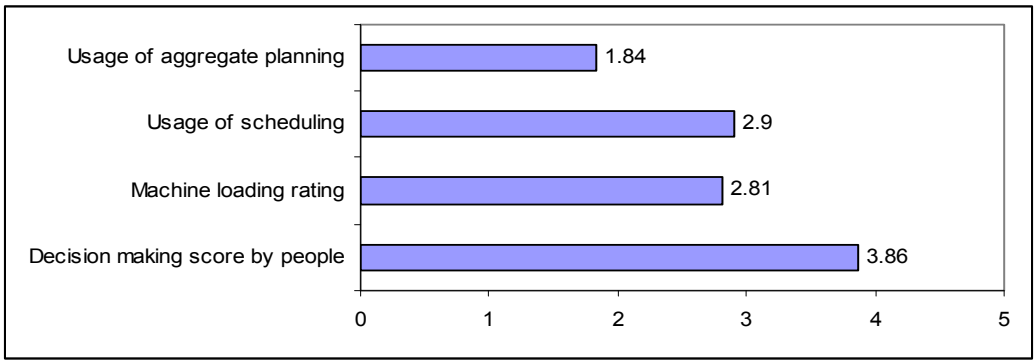


Figure 5.5 Mean Scores of the Depth of Control

Figure 5.6 shows the histogram of the use of controlling. The descriptive statistics of the variables are shown in table 5.3. All K–S Tests of normality indicate significant deviation from the normal distribution (Table 5.4).

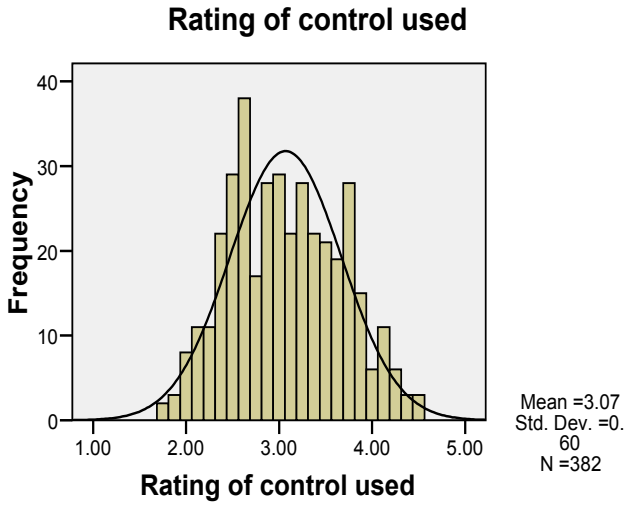


Figure 5.6 Histogram of the Use of Controlling

Table 5.3 Descriptive Statistics of Measured Data

Indicators	N	Mean	Std. Deviation	Skewness	Kurtosis
	Statistic	Statistic	Statistic	Statistic	Statistic
Firm Performance	382	3.48	.601	-.574	-.021
Use of forecast rating	382	3.60	.503	-.308	.062
Use of Planning	382	3.39	.704	-.632	-.574
Rating of control used	382	3.07	.599	.163	-.712
Score of IT Usage	382	2.74	.931	.207	-.776
Score of learning	382	3.54	.548	-.542	.230

Table 5.4 Details of Kolmogorov – Smirnov Test

N = 382		Firm performance	Use of forecast rating	Use of Planning	Total control rating	Score of IT Usage	Score of learning
Normal Parameters	Mean	3.4817	3.6032	3.3973	31.0890	2.7408	3.5471
	Std. Deviation	.60183	.50357	.70437	5.78644	.93131	.54803
Most Extreme Differences	Absolute	.180	.101	.133	.082	.117	.167
	Positive	.087	.077	.079	.082	.117	.139
	Negative	-.180	-.101	-.133	-.043	-.094	-.167
Kolmogorov-Smirnov Z		3.518	1.981	2.607	1.605	2.283	3.274
Asymp. Sig. (2-tailed)		.000	.001	.000	.012	.000	.000

5.6. Nature of Association between the Variables.

It is hypothesized that the use of controlling influences the firm performance. The scatter plots and the box plots are used to observe the presence of the specific trends and the relationships (Blaikie 2003). Figure 5.7 illustrates the nature of association between the firm performance and use control. Figure 5.8 shows the positive association between the use of control and the IT usage.

Figures 5.9 to 5.16 show the variation of the use of controlling with firm performance, age, education, experience, standardization, IT usage, learning and ownership type. A positive association is observed among the use of controlling and firm performance. The education of the key person, standardization and the IT usage are associated with the use of controlling. The learning and the IT usage indicate a positive association with the use of controlling. Box plots show that the professional managers use controlling function in a better way than owners/ entrepreneurs (figure 5.16).

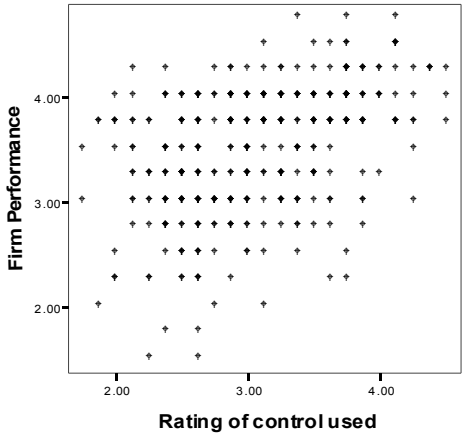


Figure 5.7 Scatter Plot between the Use of Controlling and Firm Performance

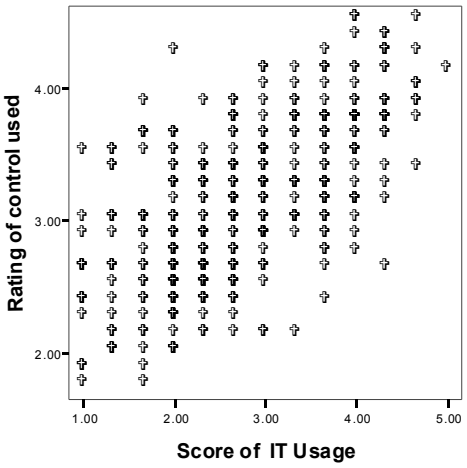


Figure 5.8 The Scatter Plot between the Use of Controlling and IT Usage

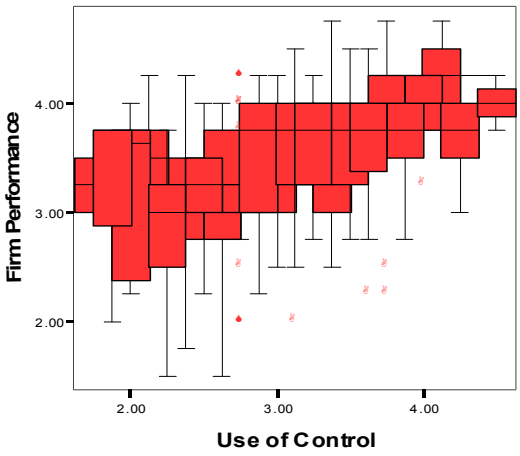


Figure 5.9 Box Plot between Use of Controlling and Firm Performance

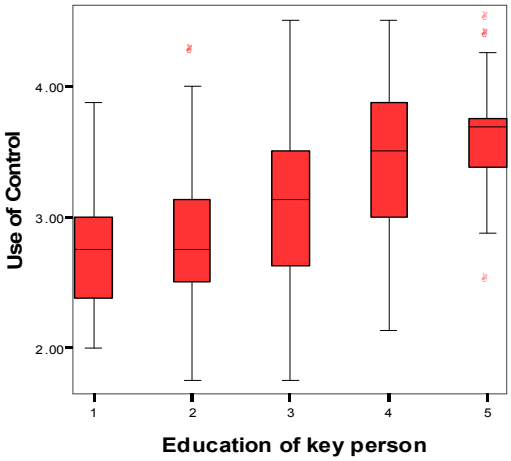


Figure 5.10 Box Plot between Use of Controlling and Education of Key Person

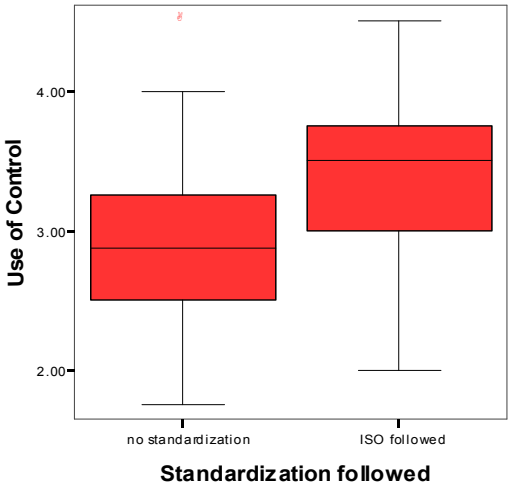


Figure 5.11 Box plot between Use of Controlling and Standardization

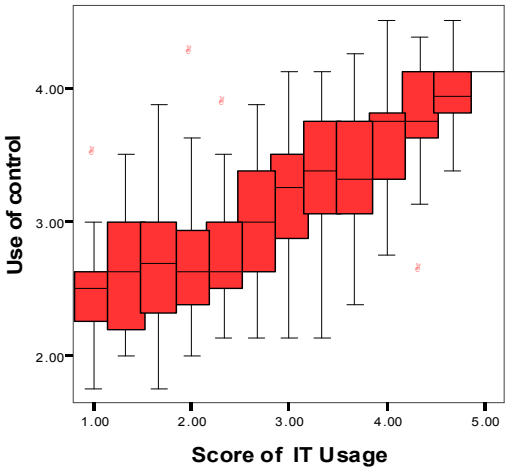


Figure 5.12 Box plot between Use of Controlling and IT Usage

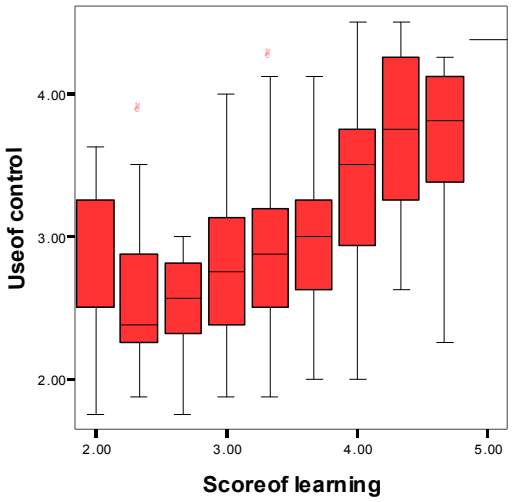


Figure 5.13 Box Plot linking Use of Controlling and Learning Orientation

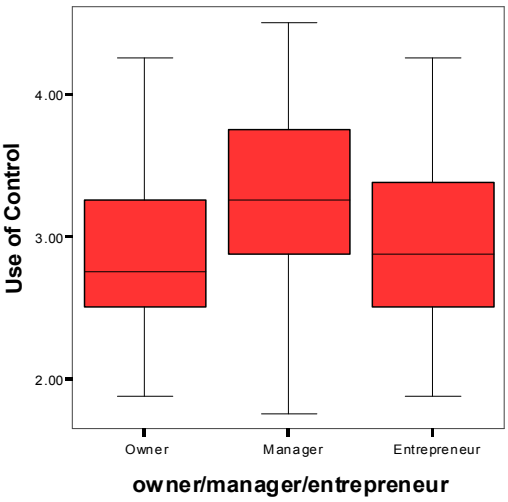


Figure 5.14 Box Plot linking Use of Controlling and Type of Ownership

Table 5.5 The Non Parametric Correlation between the Variables

Variable	Firm performance	Use of forecasting	Use of planning	Use of Controlling	Learning	IT usage	Age	Education	Experience
Firm Performance	1								
Use of Forecasting	.512**	1							
Use of planning	.294**	.400**	1						
Use of controlling	.388**	.406**	.617**	1					
Learning	.410**	.339**	.539**	.574**	1				
IT usage	.376**	.424**	.715**	.600**	.598**	1			
Age	.057	.109*	.120*	.043	.149**	.126*	1		
Education	.235**	.295**	.563**	.405**	.387**	.571**	.112*	1	
Experience	.084	.047	.076	.001	.108*	.083	.619**	-.011	1

A good correlation was found among the variables, except for the key person's age and experience (Table 5.5). The data was sufficiently linear and the presence of a minor amount of multicolleniarity was noticed. The deviation from the normality necessitated the special non parametric tests (Blaikie 2003).

5.7. Exploratory Factor Analysis

The control variables such as the age, education and experience of the key person, ownership type, standardization followed etc were used for the cross validation of data. The description of the factor analysis done is given below.

5.7.1. Use of Controlling

"Use of Controlling" is defined as the extent by which the control used by the SME fits to the purpose. The controlling was rated according to the suitability for improving the firm performance. The conceptual definition of the use of controlling and its nine indicators were established by the works of Rauch *et al*. (2000); Beaver (2002); Karami (2006), Bhutta *et al.* (2008) and Boohene *et al*. (2008). Table 5.6 shows the descriptive statistics of the indicators of the use of controlling. The significant correlations (table 5.7) and multicolleniarity indicate the suitability of the data for the factor analysis.

Table 5.6 The Descriptive Statistics of the Use of Controlling

Indicators (N =382)	Mean	Std. Deviation
Degree of control Aggregate planning **C1**	3.45	.700
Degree of control shop floor planning **C2**	3.47	.701
Accuracy of control **C3**	3.29	.699
Overall satisfaction of control **C4**	3.25	.848
Decision making style **C5**	2.67	1.020
Percentage of time production stopped **C6**	3.44	.706
Machine loading rating **C7**	2.86	.963
Usage of aggregate planning **C8**	2.20	.870
Usage of scheduling **C9**	2.92	1.008
Critical Ratio usage **C10**	3.58	.647
Violation of Production Schedules **C11**	3.40	.588

The measure of the sample adequacy was tested using the K-M-O criterion and the Bartlett's test of sphericity. The MSA values (shown in table 5.8) more than 0.5 (in this case equal to .931) indicates the presence of none zero correlations. The Bartlett's test of sphericity value significant at .0001 level verifies the presence of none zero correlations. The Scree plot is shown in figure 5.15. The initial communalities after conducting the principal component analysis are shown in table 5.9. The indicator variable "percentage of time production stopped" was dropped from the analysis because of low communality score.

Table 5.7 Inter-tem Correlation Matrix of the Use of Controlling

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
C1	1										
C2	.624	1									
C3	.624	.604	1								
C4	.600	.638	.638	1							
C5	.536	.546	.629	.593	1						
C6	.521	.525	.599	.577	.628	1					
C7	.310	.323	.355	.360	.382	.373	1				
C8	.509	.574	.571	.544	.540	.548	.316	1			
C9	.519	.559	.575	.558	.522	.525	.375	.545	1		
C10	.307	.306	.393	.374	.344	.369	.113	.353	.291	1	
C11	.331	.384	.456	.442	.401	.335	.195	.431	.402	.608	1

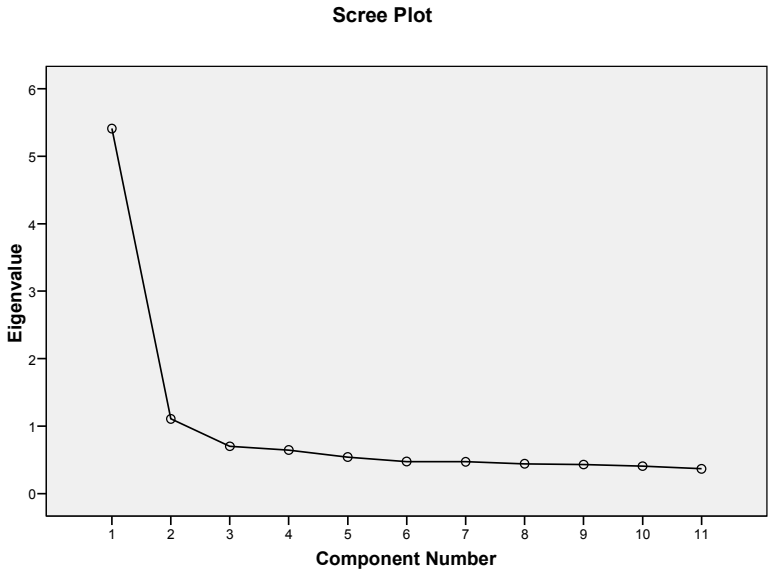


Figure 5.15 The Scree Plot of Use of Controlling

Table 5.8 KMO and Bartlett's Test Results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.931
Bartlett's Test of Sphericity	Approx. Chi-Square	1758.84
	df	55
	Sig.	.000

Table 5.9 The Initial Communality Values

Indicators	Initial	Extraction
Degree of control Aggregate planning	1.000	.584
Degree of control shop floor	1.000	.576
Accuracy of control	1.000	.573
Overall satisfaction of control	1.000	.610
Decision making style	1.000	.581
Percentage of time production stopped	1.000	.466
Machine loading rating	1.000	.568
Usage of aggregate planning	1.000	.574
Usage of scheduling	1.000	.567
Critical Ratio usage	1.000	.699
Violation of Production Schedules	1.000	.721
Extraction Method: Principal Component Analysis.		

After eliminating the indicator "Percentage of time production stopped", the EFA was again conducted. New communality values of all the indicators were found satisfactory. The factor loading is illustrated in table 5.10. All the items were reduced to two factor constructs with no cross loading indicators. The items, namely "Critical ratio usage" and "Violation of production schedules" loaded on the construct 2, while all other indicators loaded on the construct 1. About 61.6 percent variability is explained by the constructs and is therefore accepted (Hair *et al*. 2011).

Table 5.10 The Factor Loadings of the Use of Controlling with Ten Indicators

	Component	
Indicators	1	2
Degree of control Aggregate planning	.736	.209
Degree of control shop floor	.740	.171
Accuracy of control	.729	.208
Overall satisfaction of control	.737	.269
Decision making style	.754	.121
Machine loading rating	.722	.216
Usage of aggregate planning	.742	.157
Usage of scheduling	.719	.225
Critical Ratio usage	.202	.856
Violation of Production Schedules	.230	.830
Extraction Method: Principal Component Analysis. Rotation Method: Varimax rotation with Kaiser Normalization. Rotation converged in 3 iterations.		

The reliability test results and the item-total correlation statistics are shown in table 5.11. The reliability coefficient measured the consistency of the entire scale (alpha value more than 0.7). All items do report with the alpha value above 0.8, which is considered excellent.

Table 5.11 Reliability Test Results and Item-Total Correlation

Indicator items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Degree of control Aggregate planning	27.64	27.984	.677	.482	.876
Degree of control shop floor	27.62	28.059	.664	.458	.876
Accuracy of control	27.80	28.044	.668	.470	.876
Overall satisfaction of control	27.84	26.583	.707	.517	.872
Decision making style	28.42	25.645	.658	.459	.877
Machine loading rating	28.23	25.924	.676	.481	.875
Usage of aggregate planning	28.89	26.757	.663	.456	.875
Usage of scheduling	28.16	25.587	.675	.473	.875
Critical Ratio usage	27.51	29.846	.456	.347	.889
Violation of Production Schedules	27.69	30.125	.467	.343	.888

5.7.2. Testing the Validity and the Reliability of the Use of Controlling

a) Content Validity: The face validity of this construct is established from the studies of Variyam & Kraybill (1993); Beaver (2002); Karami (2006) and Bhutta *et al.* (2008).

b) Unidimensionality: All indicators of the respective constructs were loaded to a single factor construct, without any cross loading (Kothari). Thus unidimensionality was ensured.

c) Reliability: The reliability was checked by the following measures: i) Internal Consistency ii) Cronbach's alpha.

a. **Internal Consistency**: The internal consistency refers to the consistency of the variables in a summated scale. The values of the inter item correlation for all indicators are more than 0.3. The items to total correlation for all indicators are above 0.5. These figures show that the indicators are internally consistent. Table 5.7 shows the internal consistency of items.

b. **Cronbach's Alpha:** Alpha values of .6 to .7 are considered the lower limits of acceptability. Table 5.11 shows the alpha values of all indicators. All values are above 0.8 (well above the acceptable limit).

d) Convergent Validity: To establish the convergent validity, summated scale was compared with a surrogate variable. The testing of convergent validity is shown in table 5.12. The mean scores of the use of controlling and surrogate variable

"overall satisfaction of control" were compared among three groups (firms managed by the owner / manager / entrepreneur). Similar relationship was observed for the construct and indicator (F distribution values shown in table 5.12). Significant correlation (greater than .7) was also observed. Thus the convergent validity was established.

Table 5.12 Testing of Convergent Validity

Measure	Mean scores Group1(N=124)	Mean scores Group2(N=88)	Mean scores Group3(N=70)	F-value	Significance
Summated scale "use of controlling"	2.837	3.271	2.948	23.89	.000
Indicator item, "Overall satisfaction of control"	2.98	3.47	3.14	14.53	.000
Correlation between item and summated scale			.786**		

e) **Discriminant Validity:** The use of controlling scale was correlated with the firm performance scale. The correlations are positive, but of value less than 0.3 (much less than that observed in the case of the convergent validity test, conducted between the use of controlling and its indicators), thereby establish the discriminant validity.

5.7.3. Split Factor Analysis and Validation of the EFA Model

The objectives of conducting the split factor analysis are the following:

- To validate the use of factor constructs under the influence of the control variables.
- To study the loading pattern under the influence of the control variables.

5.7.3.1. Split Factor Analysis of the Use of Controlling

The loadings and the communalities for the perceptions of the "Use of Controlling" are compared with the control variable "Ownership Type". The first group included the firms headed by the professional managers and the entrepreneurs (N = 258). The second group of the firms are headed by the next generation owners (N = 124). Using control variables "ownership type" and "education of key person", split factor analysis was conducted. The factor loadings and the communalities for the top seven perceptions of the "use of controlling" were compared (shown in table 5.13).

Table 5.13 The Split Factor Analysis of the Use of Controlling

SPLIT SAMPLE 1			SPLIT SAMPLE 2	
Item	Component factor loading	Communality	Component factor loading	Communality
Degree of control Aggregate planning	.814	.662	.628	.394
Degree of control shop floor planning	.755	.569	.724	.525
Accuracy of control	.753	.567	.725	.525
Overall satisfaction of control	.773	.598	.777	.604
Decision making style	.740	.548	.750	.563
Machine loading rating	.764	.584	.700	.490
Usage of aggregate planning	.760	.578	.687	.472

5.7.3.2. Interpretation of Split Factor Analysis

Items were loaded on a single construct in both cases. The theoretical assumption that the indicators correspond to the factor construct, "Use of Controlling" is verified. The indicators including the "Degree of control in aggregate planning", "Degree of control in shop floor planning", "Accuracy of control" and "Usage of aggregate planning" have been loaded better in sample 1 (firms run by the managers and the entrepreneurs) when compared to sample 2 (firms run by the next generation owners). The managers and the entrepreneurs give more orientation to the "Systematic control" perspective than the next generation owners. The "Overall satisfaction of control" and the "Decision making style" are characterized in a better way by the firms run by the managers and the entrepreneurs than the firms run by the owners. This indicates that the next generation owners are more oriented to the "power distance" perspective. The findings of this study agree with the observations of O'Regan & Ghobadian (2002) and Gray (2002).

5.8. Kruskal – Wallis Test Results

The results of hypotheses tests linking with use of control is listed in table 5.14.

The difference in the scores of the dependent variable (the use of controlling) is compared among the two groups, namely the low and high level users. In order to define the low and the high level users, the control variables such as the type of the owner, the number of employees, the demographics of key person, the IT usage, the standardization followed and the training orientation were used.

Significant difference in the firm performance is observed between the low and the high level users of control and the null hypothesis H_{04a}, which states that no relation between the use of controlling and the firm performance is rejected. The positive association between firm performance and use of control supported the alternate hypothesis H_{4b} which states that the more influence of a professional manager on the use of controlling is accepted.

Table 5.14 The Results of the Hypothesis Tests Linking with the Use of Controlling

Difference in the Use of Controlling (Dependent Variable)				
Independent Variable	**Kruskal - Wallis Chi square**	**Significance**	**Influencing dependent variable**	**Type of relationship**
Between Owner/Manager/Entrepreneurs	42.941	.001**	YES	Positive
Less and More employees (N<10 to N >150)	79.32	.000**	YES	Positive
Education: Low (Pre university and below), Higher level (Graduate and professional)	76.344	.000**	YES	Positive
Experience: Less experienced < 8 years, More experienced > 8 years	2.927	.087(NS)	NO	Nil
Age: Young < 40 years, Aged > 40 years	3.702	.074 (NS)	NO	Nil
Low and high level performers of "Use of IT".	141.5	.000**	YES	Positive
Low and high level "Use of Learning".	92.014	.000**	YES	Positive
Low and high users of Standardization.	73.617	.000**	YES	Positive
Note: Kruskal –Wallis Test - variables measured on Likert's five-point scale (1 – low score; 5 high score); mean value; SD- standard deviation. *: p<0.05; **: p<0.01.NS-Not statistically significant.				

The null hypothesis H_{04c} which states that there is no relation between the number of employees and the use of controlling is rejected. The alternate hypothesis that the use of controlling is influenced by the number of employees is accepted. The null hypothesis H_{04d} which states that there is no relation between the use of controlling and education of which states that there is no key person was rejected. Significant and positive association between the use of controlling and the education of the key person is established.

The null hypothesis H_{04e} that states no relation between the use of controlling and the experience of the key person is accepted. The null hypothesis H_{04f} which states no relation between the age of key person and use of controlling is also accepted. The use of controlling is positively influenced by the IT usage and so the null hypothesis H_{04g} is rejected. The null hypothesis H_{04h} (stating no difference in the use of controlling

between the firms with more and less learning orientation) is rejected. The positive association between the use of controlling and the learning orientation supported the alternative hypothesis. It was also found that the use of controlling is better in ISO 9000 certified firms.

5.9. Research Findings and Conclusions

Based on the benchmark of comparison (Singh *et al*. 2007, 2010), the cases were grouped into two: high level of control users and low level of control users. The high level of control users recorded an average firm performance score of 3.73, while the low level users of control recorded 3.22. This result is statistically significant and it indicates the positive influence of use of control on firm performance. The firms headed by the professional managers reported an average use of controlling score of 3.27, while it is 2.84 for the firms headed by the next generation owners and 2.95 for firms headed by first generation entrepreneurs. From this, it is observed that the professional managers are using the control function more effectively than the next generation owners and entrepreneurs.

Hambrick & Manson (1984) and Karami *et al.* (2006) argue that the younger CEOs pursue risky business strategies. Bantel & Jackson (1989) report that the younger managers are more educated and they have more exposure to the current technical knowledge. The younger key persons are likely to bring better outcome. But such a relationship is not observed in this study. No difference in the use of controlling existed among the young and the aged key persons. The correlation between age of the key person and the use of controlling is low and also is not significant ($\gamma = .073$, $p > .15$). This research finding agrees with the findings of Karami *et al*. (2006). According to Karami (2006), the older manager develops his people and fosters an effective performance in SMEs. The younger managers are ambitious. They are concerned with the immediate results. The lower operating volumes, the assured demands and the dependence on internal markets are the anticipated reasons for the less proactive nature of SME key personnel. The present day's controlling strategies are to be changed as they will not help the firms in acquiring the global competencies (agrees with Todd *et al*. 2007).

The educated key persons are seen employing the controlling function more effectively. The results of this research do agree with the findings of O'Regan (2002) and Karami *et al*. (2006). The correlation between the education of the key person and the use of controlling is also significant ($\gamma = .583$, $p < .001$). More educated key persons are found using more amount of controlling function than the counterparts. It is understood that the younger managers are having less experience but are more educated. The younger managers are more knowledgeable and are prepared to gather appropriate information. The older managers are less educated. They have rich experience. Hence no significant difference in the use of control is observed among the young and the old managers.

Figure 5.16 shows that the overall rating of control usage, the usage of scheduling tools, the machine loading and the degree of control scores are higher for the educated key person. The use of scheduling and the machine loading is reported around the nominal score of 3. This indicates the fact that the usage of controlling in the SMEs is much lower. The lower score for the usage of controlling instruments is attributed to the less importance to the modern techniques by the key person.

Significant difference in the use of controlling is observed among the ISO and the non ISO firms (use of controlling scores of 2.85 for the non ISO firms and 3.41 for the ISO firms). The correlation between the standardization and the use of control was also significant ($\gamma = .687$, $p = .001$). Brown *et al.* (1998) has also reported significant difference in firm performance between the ISO and the non ISO firms. Steps of the standardization and the certification process will lead to the better usage of control in SMEs.

The high level users of IT record a use of controlling score of 3.76, while for the low level users of IT, it is 2.74. The correlation between the IT usage and the control rating is strong and significant ($\gamma = .737$, p .001). Similarly the firms with the high learning orientation reports an average use of controlling score of 3.64, while the firms with the low learning orientation reports a score of 2.62 ($\gamma = .613$, p .001). The differences are significant at .001level. It is evident that the use of IT and learning results in better use of control. The scores are given in Figure 5.17.

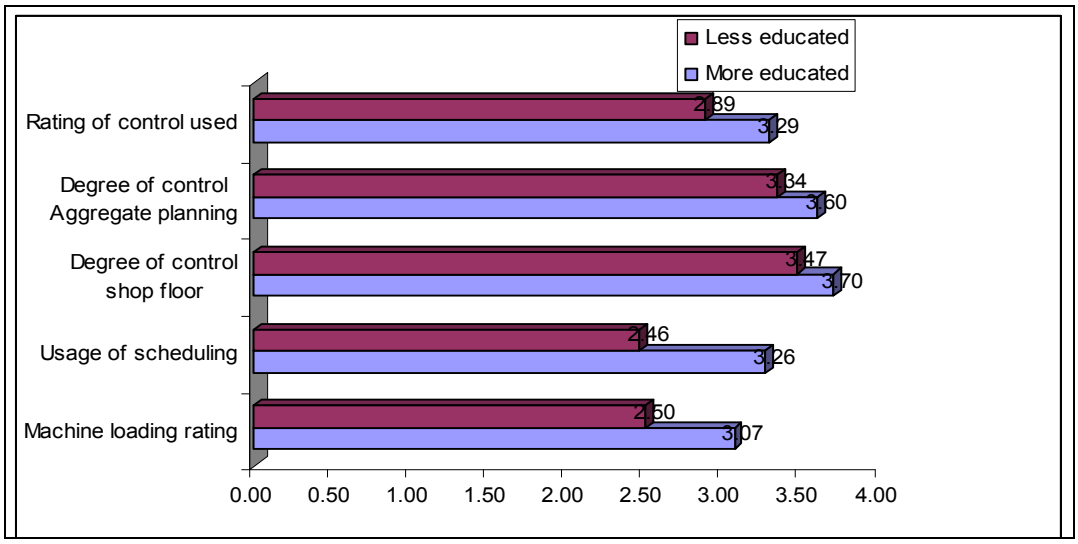


Figure 5.16 Comparison of Use of Control among Less and More Educated Key Person

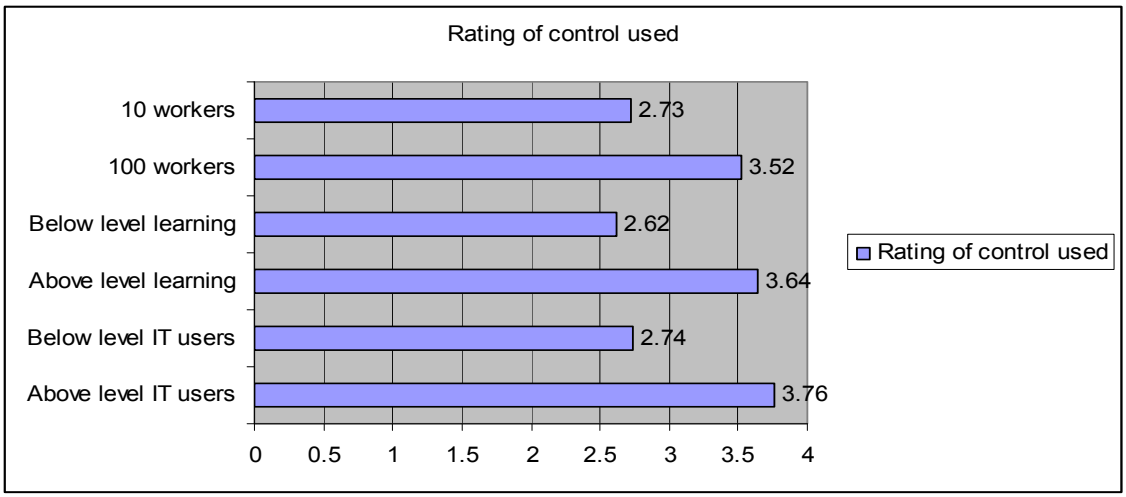


Figure 5.17 The Comparison of Use of Control among above and below users of IT and Learning

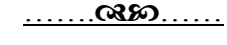
The lowest use of controlling is reported from the firms with less than 10 employees (2.73), while it is 3.52 for the firms with more than 100 workers. The medium correlation score (γ =.737, p .001) is observed between the use of controlling and the number of employees. The explanation for this could be that more the number of employees, the more the need for control.

The analysis linking the type of product, the process typology and demand with the use of controlling is not reported since they fail to give any significant results.

5.9.1. The Ways of Improving the Use of Controlling in SMEs

The practical ways and means to improve the use of controlling which in term will improve the firm performance are summarized as below:

- SMEs with limited resources and practices of autocratic decision making results in the adoption of less efficient control methods. Updating the knowledge resources enables the SMEs to use the modern tools of loading and scheduling. This is necessary while competing in the modern business world.
- Firms with less number of employees are to update their competencies in using the controlling function.
- At present SMEs are not using modern tools for production control. Exposure and training to which is recommended.
- Use of the IT and the IS must be entertained, as better controlling can be ensured by doing so.
- Education of the key person aids proper usage of controlling techniques. The executive education in SMEs is required.
- Professionalization of management of the SME will result in a better firm performance, hence that should be tried out.
- Standardization and the certification of process are found improving the management control and the firm performance.
- Younger key persons should extract the tacit knowledge from the experienced persons to strengthen their management capabilities.
- Team work in control should be encouraged.
- The crude practices should be substituted with the formal, systematic and modern control tools.
- Having a good forecasting and planning system will reduce the controlling work and improve the system performance.



Chapter 6

COMBINED INFLUENCE OF FORECASTING, PLANNING AND CONTROLLING ON SME PERFORMANCE

Contents

This chapter presents the details of the combined influence of forecasting, planning and controlling on the firm performance. The first part of the chapter explains a logistic regression model used to classify and explain the characteristics of the low performing and the high performing firms. Then the ways of improving the PPC, as revealed from the logistic regression, are summarized. The second part explains the confirmatory factor analysis (CFA) to test how well the measured variables represent the constructs. The findings of the CFA and the SEM models are summarized in the end.

6.1. Introduction

The study linking the use of forecasting, planning and controlling with the firm performance separately are discussed in chapters 3, 4 and 5 respectively. In the above chapters, the use of forecasting, planning and controlling are linked (one at a time) to the characteristics such as the demographics of the key person, firm characteristics, IT usage and learning. Suitable hypotheses were formed to test the relationship between the dependent and the independent variables. But they did not explain the combined influence of many variables at a time. The multivariate analysis techniques, explaining the relationship between many variables, when acted upon simultaneously is discussed in this chapter.

The first part of this chapter is devoted to a logistic regression model, to classify and explain the characteristics of the low performing and the high performing firms. It is a special form of regression analysis (Hair *et al.* 2011) in which the dependent

variable is generally non metric. In this work, firm performance was selected as the dependent variable. All other variables mentioned in chapters 3, 4 and 5 were used as independent variables. The model, the framework and the steps of the logistic regression are explained in the respective sections. The second part of this chapter deals with a confirmatory factor analysis (CFA), to test how well the measured variables represent the constructs (Hair *et al*. 2011).

6.2. Model and Framework of Logistic Regression.

The logistic regression is a special type of regression analysis used to predict and explain a binary (two-group) categorical variable, rather than a metric dependent measure (Hair *et al.* 2011). Logistic regression and discriminant analysis are used to represent one dependent variable of the non metric type in terms of two or more independent variables. The discriminant analysis insists that independent variables be of the metric type, while logistic regression permits even non normal independent variables. Discriminant analysis necessitates multivariate normality and equal variance assumed, which are impractical for most of the business research data (Keskin *et al*. 2006; Alasadi *et al*. 2008).

Islam & Karim (2011) used linear regression to predict the business performance of the Malaysian SMEs. Some researchers assumed data with sample size more than 300 as normally distributed (Deshmukh 2005; Karami *et al*. 2006). Daily & Dollinger (1992); Perez & Durendez (2006) and Hair *et al*. (2011) used logistic regression for dealing with non normal data. In the logistic regression, the dependent variable is categorized into two groups (binary coding). Alasadi *et al*. (2008) used the logistic regression for predicting SME performance in Syria. Perez & Durendez (2006) analyzed the managerial behavior of the Spanish SMEs with the aid of the logistic regression.

In this research, the firm performance is selected as the dependent variable. A value of 0 is given to the low level performers (firm performance score below 3). The high level performers are coded with the value 1.

6.3. Description of the Logistic Regression Model

The objectives of the logistic regression model are the following:

- To identify those independent variables, which have a significant role in classifying the firms on the basis of their performance.

- To study the role and the influence of different control variables (such as standardization, use of forecasting, IT use etc) in classifying the firms as the low and the high level performers.

The logistic regression follows three steps as described below:

1. To estimate a null model (this is a base line model, with which any real models containing the independent variables are compared).
2. To estimate the proposed model (calculate -2LL for the proposed model containing the independent variables).
3. To asses the difference in the value of -2LL.

The maximum likelihood ratio, the Hosmer and Lemeshow measure and the classification table are used to test the logistic regression model. The pseudo R^2 of Cox and Snell and the R^2 of Nagelkerke are used to evaluate the overall fit. The Wald's statistic evaluates the statistical significance of the variables included in the model (Hair *et al*. 2011).

6.3.1. Assumptions of the Logistic Regression

In this research work, the following assumptions were made:

- Firm performance is the dependent variable, and was measured using a five point scale. The firms with performance score above 3 were grouped into high level performers and coded 1. Score up to 3 were coded 0 and grouped as low level performers.
- The measures such as the demographics of the key person, standardization, IT usage, use of forecasting, planning and control were selected as the independent variables.
- Distribution of the independent variables is not normal.

6.3.2. Analysis of the Logistic Regression Model

A forward step wise likelihood ratio method was followed for the inclusion of the variables in the equation. Four steps were used to minimize the -2 Log likelihood value. The initial Log likelihood value is shown in the table 6.1.

Table 6.1 Iteration History of Initial (0^{th}) Step

Iteration		-2 Log likelihood	Coefficients
		Constant	Constant
Step 0	1	528.297	.115
	2	528.297	.115

a Constant is included in the model.
b Initial -2 Log Likelihood: 528.297
c Estimation terminated at iteration number 2 because parameter estimates changed by less than .001.

The model summary of reduction in the log likelihood is shown in table 6.2. As per the decision rule, the variables with the highest log likelihood reduction potential and the lowest significance level are to be entered first. Sticking to this rule, the iteration was performed. Iteration history and log likelihood is shown in table 6.3.

Table 6.2 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	434.257(a)	.218	.291
2	402.790(a)	.280	.374
3	390.591(a)	.303	.404
4	385.385(a)	.312	.417

Table 6.3 Iteration History of Logistic Regression

Iteration		-2 Log likelihood	Coefficients				
		Constant	Use of forecasting	Use of planning	standardization	Use of Control	Constant
Step1	1	437.769	-6.578	1.857			
	2	434.290	-8.260	2.327			
	3	434.257	-8.446	2.378			
	4	434.257	-8.448	2.379			
	5	434.257	-8.448	2.379			
Step2	1	409.793	-7.697	1.434	.779		
	2	402.943	-10.244	1.936	.996		
	3	402.790	-10.703	2.027	1.035		
	4	402.790	-10.716	2.029	1.036		
	5	402.790	-10.716	2.029	1.036		
Step 3	1	398.715	-6.720	1.284	.561	.776	
	2	390.810	-9.160	1.802	.722	.949	
	3	390.591	-9.653	1.908	.753	.986	
	4	390.591	-9.671	1.911	.754	.987	
	5	390.591	-9.671	1.911	.754	.987	
Step 4	1	394.589	-7.193	1.226	.413	.680	.398
	2	385.676	-9.903	1.747	.502	.836	.569
	3	385.386	-10.502	1.865	.516	.874	.610
	4	385.385	-10.527	1.870	.517	.875	.611
	5	385.385	-10.527	1.870	.517	.875	.611

A considerable reduction in the log likelihood value was observed. The "Hosmer and Lemeshow" test of significance was used to check the scope of including any more variable in the regression equation. The significant "p" values indicated the validity of the data. The Hosmer and Lemeshow test history is listed in table 6.4.

Table 6.4 The Hosmer and Lemeshow Test Results

Step	Chi-square	df	Sig.
1	10.858	8	.210
2	4.137	8	.845
3	5.749	8	.675
4	5.677	8	.683

The classification table describes the status of the observed and the predicted score of both the low and the high performing firms. Normally a classification that results in an accuracy of above 60 percent correct is considered satisfactory (Hair *et al*. 2011). In this analysis the classification of 76.4 percent is obtained, which is acceptable (table 6.5). At the end of the step 4, use of forecasting, planning, controlling and standardization were included in the regression equation. Prediction of the low performing firms shows 73.9 percent agreement with the data that has classified correct. Similarly 78.7 percent of the high performing firms are found classified correctly.

Table 6.5 Classification Table

Step	Observed		Predicted		
			Above and below FP		Percentage Correct
			Below FP	Above FP	Below FP
Step 1	Above and below FP	Below FP	112	68	62.2
		Above FP	40	162	80.2
	Overall Percentage				71.7
Step 2	Above and below FP	Below FP	120	60	66.7
		Above FP	44	158	78.2
	Overall Percentage				72.8
Step 3	Above and below FP	Below FP	129	51	71.7
		Above FP	48	154	76.2
	Overall Percentage				74.1
Step 4	Above and below FP	Below FP	133	47	73.9
		Above FP	43	159	78.7
	Overall Percentage				76.4

Table 6.6 shows the variables not included in the regression equation. Only those variables with the significance value more than 0.05 were included in the regression equation. Hence the variables mentioned in the table 6.6 were excluded from the model. It is quiet evident from the classification scheme that the combined influence of the IT and the learning on the firm performance is of little significance. However, their role cannot be under estimated as many low performing firms report a better IT usage.

Table 6.6 Variables not in the Regression Equation

Variables not in the equation		Score	df	Sig.
Step 4	Age key person	.031	1	.861
	Education key person	3.025	1	.082
	Exp key person	1.999	1	.157
	IT use	.003	1	.956
	Learning score	.039	1	.844
	Overall Statistics	5.155	5	.397

The table 6.7 shows the variables in the regression equation. Use of forecasting was included in the first step. Use of planning was entered in the second step. Standardization was entered in the third step and use of controlling in the last step. Positive values of all regression coefficients indicate a positive association.

Table 6.7 Variables Included in the Regression Equation

Variables		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Step 1(a)	Forecasting	2.379	.289	67.761	1	.000	10.793	6.126	19.017
	Constant	-8.448	1.048	65.011	1	.000	.000		
Step 2(b)	Forecasting	2.029	.302	45.075	1	.000	7.609	4.207	13.759
	Planning	1.036	.194	28.682	1	.000	2.819	1.929	4.119
	Constant	-10.716	1.225	76.528	1	.000	.000		
Step 3(c)	Standardization	.987	.285	12.033	1	.001	2.684	1.536	4.688
	Forecasting	1.911	.310	38.124	1	.000	6.763	3.687	12.406
	Planning	.754	.208	13.195	1	.000	2.126	1.415	3.194
	Constant	-9.671	1.256	59.328	1	.000	.000		
Step 4(d)	Standardization	.875	.290	9.094	1	.003	2.400	1.359	4.239
	Forecasting	1.870	.315	35.325	1	.000	6.485	3.501	12.014
	Planning	.517	.230	5.032	1	.025	1.676	1.067	2.632
	Control rating	.611	.270	5.130	1	.024	1.843	1.086	3.128
	Constant	-10.527	1.338	61.912	1	.000	.000		

a Variable(s) entered on step 1: Forecasting
b Variable(s) entered on step 2: Planning
c Variable(s) entered on step 3: Standardization.
d Variable entered on step 4: Control rating.

6.3.3. Interpretation of the Logistic Regression Results

The overall hit ratio (the percentage of the total number of the variables in the low and the high performing firms, that are classified correctly by the model) for the overall fit model was found acceptable (shown in the table 6.5). Standardization, use of forecasting, use of planning and use of controlling are positively related to firm performance (inferred from positive beta coefficient). Positive values of the original coefficients (B_0, B_1 etc) reflect the increase in predicted probability with the increase in independent variable. Wald statistic confirmed the significant influence of each independent variable included in the model.

The exponentiated coefficient's value, above 1 indicates the positive relationship and value below 1 indicates the negative relationship. The use of forecasting is the most predominant factor, followed by the standardization and then the controlling (as observed from the exponent of beta coefficient values 6.485, 2.4, 1.843 and 1.673 respectively). The model fit was assessed by means of global fit measure of Hosmer and Lemeshow. Statistically significant difference between the observed and predicted classifications are not existing, as inferred from the insignificant value of Chi square (Chi square 5.667, p = 0.683). The pseudo R square values roughly estimate the percentage variability explained by the model. R square values of .3 and .41 are comparatively fair values (Hair *et al*.).

The regression equation is shown below:

Logit = -10.527+.875 (score of standardization) + 1.870 (score of forecasting) + .517 (score of planning) + .611 (score of controlling)

Odds = e^{Logit}

Probability = Odds/ (1+Odds)

Percent change in odds = (Exponentiated coefficient$_i$ -1) x100

An increase by one point in the use of forecasting has resulted in a 548 percent increase in the odds. The increase by one point in the use of planning, controlling and standardization have resulted in an increase in the odds by 67.6 percent, 84.3 percent and 140 percent respectively.

6.3.4. Validation of the Logistic Regression Model

Type of the key person (Owner/manager/entrepreneur) was used as a control variable for the validation. The firms managed by the second generation owners (N= 124), the professional managers (N = 188) and the first time entrepreneurs (N =70) were selected as the three groups.

Table 6.8 Comparison of Hit Ratios in Three Groups

Actual group membership	Predicted group membership [d]								
	Analysis sample 1 [a]			Analysis sample 2 [b]			Analysis sample 3 [c]		
	Ownership type 1			Ownership type 2			Ownership type 3		
	Owners (N = 124)			Managers (N =188)			Entrepreneurs (N = 70)		
	Below performers	Above performers	total	Below performers	Above performers	total	Below performers	Above performers	total
Below performers	60 *(85.7)*	11	71	29 *(54.7)*	24	53	23 *(71.9)*	9	32
Above performers	21	32 *(60.4)*	53	12	123 *(91.1)*	135	6	32 *(84.2)*	38

[a]74.2 percent of analysis sample 1 correctly classified
[b]80.9 percent of analysis sample 2 correctly classified
[c]78.6 percent of analysis sample 3 correctly classified
[d]Values shown in brackets are the percentage correctly classified (hit ratio)

The analysis results are shown in the table 6.8. The accuracy of the classification was assessed by using two criteria (Hair *et al*. 2011). As per the "Proportional Chance criterion", the average probability of classification (hit ratio) was calculated as the average of all group values. The "Maximum Chance criterion" use the classification accuracy of the largest group. The classification accuracy (hit ratio) should exceed any criterion value by at least 25 percent. Threshold values of hit ratios obtained (in this study) by the above mentioned two criteria are 47.7 and 53.4 respectively. The overall hit ratios for all the three groups were within the threshold value. Classification accuracy was achieved for both the criteria, and thus condition for external validity was satisfied.

The first group which represents the "firms managed by the second generation owner" exhibited the pattern that matched with the whole sample. The regression equation included the variables such as "standardization", "use of forecasting", "planning" and "controlling". The second group that represents the "firms run by the managers" showed slightly a different pattern from the overall sample. The regression equation includes the independent variables such as the standardization, the use of forecasting, the use of planning and the use of IT. This indicates the impact of the usage

of the modern techniques of the IT and the IS by the professional managers. For the third group i.e. the firms managed by the entrepreneurs, "use of forecasting", "planning" and "standardization" are identified as the factors that discriminate between the low and the high firm performance.

The logistic regression model was also validated by comparing the "centroid" values of the independent variables and estimation of the probability of the odds. The centroid values of both the high and the low performing firms were calculated for the whole sample. The details of the classification are shown in table 6.9. The centroid for the group zero (low performing firms) was predicted with a probability of 0.1084 and for the group one (high performing firms) was predicted with a probability of 0.8876. There is clear distinction between the centroid for the group zero and those for the group one and therefore the classification was found reasonable.

Table 6.9 Estimated Probability Values for the Group Centroids with Control Variable "Ownership Type"

Independent variables	Control variable	
	High performers (Group 1)	Low performers (Group 0)
Centroid: Forecasting	3.77	3.37
Centroid: Planning	3.68	2.98
Centroid: Controlling	3.23	2.71
Centroid: Standardization	.57	.13
Logit Value [a]	.89784	-.91488
Odds [b]	7.90	.1217
Probability [c]	.8876	.1084

[a] Calculated as Logit = = -10.527 + .875 (score standardization) + 1.870 (score forecasting) + .517 (score planning) + .611 (score controlling)

[b] Odds = e^{Logit}

[c] Probability = Odds/ (1+Odds)

6.4. Logistic Regression: The Findings

The logistic regression model successfully classified the firms into those which perform high and those which perform low by maintaining acceptable levels of classification accuracy. The "Use of forecasting", "use of planning", "use of controlling" and "standardization" significantly influenced the SME performance. Out of the four variables, use of forecasting is the most influencing variable. The model is

validated with the control group of ownership type and the validation supported the model structure.

Use of forecasting has already been identified as one of the key success factors for the improved firm performance (Herbig *et al*. 1994; Saunders 1994; Mahmoud 1996; Smith *et al.* 1996; Makridakis 2009 and Annastiina *et al*. 2010). A clear distinction is observed in the firm performance scores between the high and the low level users of forecasting. The similar results are found for the use of planning, controlling and standardization.

Standardization has established systematic procedures, intimate knowledge and high confidence, so firm performance is found to be better. The significant role of the planning and controlling agrees with the findings of O'Regan *et al*. (2002); Karami *et al*. (2006) and Bhutta *et al*. (2008). These results confirm the importance of the use of forecasting, planning, controlling and standardized procedures for improving SME performance.

Education of the key person, IT usage and learning are not included in the final equation, however, from the significance values, they are likely to be included in the regression equation.

Findings of the logistic regression model are summarized as below:

- Use of forecasting is observed as the most influencing PPC function.
- Forecasting, planning, controlling and standardization take a role in classifying the low and the high performing firms.
- Influence of the variables such as the demographics of the key person, IT usage, learning etc, are not significant, when their influence is taken together. It does not mean they are irrelevant but their influence on firm performance is already explained in terms of the variables, "use of forecasting", "planning" and "control".
- The firms managed by the professional managers utilized the IT and the formal planning more effectively than the firms managed by the owners and the entrepreneurs.

- IT usage, learning and education are more likely to be included in the regression equation. Firms should pay attention to these functions also.

6.5. Confirmatory Factor Analysis: An Introduction

SEM is applied to test the extent to which the researcher's a priori pattern of factor loadings represents the actual data (Metts 2007). Thus the CFA serves as a tool to confirm or reject the preconceived theory presented by the researcher. Measurement theory specifies the manner in which the measured variables represent the constructs in a theoretical model (Hair *et al*. 2011) and uses a series of relationships for explaining the extent by which the variables represent a latent construct.

In PPC, it is perceived that the forecasting influences the planning. Planning influences the choice of the forecasting technique. Both forecasting and planning do influence the firm performance. A hypothesized dependent variable becomes an independent variable in a subsequent dependence relationship. Structural equation modeling (SEM) examines a series of dependence relationships simultaneously (Hair *et al*. 2011). Cross (bilateral) relationships often exists among the variables.

Structural theory is a conceptual representation of the linkage between the constructs (Hair *et al*. 2011). Theoretical models explain the causal relationships by means of a set of structural equations. Causal model infer whether the relationships meet the conditions necessary for causation. The theory of Reasoned Action (TRA, Fishbein & Ajzen 1975) and the Technology Acceptance Model (TAM, Davis *et al*. 1989) are examples of the theoretical grounds on which perceived ease of use of a concept and perceived usefulness are successfully linked. SEM models are used in the fields such as "computer acceptance in business field" (Igbaria *et al*. 1977), "implementation of IT and IS" (Grandon & Pearson 2003) etc. Demirbag *et al*. (2007) used SEM in the analysis of relationship between TQM implementation and firm performance. Omerzel & Antoncic (2008) used SEM to link entrepreneur knowledge dimensions with firm performance. In this research use of forecasting, planning, controlling and firm performance are linked.

6.6. Description of the Measurement Model

The relationship that links the constructs to the items (variables) are represented by the loading estimates (λ). The relationships between the constructs are represented by the loading estimates (Φ). The pre specified assumptions (propositions) which link the use of forecasting, planning, controlling, IT usage and learning with firm performance are tested. Initially, it is assumed that, the firm performance is a function of all other variables mentioned.

6.6.1. Defining the Individual Constructs

Working definition of the six constructs used in the measurement model already discussed is again given below:

- **Use of Forecasting (FOR)**: Appraisal of the usefulness of forecasting by the firm. Seven indicators are used to measure the construct.
- **Use of Planning (PLA)**: Appraisal of the usefulness of planning by the firm. This construct is measured with nine indicators.
- **Use of Controlling (CON)**: Appraisal of the usefulness of controlling by the firm. This construct is measured with eight indicators.
- **IT usage (IT Use)**: The extent to which IT and IS are utilized by the firm. The construct is measured with three indicators.
- **Use of Learning**: Extent of learning orientation possessed by the firm. This is measured with three indicators.
- **Firm Performance**: Self reported rating of firm performance. This construct is measured using six indicators.

A detailed description of the content validity of the items is given in section 3.4. The questionnaire used in this study is given in Appendix 1.

6.6.2. The Development of the Overall Measurement Model

The measurement model is explained by a visual diagram shown in figure 6.1. There are thirty four indicator variables and six latent constructs. All the constructs are allowed to correlate with each other. Each individual constructs are identified. Degree

of freedom of the overall model is more than the number of the paths to be estimated. Thus the order condition of measurement model is satisfied.

A reflective model is assumed (the direction of the causality is from the latent construct to the measured items). As an illustrative case, lower level usage of IT and IS caused only low scores on each of the three indicators of the use of IT. Each construct has a series of indicators which represent different dimensions. These dimensions shared a common conceptual basis. Particulars of the indicators are shown in table 6.10.

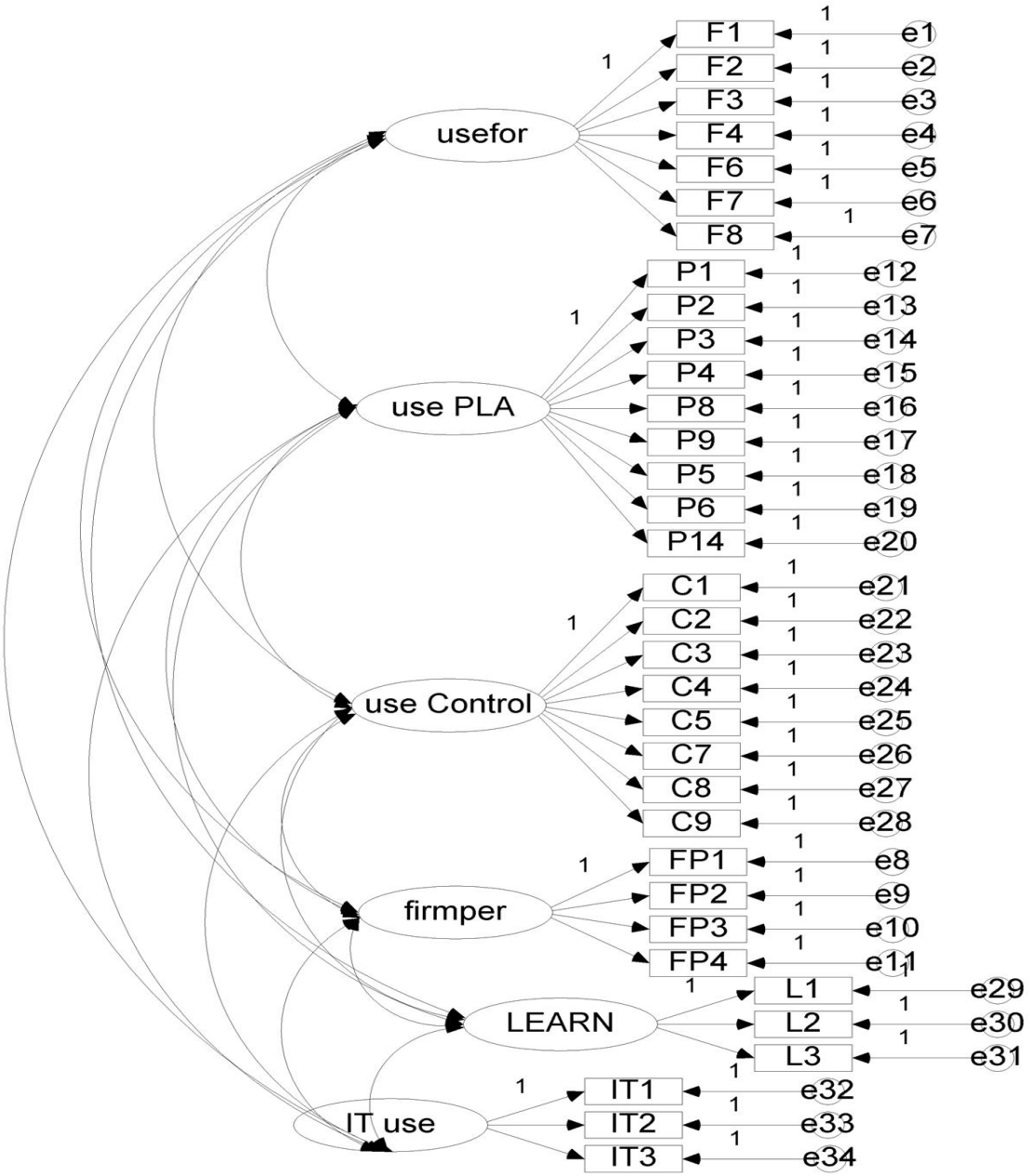


Figure 6.1 The Overall Measurement Model used in SEM

Table 6.10 The Indicators used in the Overall Measurement Model

Item	Scale Type	Description	Construct
F1	5 Point Likert, Low - High	Simplicity of the forecasting method	usefor
F2	5 Point Likert, Low - High	Understandability of the forecasting method	usefor
F3	5 Point Likert, Low - High	Ease of use of the forecasting method	usefor
F4	5 Point Likert, Low - High	Effectiveness of the forecasting used	usefor
F6	5 Point Likert, Low - High	Timeliness of the forecasting method	usefor
F7	5 Point Likert, Low - High	Accuracy of the forecasting used	usefor
F8	5 Point Likert, Low - High	Overall satisfaction of the forecasting method	usefor
P1	5 Point Likert, Low - High	Formalization in materials planning	Use PLA
P2	5 Point Likert, Low - High	Formalization in production planning	Use PLA
P3	5 Point Likert, Low - High	Formalization in HR Planning	Use PLA
P4	5 Point Likert, Low - High	Formalization in finance planning	Use PLA
P5	5 Point Likert, Low - High	Maintaining safety capacity	Use PLA
P6	5 Point Likert, Low - High	Maintaining safety level of inventory	Use PLA
P8	5 Point Likert, Low - High	Comparing goals with performance	Use PLA
P9	5 Point Likert, Low - High	Comparing performance with competitors	Use PLA
P13	5 Point Likert, Low - High	Use of budgetary planning	Use PLA
C1	5 Point Likert, Low - High	Degree of control in aggregate planning	Use Control
C2	5 Point Likert, Low - High	Degree of control in shop floor planning	Use Control
C3	5 Point Likert, Low - High	Accuracy of control used in the firm	Use Control
C4	5 Point Likert, Low - High	Overall satisfaction of control used	Use Control
C5	5 Point Likert, Low - High	Decision making style followed in the firm	Use Control
C7	5 Point Likert, Low - High	Rating of machine loading	Use Control
C8	5 Point Likert, Low - High	Use of aggregate planning	Use Control
C9	5 Point Likert, Low - High	Use of scheduling	Use Control
IT1	5 Point Likert, Low - High	Computers are used for the following purposes	IT use
IT2	5 Point Likert, Low - High	Number of computers used in the firm	IT use
IT3	5 Point Likert, Low - High	Number of people having computer proficiency	IT use
L1	5 Point Likert, Agree-disagree	Perception that learning is beneficial	LEARN
L2	5 Point Likert, Agree-disagree	Enough learning opportunities provided	LEARN
L3	5 Point Likert, Agree-disagree	Outside learning is provided	LEARN
FP1	5 Point Likert, Low - High	Sales performance for the last year	firmper
FP2	5 Point Likert, Low - High	Growth plan, if any set by the firm	firmper
FP3	5 Point Likert, Low - High	Rating of the target achieved for the last year	firmper
FP4	5 Point Likert, Low - High	Profit levels met by the firm	firmper

6.6.3. Validity and Reliability of the Measurement Model

The measurement model was over identified. The sample size included 382 cases. On completion of drawing the logical diagram, the number of the free parameters was identified using AMOS 9.

Total number of unique variance and covariance terms = (34x35)/2 = 595.

Total number of free parameters = 28 factor loadings + 20 factor covariance terms + 34 error variance terms = 82.

Degree of freedom = 595 – 82 = 513

The degree of freedom was greater than the total number of free parameters. Rank condition for identification was satisfied. Sample size of 382 was found adequate to carry out the CFA.

6.6.3.1. Construct Validity

Construct validity is the extent to which a set of measured variables actually represent the theoretical latent constructs. It is assessed in terms of face validity, convergent validity, discriminant validity and nomological validity. Face validity or content validity is established on the basis of the content of the corresponding items. Detailed discussion of the content validity is followed in section 3.3.2 in chapter 3.

6.6.3.2. Convergent Validity

Convergent validity measures the amount by which the indicators of a specific construct share a high proportion of the variance in common. In AMOS, standardized regression weights are referred as factor loadings. To satisfy this constraint of explaining more than 50 percent of the variance, standardized regression weights should be greater than 0.7. All regression weights were around 0.7 and thereby satisfy the condition for convergent validity. Standardized factor loadings, average variance explained by the constructs and the construct reliability values are shown in table 6.11.

Table 6.11 Standardized Regression Weights, Construct Validity and Reliability of Measurement Model

	usefor	use PLA	use Control	IT use	LEARN	firmper
F1	.699					
F2	.761					
F3	.760					
F4	.717					
F6	.699					
F7	.707					
F8	.721					
P1		.734				
P2		.770				
P3		.807				
P4		.795				
P5		.753				
P6		.735				
P8		.724				
P9		.713				
P14		.708				
C1			.726			
C2			.709			
C3			.711			
C4			.758			
C5			.715			
C7			.706			
C8			.706			
C9			.727			
IT1				.896		
IT2				.890		
IT3				.803		
L1					.702	
L2					.753	
L3					.778	
FP1						.745
FP2						.725
FP3						.791
FP4						.729
Variance extracted	52.4%	56.2%	51.9%	74.8%	55.5%	58.8%
Construct reliability	.95	.93	.92	.86	.83	.85

The Construct Reliability is a measure of the reliability and the internal consistency of the measured items which represent a construct. It is given by the following expression:

$$CR = \frac{\{\Sigma\lambda_i\}^2}{\{\Sigma\lambda_i\}^2+\{\Sigma\delta_i\}}$$

λ_i is the factor loading and δ_i is the error variance term for a construct.

Value of CR above 0.8 is treated as excellent (Arbuckle 2008). Value of CR above 0.7 is considered good and value between 0.6 and 0.7 is considered fair. In this study, all values of CR were above 0.8 and there by established construct reliability.

6.6.3.3. Discriminant Validity

Discriminant validity measures the extent to which a construct differs from other constructs. Discriminant validity is established by comparing the variance – extracted estimates for each factor with the squared values of inter construct correlations (Arbuckle 2008). The table 6.12 shows that all variance – extracted estimates are greater than the squared inter construct correlations (squared inter construct correlations are shown above the diagonal elements in table 6.12). This test has established the discriminant validity.

Table 6.12 The Discriminant Validity of the Measurement Model

Constructs	firmper	usefor	use PLA	use Control	IT use	LEARN
firmper	**1.00**	0.43	0.25	0.24	0.21	0.12
usefor	0.66	**1.00**	0.18	0.15	0.18	0.11
use PLA	0.50	0.43	**1.00**	0.31	0.43	0.24
use Control	0.49	0.39	0.56	**1.00**	0.43	0.33
IT use	0.46	0.43	0.63	0.63	**1.00**	0.43
LEARN	0.35	0.33	0.49	0.58	0.66	**1.00**

6.6.3.4. Nomological Validity

The nomological validity examines whether the correlations between the constructs in the measurement theory make sense. Table 6.12 explains the inter construct correlation scores (shown on the below diagonal elements). All correlations are significant at .05 level of significance (most of them are significant at .01 level), as evident from AMOS and SPSS output. The bivariate hypotheses test results (discussed in chapter 4, 5 and 6 respectively), box plots, correlation graphs etc support the nomological validity.

6.6.4. Assessment of the CFA Model Fit

Overall model fit is assessed using the following three measures:

a) The Chi – Square (χ^2) Goodness of Fit (GOF)

b) The Absolute Fit Index – Root Mean Square Error of Approximation (RMSEA)

c) The Incremental Fit Index – Comparative Fit Index (CFI)

The goodness of fit index measures, how well the specified model reproduces the covariance matrix among the indicator items (Hair *et al*. 2011). The Chi square goodness of fit is used to test the difference between observed covariance matrix (S) and the estimated covariance matrix ($\sum_k$). The test statistic is given as: $\chi^2 = (N-1)(S - \sum_k)$. A small value of χ^2 with an insignificant difference is expected as a measure of goodness of fit (Chi square GOF in SEM require a small chi square value and a significance value preferably greater than .05).

Chi-square GOF results are given in table 6.13. Minimum chi-square value is 522.098 with p value of 0.369. The high value of the significance (p = .369) indicates that the model fits sufficiently well with the data. Goodness of Fit Index (GFI) generated by AMOS output is 0.926. GFI values more than 0.9 is considered good (Hair *et al*. 2011).

Root Mean Square Error of Approximation (RMSEA) shows how well a model fits to the population. It is generally accepted that (Hair *et al*. 2011) RMSEA value below 0.07 is a better measure of model fit with more than 30 indicator variables and sample size greater than 300. Table 6.14 shows the RMSEA values. RMSEA value of .007 and 90 percent confidence limits of RMSEA values is very much less than the limiting value of 0.07. Thus a better model fit is established.

Table 6.13 Chi-square GOF test results

Number of distinct sample moments:	595
Number of distinct parameters to be estimated:	83
Degrees of freedom (595 - 83):	512
Minimum was achieved, Chi-square = 522.098 Probability level = .369	

Table 6.14 RMSEA Values of the Measurement Model

Model	RMSEA	LO 90	HI 90
Default model	.007	.000	.019
Independence model	.178	.175	.182

Incremental fit indices assess the relative advantage of a specified model relative to some baseline model. The Normed Fit Index (NFI) measures the difference in chi square between specified and null model as a ratio. NFI value above 0.9 is considered good. The Comparative Fit Index (CFI) is used as a standard reference. Measures such as Tucker Lewis Index (TLI) and Relative Noncentrality Index (TLI) are also used. Values above 0.92 are considered good. Baseline comparisons of incremental fit indices are shown in table 6.15.

Table 6.15 Baseline Model Comparisons with the Measurement Model

Model	NFI	RFI	TLI	CFI
Default model	.929	.922	.998	.999
Saturated model	1.000	-	-	1.000
Independence model	.000	.000	.000	.000

It is concluded that the measurement model fits well with the concepts and the theory.

6.7. Specification of the Structural Model

The theoretical model, the CFA model and the structural model are shown in figures 6.2, 6.3 and 6.4 respectively. The exogenous constructs are represented by the symbol ξ and the endogenous constructs are represented by the symbol η. The Greek letter γ represent the regression weight (measure of association) between the explanatory and the explained variables.

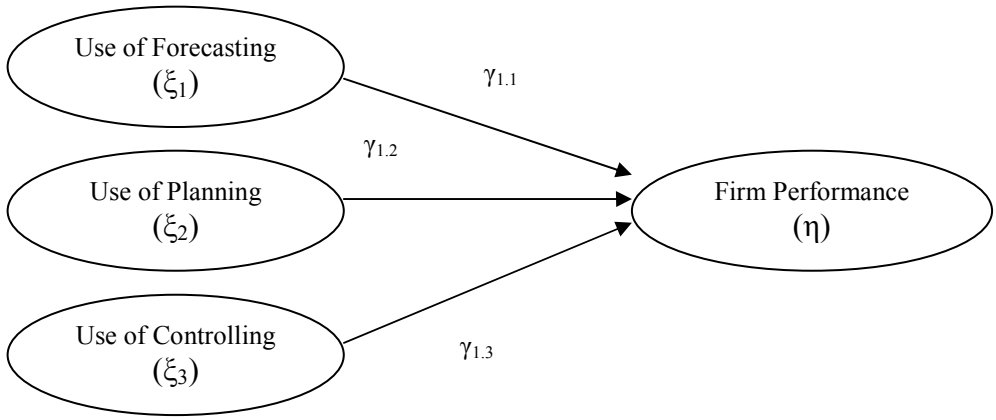


Figure 6.2 The Theoretical Model Linking the Forecasting, Planning and Control

The standardized loadings of the measurement model are shown in figure 6.4. This model contains four constructs, namely the use of forecasting, planning, controlling and firm performance. The model has 344 degree of freedom and a chi square value of 353.487 (shown in table 6.16). Significance level is 0.351. This model shows a better fit with the base line model, indicating meaningful relationship between the constructs.

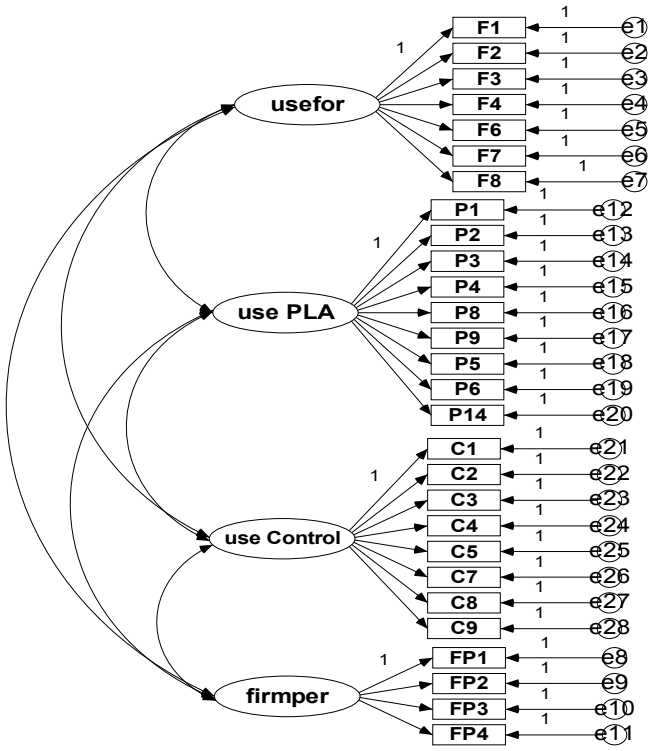


Figure 6.3 Measurement Model Linking Forecasting, Planning and Control with Performance

Table 6.16 Calculation of Degree of Freedom of the Structural Model

Number of distinct sample moments:	406
Number of distinct parameters to be estimated:	62
Degrees of freedom (406 - 62):	344

The figure 6.5 illustrates the structural model. There are four constructs. Use of forecasting is represented by seven indicators. Use planning is measured with nine indicators and use of control is measured with seven items. Firm performance included four items. Degree of freedom of structural model is 344. In the structural model, covariance between the PPC elements and firm performance (three numbers of co-variances, namely forecasting – firm performance, planning – firm performance and controlling – firm performance) are replaced by the regression weights.

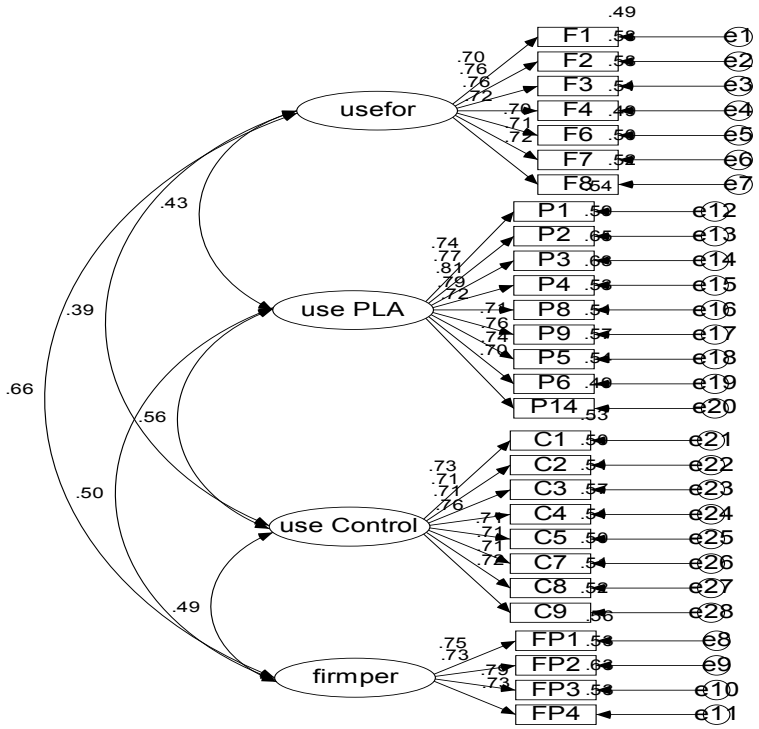


Figure 6.4 Standardized Loadings of the Measurement Model

Structural model is used to test the following three hypotheses:

H_1: Use of forecasting positively influences the firm performance.

H_2: Use of planning positively influences the firm performance.

H_3: Use of controlling positively influences the firm performance.

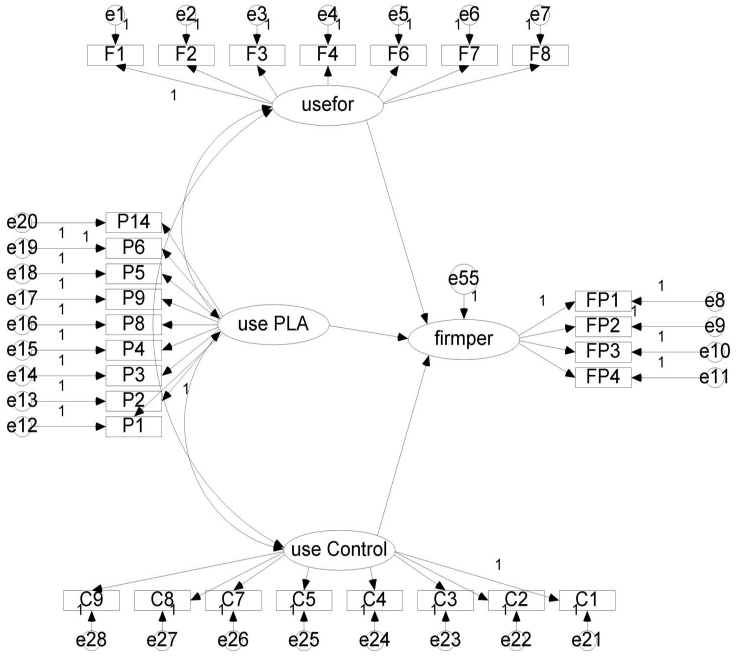


Figure 6.5 Structural Model Linking Forecasting, Planning and Control with Performance

6.7.1. Discussion of the SEM Output of the Structural Model

The output of the structural model is shown in figure 6.6. Standardized loading estimates (structural maximum likelihood estimates) show the significant influence of forecasting, planning and controlling on firm performance. Standardized regression weights and the results of hypotheses tests are shown in table 6.17:

Table 6.17 Hypotheses Test Results

Hypothesis	Parameter	Supported or not
H_1: Use of forecasting influence Performance	$\gamma_{1.1} = .50$	Yes
H_2: Use of planning influence Performance	$\gamma_{1.2} = .18$	Yes
H_3: Use of controlling influence Performance	$\gamma_{1.3} = .19$	Yes

All structural path estimates are significant (p less than .01). The estimated values are shown in table 6.18. Use of forecasting is the most influencing variable. All relationships are positive. Incremental fit indices and RMSEA values of the structural model are shown in table 6.19. RMSEA value of 0.009 and 90 per cent confidence levels of the RSMEA values are within the limiting value of 0.07. Incremental fit indices (TLI, CFI, NFI and RFI) are more than 0.9. These results validate the structural model.

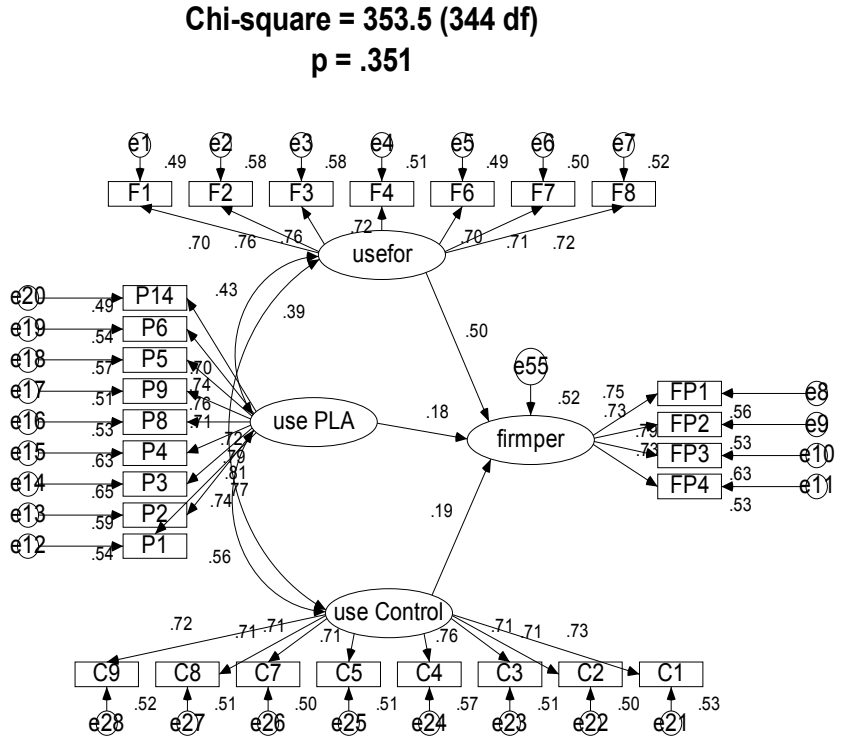


Figure 6.6 Standardized Loadings of the Structural Model

Table 6.18 Baseline Model Comparison Statistics

Model	NFI	RFI	TLI	CFI
Default model	.938	.932	.998	.998
Saturated model	1.000			1.000
Independence model	.000	.000	.000	.000

Table 6.19 RMSEA Values of Structural Model

Model	RMSEA	LO 90	HI 90
Default model	.009	.000	.021
Independence model	.192	.188	.197

6.7.2. Cross Validation of the Structural Model

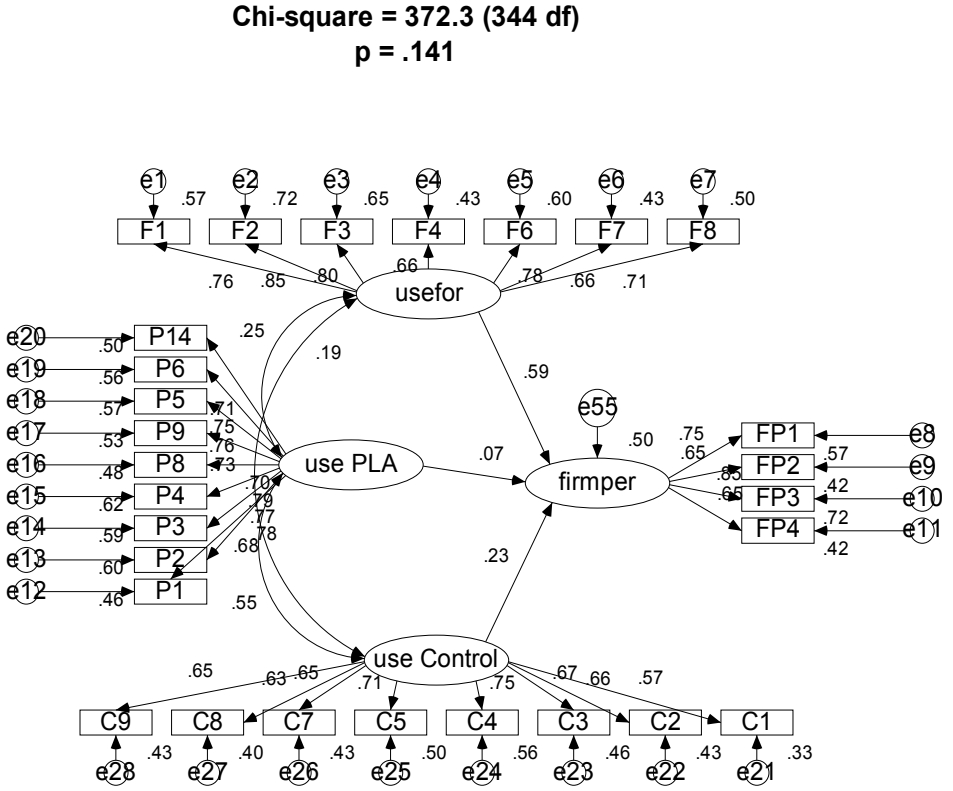


Figure 6.7 The Loose Cross Validation of the Structural Model: Case 1

The loose cross validation of the structural model was performed. Two sub group data: group 1 and group 2 were selected. Those firms, which were managed by the conventional owners with the sample size 124, constitute the group one and those firms which are managed by the professional managers with the sample size 188 form the group two. Both the groups were found in conformity with both the validity and the

reliability criteria. The visual diagram of the standardized loading estimates is shown in figure 6.7 and figure 6.8.

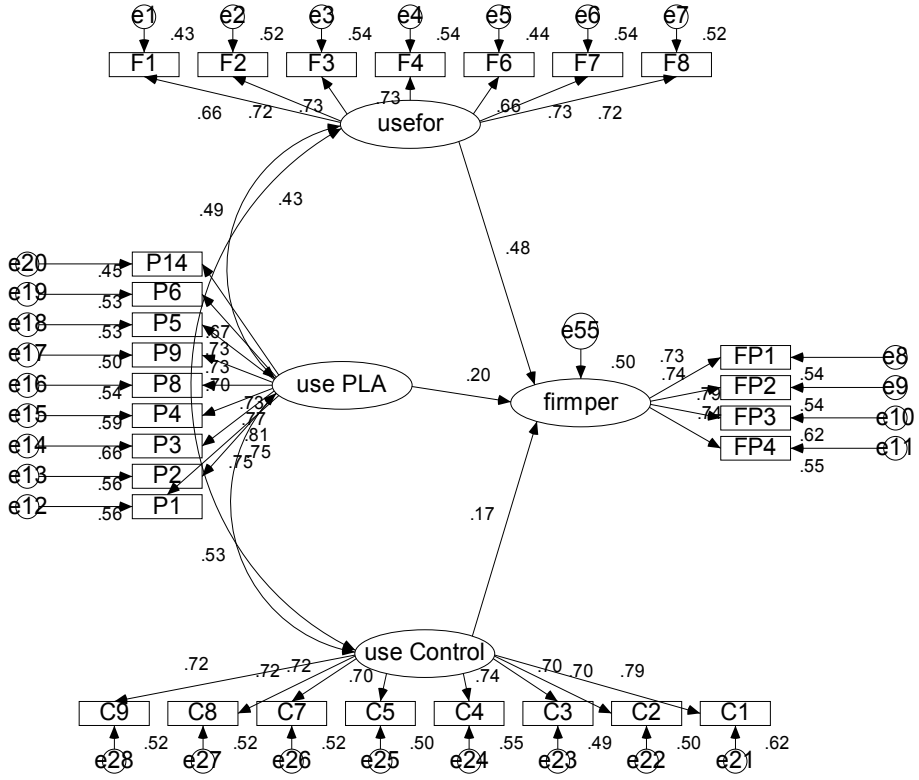


Figure 6.8 The Loose Cross Validation of the Structural Model: Case 2

A better loading (regression weight) of forecasting and controlling with the firm performance is observed in the firms that are managed by the next generation owners than in those that are managed by the professional managers. The firms that are managed by the next generation owners show poor loading (0.07) between the use of planning and the firm performance. This may be due to the least importance given to the use of planning instruments by the next generation owners.

The figures 6.7 and 6.8 illustrate the loadings of the group one and the group two. A satisfactory goodness of fit values (chi square of 372.45 with p value 0.141 for group one and chi square of 418.3 with p value 0.004 for group two) is observed in both cases. A better fit is observed in group one from the GOF value. More uniformity of the data is observed in the firms managed by the second generation owners. It does not mean the group one is more useful, though more uniformity is observed in this group.

The incremental fit indices (NFI, RFI and CFI) are above 0.9. The RMSEA values are within the acceptable limit of 0.07. Three criteria of the model fit is

established (one GOF index, a badness of fit index and an incremental fit index). The value of each squared multiple correlation is around 0.7, which means that at least 50 percent of the variability is explained by the indicator items.

6.8. The Findings from the CFA and the SEM Models

The hypotheses formed in the bivariate tests were confirmed by the CFA model. The validity of the model is found explained well. Positive and significant scores of the construct loadings have established the influence of the forecasting, planning and controlling on the firm performance.

The following results are obtained from the structural model:

- The standardized regression weight of the use of forecasting is 0.5. The regression weight for the planning is 0.18 and for the controlling, it is 0.194. Hence it is observed that the use of forecasting has more influence on the firm performance.
- A good correlation is observed between the constructs (of the order of 0.4 and 0.5). These figures support the theoretical concept that the use of forecasting, planning and controlling are interrelated.
- The covariance in the use of forecasting, planning and control is significant.
- The cross validation has revealed a better fit in the firms run by the owners than in those firms that are run by the professional managers. When the score of forecasting decreases, subsequent increase in the scores of planning and controlling are observed.
- The low path loadings of planning and controlling in the firms managed by the second generation owners reflect the poor use of planning and controlling in these firms.

6.9. Recommendations for Improving the PPC Usage and SME Performance

Cross validation and evaluation of the classification scheme indicated the importance of forecasting, planning, controlling and standardization for improving SME

performance. Following recommendations are made in the light of CFA and logistic regression, to improve PPC use and performance of SMEs:

- The identification and the selection of the forecasting method are vital, as the forecasting is the most important factor that influences the firm performance.
- The standardization procedures (such as ISO 9000) are found effective because, they do result in the formal practices. The attempts for standardization and formal practices are to be promoted.
- Cross comparison of the CFA models indicates that the firms which are not using planning much are compensating it with the increased use of controlling. The limited use of planning is reported from the SMEs headed by owners than the firms managed by professional managers. Awareness of the use of planning is to be provided.
- Importance of IT and education of the key person to improve firm performance have already been established following the results of the hypotheses tests that are mentioned in the earlier chapters. The CFA and the logistic regression models also establish that the usage of the IT and the education are the pre-requisites for the improvement of the PPC usage.
- It is necessary to provide education and learning to the key person, because this will result in an increased awareness and use of better PPC.

Chapter 7

CASE STUDIES

Contents

The case studies that link the use of forecasting, planning and controlling with the SME performance are presented in this chapter. The selected cases deal with the organizations in which the use of PPC is done at different levels. The case studies are used to support and clarify the hypotheses tested. The chapter ends with the conclusion and the suggestions to improve the firm performance through a better use of the PPC.

7.1. Introduction

Studies that link the use of forecasting, planning, controlling and the firm performance have already been discussed in the earlier chapters. This chapter is devoted to the presentation of five cases that were conducted. Selection of cases was done to cover the range of key factors that influence PPC including size of the firms.

7.2. The Objectives of the Case Study

The case study is conducted to fulfill the following objectives:

- To observe and understand the pattern of the use of PPC, firm performance and other measures.
- To compare the firm's use of forecasting, planning and control with the findings of the research model.
- To examine the nature of linkage between the use of PPC and the firm performance.
- To suggest methods to improve the use of PPC and the firm performance.

Details of the cross case examination (linking the use of forecasting, planning and controlling with firm performance) of the selected firms is described in this chapter. The findings of the cases are discussed and alternatives for improving PPC usage and firm performance are suggested at the end of the chapter.

7.3. The Case Studies

Forecasting, planning and controlling practices of the five manufacturing firms are presented in the five cases. The different processes involved in order to delivery cycles in the five selected cases are examined to understand the adequacy of PPC functions adopted in the various phases. Major problems or limitations of PPC usage in each case are found and the solutions are proposed, to improve the performance. A cross case comparison is also made to identify general requirements and guidelines to satisfy SME needs. Characteristic features of the SMEs included in the cases are shown in the table 7.1.

Table 7.1 The Demographics of the Firms included in the Case Study

Firm	Product	Nature of business	Sector	Capacity	Investment in plant & machinery	Turnover	Level of profit
Firm A	Metal frames and trusses	Make to order Non ISO	Small sized	360 tones/year	Rs 5 million	Rs 15 million	Medium
Firm B	Carbon dioxide gas	Make to stock and make to order, Non ISO	Small sized	1200 tones/year	Rs 20 million	Rs 15 million	High
Firm C	Rubber Sheets	Make to order ISO	Medium sized	1500 tones/year	Rs 75 million	Rs 370 million	Medium
Firm D	Foam beds and mattresses	Make to order ISO	Medium sized	2750 tones/year	Rs 200 million	Rs 340 million	Low
Firm E	Foot ware	Make to order ISO	Medium sized	840 tones/year	Rs 80 million	Rs 140 million	High

7.3.1. Case Study of the Firm A

The firm A is a small firm (engineering fabrication), involved in the manufacture and supply of trusses, metal frames and other steel supports according to customer specifications. The firm meets an approximate demand of 80 – 110 orders per year. Key person is the owner. The key person is having 15 years of experience in the field of manufacturing. Key person has secondary school education. Firm employ 30 permanent workers and uses a few extra workers on contract, whenever necessary. Major decisions are made by the owner. Order to delivery cycle process of firm A is shown in figure 7.1.

The production operation includes manufacture and assembly. Customer orders are collected directly by the owner or younger brother of the owner, who is responsible for the order management. Fabrication done at the firm premises and the assembly and the erection is done at the site. Final product is generally customer specific, but the past experience and the guidelines help firm A to manage the production. The duration for the completion of an order may vary from three weeks to two months. Instead of the formal forecasting, estimates and reviews of the past data are used for the guidance.

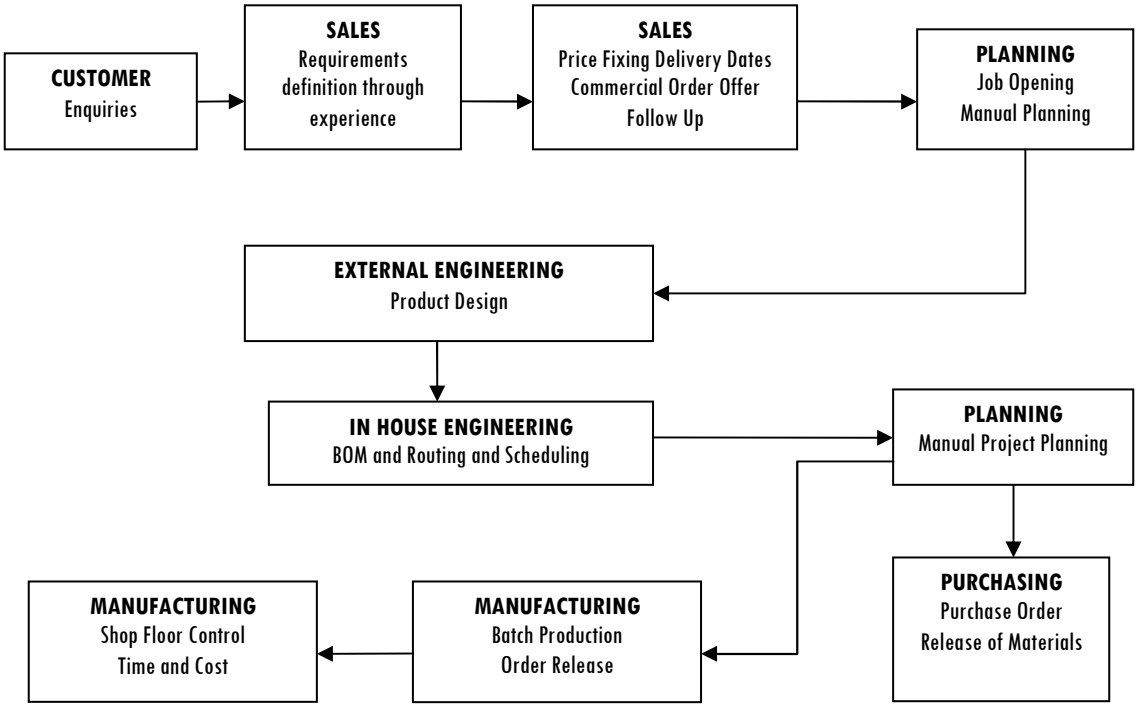


Figure 7.1 Order to Delivery Cycle in Firm A

The sales representative is free to decide the price and the delivery date within specified boundaries. There is no formal method for the estimation of both the price and delivery time. The manual method of configuration management is followed. The owner himself or a close associate (generally an experienced person) refers the past production details from a book, which contains the details of all bill of materials and de-composes the customers order into different groups. For clarity on non existent parts, the owner seeks technical expertise from outside consultants. Generally for data management MS Word and MS Excel are used. The internet and e-mail are used for the tax purpose and are rarely used to contact the customers.

The major problems found in the study of the firm A are listed below:

- The price and the delivery data estimation are not accurate and scientific.
- Collection of the customer specification takes too much time.
- Lack of standardization and formal practices result in more wastage.
- Up to date BOM data base is not used.
- Inaccurate MRP and resource leveling causes unproductive operations.
- Lack of formal forecasts contributes to errors in planning.

Recommendations to improve the performance of Firm A:

- Use formal methods for cost estimation and time estimation.
- Use of formal methods of forecasting and planning.
- Use an IT based data storage system for dealing with BOM data and other records.
- Use standardized components, wherever possible.
- Level the manpower resources using some of the project management techniques.
- Avail the services of a consultant to learn capabilities to exercise forecasting, planning and controlling functions in a formal manner.

7.3.2. Case Study of the Firm B

The firm B is involved in the bottling and selling of carbon dioxide gas mainly used to satisfy the domestic needs of aerated soft drink producers. This firm is a small sized company with permanent staff strength of 20 and a few contract workers. Firm B is a public limited company, managed by a professional manager. The manager is a science graduate who has 10 years experience in the field. The organization structure is of five levels. The product is highly seasonal and the production schedule is further complicated by the constraints of the major raw material supplier. Two months a year, the supply of the raw material is interrupted due to the shut down maintenance in the

plant of the major raw material supplier. During the off season, the firm has to cut its production for two months due to the dip in demand.

Firm B has understood the importance of forecasting and tries to use it. The data in the past years clubbed with the seasonal indicators are used to forecast the future requirement. Subjectivity of the preparers of the forecast influences the accuracy of forecasts. The management staff in charge of sales prepares the forecasts, after getting the concurrence of the senior manager. During the busy working periods, a moving average is used to forecast production and to reap the benefit from the competitive situation. During off seasons, back orders and outsourcing are used to meet the demands of the regular customers.

Order to delivery cycle of firm B is shown below (figure 7.2):

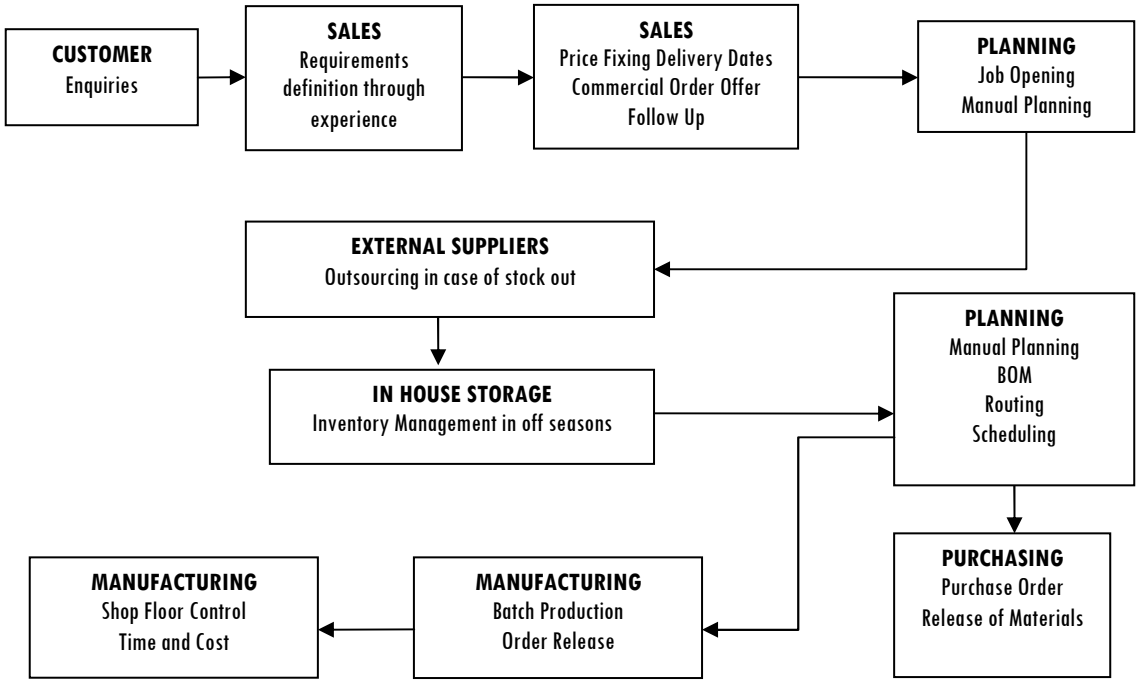


Figure 7.2 Order to Delivery Cycle in Firm B

Major problems found from the study of the firm B are listed below:

- The demand is fluctuating and the firm is not able to cope up with the adverse effects of these fluctuating demands.

- Even though the firm is highly satisfied with the usefulness of forecasting, the high level of subjectivity and the crude methods followed in the present practice of forecasting have resulted in the improper planning.
- Manual entry of the customer orders and the BOM result in delays and errors in the entry.
- Raw material storage capacity and high dependence on a single supplier for raw material creates problems when there are supply disruptions.
- Lack of a unique and effective information processing system affects the control measures such as back order processing and outsourcing.
- Lack of formal practices and standardization resulted in more ambiguities.

Recommendations for improving the performance of the firm B are listed as follows:

- Use a computerized data base and an IT enabled follow up to manage the demand of the regular customers. Also it is recommended to learn and adopt a computer based information system for planning and scheduling.
- Effectiveness of the forecasting is to be improved so as to reduce forecast errors.
- Probe possibility of adding raw material storage capacity for developing new and cost effective supply for raw material.
- Certification measures such as ISO 9000 is to be implemented.
- Formal and systematic practices of dispatching and invoicing should be practiced to avoid inordinate delays in executing the orders.

7.3.3. Case Study of the Firm C

The firm C is a mid-sized SME managed by the owner himself. The firm is involved in the manufacture of rubber sheets (1500 tones per year). It is an ISO certified firm and has 42 workers. The organization structure is relatively flat with 5 levels. Age of the key person is 49 and is having more than 15 years of experience in the field. The key person is a commerce graduate. Order to delivery cycle in the firm C is shown in the figure 7.3. The figure 7.4 shows the scores due to the use of forecasting, planning,

controlling and overall firm performance, which is on the higher side of the scale. The firm uses a judgmental type forecasting, based on experience.

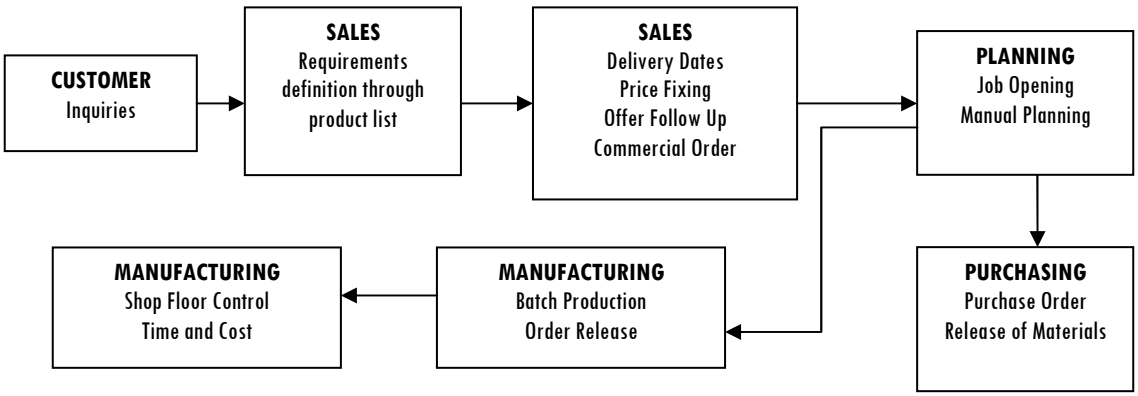


Figure 7.3 Order to Delivery Cycle in Firm C

The case study revealed that the firm C is aware of some modern PPC techniques and does use some of them. The awareness of modern techniques, use of PPC functions, learning, IT and other related information with the firm C are shown in the figures 7.5. The firm C uses computers for production, forecasting, planning, accounting and information processing. The firm C does follow participative planning.

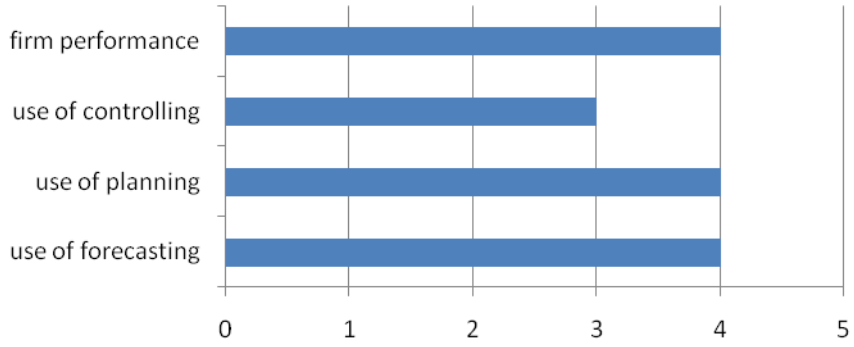


Figure 7.4 The Use of PPC by the Firm C

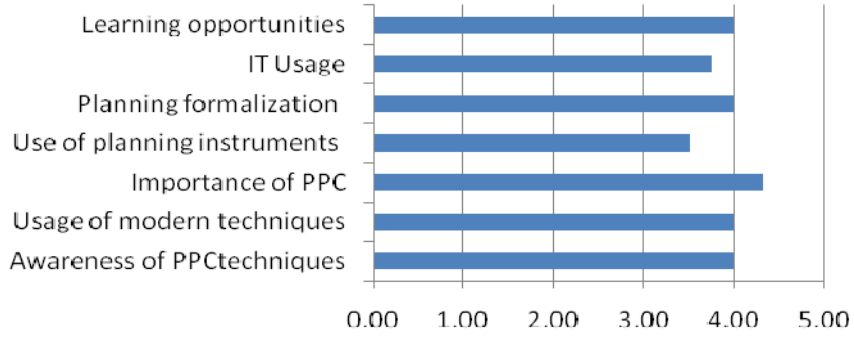


Figure 7.5 The Awareness of Modern PPC Techniques by the Firm C

Problems faced by the firm C are identified as follows:

- Manual and highly subjective forecasting method, have led to an erroneous forecasting.
- The limited use of formal practices in planning.
- Conventional approach in designing the bill of materials.
- No integration of production planning, scheduling and supply planning.
- Inability of the shop floor control system to react to the frequent changes in the production plans.

In the firm C, forecasting is done by trial and error methods and is highly subjective. In this case also the forecast used by the firm is also not satisfactory. Actual demand forecast by the firm C was compared with four test forecasts prepared using a three month moving average, a six month moving average, an exponential smoothing and the one based on the Winter's method. The Mean Absolute Deviation (MAD) and the Mean Absolute Percent Error (MAPE) by various types of forecasting methods are shown in the table 7.2. From the high values of MAD (22.9) and MAPE, the moving averages are not suitable for the firm. The exponential smoothing method has provided somewhat good results (MAD: 8.75, MAPE: 8.73). The Winters model is found the best method for the firm. This model is recommended when the seasonal variations are present. It is clear that the firm is not aware of the benefits of the modern forecasting methods.

Table 7.2 MAD and MAPE Figures of Firm C

	MAD					MAPE				
Month	MA 3 months	MA 6 months	Smoothing	Winters	Company forecast	MA 3 months	MA 6 months	Smoothing	Holt-Winters	Company forecast
Jan			19	0.01	19			18.09	0.01	18.09
Feb			12	0.01	18			11.33	0.01	16.99
Mar	17		16	0.06	11	17.21		16.19	0.06	11.13
Apr	21		7	0.01	11	20.40		6.80	0.01	10.68
May	18		3	0.06	15	17.11		2.85	0.06	14.26
Jun	22	21	4	0.15	15	22.34	21.32	4.06	0.15	15.23
Jul	25	23	8	0.13	21	27.01	24.85	8.64	0.14	22.69
Aug	27	22	13	0.12	32	30.54	24.89	14.71	0.14	36.20
Sep	33	27	4	0.04	31	35.53	29.07	4.31	0.04	33.38
Oct	27	24	1	0.14	23	27.70	24.62	1.03	0.14	23.59
Nov	25	28	12	0	16	23.15	25.93	11.11	0.00	14.81
Dec	8	15	6	0.12	6	7.58	14.20	5.68	0.11	5.68

The gap among the forecast, planned and produced is presented in the table 7.3. Up to 25% difference is found between forecast and actual demand, which is not in the acceptable range. In spite of the use of better planning instruments, IT facilities, training and PPC methods, there exists a large gap between the forecast and the actual demand. This is attributed to the key person's limited exposure to PPC methods, specially the selection and usage of the right forecasting method.

Table 7.3 Gap between Forecast, Planned and Produced: Figures of Firm C

Month	Gap between demand & forecast	%	Gap between forecast & planned figures	%	Gap between planned & produced	%
Jan	18	14.29	20	16.13	-2	0.99
Feb	16	13.56	20	16.13	-4	1.84
Mar	21	17.67	20	16.67	1	1.21
Apr	18	14.29	20	16.13	-2	1.01
May	16	13.56	20	16.67	-4	4.94
Jun	25	20.56	20	16.13	5	5.58
Jul	27	24.35	20	16.13	7	12.36
Aug	32	26.33	16	13.33	6	17.65
Sep	26	23.10	20	16.13	6	11.97
Oct	25	20.56	16	13.33	9	6.69
Nov	14	11.90	16	12.90	-2	0.00
Dec	8	6.71	16	14.29	-8	9.09

Production data indicate the major adjustments while balancing the demand on both sides, either positive or negative. The seasonal variation is the reason for the mismatch between the forecast and the actual demand. The production limitations i.e. the controlling factors such as the labour availability, raw material shortage, power problems etc limits the firm's ability to manage the production plan. For seven months the firm had been unable to meet the target planned, which means that the demand was much lower than that which had been planned.

To improve the production planning and control, following measures are recommended:

1) Adequate training is to be given in the use of demand forecasting method.
2) Develop an inventory information system for the effective planning of materials and in process items.
3) Utilize IT and learning for the development of an integrated forecasting, planning and controlling system for improved firm performance.

A simple model is suggested as below (figure 7.6):

This simple model is suggested to record and reproduce the demanded, planned and produced data and to maintain the necessary information for disaggregated demand data and the MPC (material and process control) requirements. Based on the innovative methods and the proper exposure, the right type of forecasting method and planning strategy can be evolved. What is of importance is to reduce the demand – forecast gap and make use of this reduced effect for both the better inventory management and the operational effectiveness.

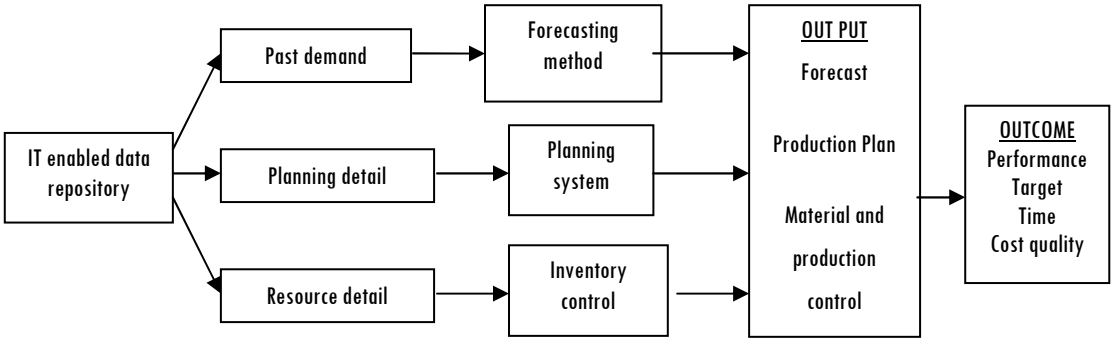


Figure 7.6 The Model for Improving the PPC System of the Firm C

7.3.4. Case Study of the Firm D

The firm D is a Government owned mid-sized firm involved in the manufacture of rubberized bed and mat. The firm is producing wide line 24 products each with many variations. The annual production amounts to about 80000 mattresses. This is an ISO certified firm with 92 workers. The organization structure has 7 levels. General Manager is the key person. Age of the key person is 54 and is having 25 years of experience in the field. Key person is a post graduate in Engineering. Forecasting used by the firm is judgmental based on experience.

The dealers and retailers do come in contact with the firm through the sales office. The sales office defines the product item demanded and determines the selling price and the delivery date. The sales person use a catalogue often called the "product list", which include a family of items in about 50 different functional groups. A functional group is a type of product serves one particular function (for example luxury, premium or economy mattress). The sales department releases an internal commercial order that generate a job to be fulfilled. The planning department manually schedules

the supply and production tasks. Activities connected to the order to delivery cycle within the firm D is described in the figure 7.7.

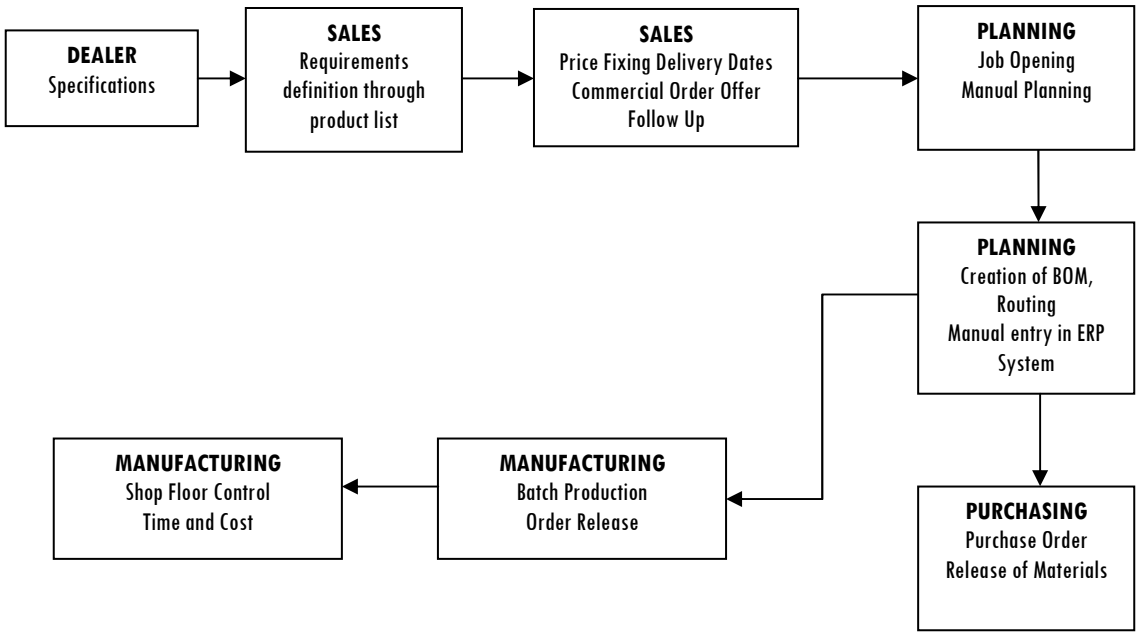


Figure 7.7 The Order to Delivery Cycle in the Firm D

Case study revealed the better uses of forecasting, planning and controlling by the Firm D. A good firm performance is reported. Satisfactory scores of IT Usage, learning and formal way of doing operations are observed. The firm D follows a centralized decision making system and the formal methods of planning and scheduling.

Major problems found in the firm D are the following:

- Large gap between the actual demand and the forecast demand (as evident from the analysis of the data for one year shown in figure 7.8).
- Cost estimations are usually not respected.
- Low level of resource utilization.
- Fluctuating lead times.
- ERP bye passed for many transactions.
- Large number of products with slight specification differences.
- Production planning ignores the bottleneck facility.

Based on the forecast and actual demand for a 14 month period, the forecasting method was evaluated. The forecast has been made using four methods which are: three and six months moving average, the exponential smoothing and the Winter's Model. Forecast figures by various methods are shown in table 7.4. MAPE values of the respective forecasts are shown in figure 7.8. Winter's model, which accounts seasonality, is found suitable to the firm D.

Table 7.4 The Forecast Figures of the Firm D

Month	Firm's own forecast	Actual demand	Forecast figures			
			MA 3 months	MA 6 months	Exp Smoothing	Holt-Winters
Apr	5430	4950	6673	6455	6176	5407
May	5225	5130	6058	6402	6053	5179
Jun	6250	5941	5791	6207	5961	6189
Jul	7215	6982	5340	6007	5959	7116
Aug	7280	6987	6018	6038	6061	7166
Sep	6215	6195	6637	6214	6154	6103
Oct	5266	4764	6721	6031	6158	5179
Nov	6302	5970	5982	6000	6019	6148
Dec	7144	6520	5643	6140	6014	6949
Jan	6794	6752	5751	6236	6064	6568
Feb	5930	5418	6414	6198	6133	5749
Mar	7294	6715	6230	5937	6062	7030

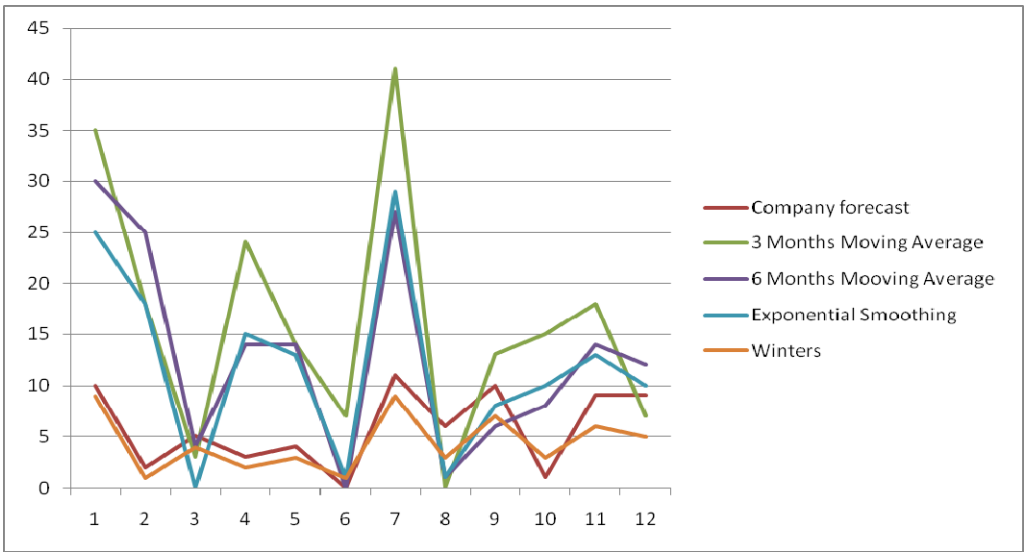


Figure 7.8 The MAPE Values for Different Types of Forecasts (Firm D)

To improve the production planning and control by the firm D, following measures are recommended:

- Use the Winter's forecasting method, which effectively accounts for the seasonal fluctuations.
- Update the computerized ERP system and effectively control the WIP.
- Try to standardize the products and reduce its variety.
- Integrate the production planning with the realistic capacity planning, inventory control and scheduling system. Utilize the service of a knowledge repository.
- Inefficient labour scheduling and control causes delays. Proper planning and control of the resources by means of standard tools (other than thumb rules) is to be followed.

7.3.5. Case Study of the Firm E

The firm E is a mid-sized firm involved in the manufacture of rubber foot wares. It is a private limited company managed by the divisional manager. It is an ISO certified firm with 75 workers. Age of the key person is 45. He has 13 years of experience. The key person is having higher secondary education. Firm uses salesmen forecast. Order to delivery cycle is shown in figure 7.9.

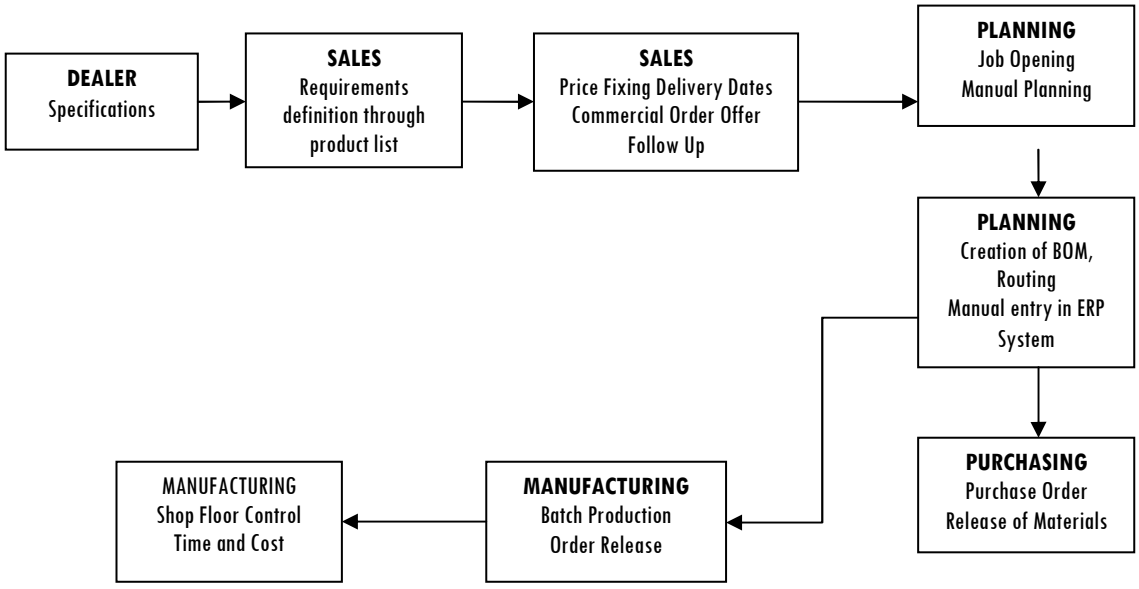


Figure 7.9 The Order to Delivery Cycle in the Firm E

It is found that the firm E is aware of the modern PPC techniques and it uses some of them. This can be considered as a high performing firm. The demographic

variables such as standardization, education, experience and use of PPC are correlated with the firm performance. The firm E is using computers for forecasting, production, planning, accounting and information processing. Participative planning and an appreciable level of internal and external training is followed in the firm E. Figure 7.10 shows the awareness of PPC functioning by firm E.

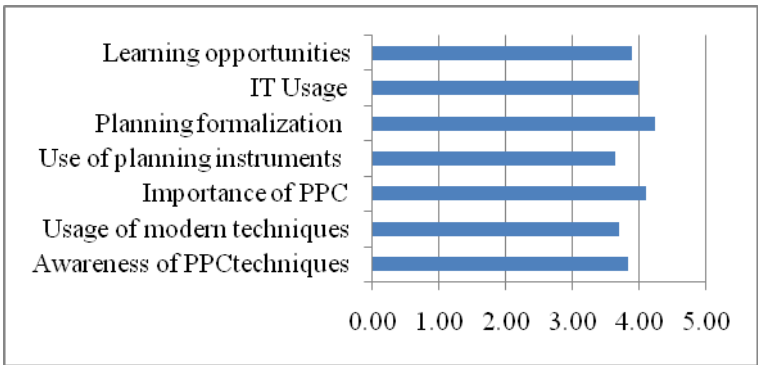


Figure 7.10 Awareness of PPC functions by Firm E

The table 7.5 shows the demand particulars of firm E.

Table 7.5 Demand particulars of Firm E for the period April 2011 to March 2012

Month	Forecasted	Planned	Produced	Demand	seasonality index
April	9400	9384	7509	8250	0.70
May	11400	11446	11922	12000	1.02
June	8000	7000	6923	11000	0.94
July	13000	14112	12603	10500	0.89
Aug	12500	12364	12072	12100	1.03
Sep	12500	12768	8729	11500	0.98
Oct	11000	10750	9473	11000	0.94
Nov	11000	10400	8853	11200	0.95
Dec	15000	16000	11823	11500	0.98
Jan	16600	16000	16218	13000	1.11
Feb	16000	15960	15445	15400	1.31
March	17000	17236	17500	13400	1.14

In order to estimate the effectiveness of the firm's forecasting method, four types of forecasts are prepared. A three month moving average, a six month moving average, an exponential smoothing and the Winter's method were used to prepare forecasts. It is quite evident from high values of both the MAD (22.9) and the MAPE (23.55) that the moving averages are not suitable. Forecast made by the firm also report high values of MAD and MAPE. Exponential smoothing is found somewhat applicable (MAD: 8.75, MAPE: 8.73). The Winters model is found best suited with the firm's demand data

(MAD: .07). The gap among the forecast, planned and produced are explained in the table 7.6.

During certain periods, more than 25 percent variation is found between the forecast and the actual demand. There is large variation between forecast and planned figures. Seasonal variations cause mismatch between the forecast and the demand data. Production inconveniences such as labour shortage, raw material shortage, electric power shortages etc limit the firm's ability to attain the production planned. However the firm attains the same by employing the controlling techniques.

Table 7.6 Gap between Forecast, Planned and Produced data of Firm E

Month	Forecasted	planned	produced	Demand	Gap demanded & forecasted	Gap forecasted & planned	Gap planned & produced
April	9400	9384	7509	8250	1150	16	1875
May	11400	11446	11922	12000	-600	-46	-476
June	8000	7000	6923	11000	-3000	1000	77
July	13000	14112	12603	10500	2500	-1112	1509
Aug	12500	12364	12072	12100	400	136	292
Sep	12500	12768	8729	11500	1000	-268	4039
Oct	11000	10750	9473	11000	0	250	1277
Nov	11000	10400	8853	11200	-200	600	1547
Dec	15000	16000	11823	11500	3500	-1000	4177
Jan	16600	16000	16218	13000	3600	600	-218
Feb	16000	15960	15445	15400	600	40	515
March	17000	17236	17500	13400	3600	-236	-264

From the analysis of the forecasting methods, it is inferred that the firm's use of forecasting can be improved further by adopting more specific models. In spite of the better use of planning instruments, the IT facilities, standardization and training, there exists a higher gap between the forecast and the actual demand. This is due to the use of inappropriate forecasting methods. The help of a consultant could be sought to hand hold and train the managers in forecasting and planning.

7.4. Cross Case Evaluation and the Discussion of the Results

In order to identify the general requirements and evolve the guidelines for the improvement of both the PPC functioning and the SME performance, the five cases have

been cross-analyzed. The table 7.7 synthesizes the main phases of the order to delivery cycle that are covered by the solutions currently adopted within each cases studied.

Table 7.7 Cross-case Analysis

Case	Customer requirement collection	Product configuration management	Final cost estimation	Production and supply planning	BOM generation job routing	MRP	Scheduling	Cost-time monitoring
Case A	Data base on Microsoft Excel	Order configuration has to be improved	Based on past orders	Manual Planning Single project environment	Traditional BOMs	Currently used	Infinite capacity scheduling	Real- time shop floor control is absent
Case B	Data base on Microsoft Excel	Order configuration has to be improved	Based on past orders	Manual Planning Single project environment	Traditional BOMs	Currently used	Satisfied by current SW Package	Real- time shop floor control is absent
Case C	No formal procedure	Manually through functional group book	Based on past orders	Manual Planning Multi-project environment	To be improved	--	Infinite capacity scheduling	Real- time shop floor control is absent
Case D	No systematic procedure	Order configuration has to be improved	Based on past orders	Manual planning, single product	To be improved	--	Infinite capacity scheduling	Real- time shop floor control is absent
Case E	Satisfied by current Software Package	Systematic through functional group book	Satisfied by current SW Package	Semi-manual-computerized planning	Satisfied by current Software Package	Satisfied by current SW Package	Satisfied by current SW Package	Claim to use real-time control

7.5. Conclusion

The study of the cases clearly shows how the firm performance improves with the better use of the PPC from Case A where PPC is least used to Case E, where its usage is maximum. In case A, where the manufacturing firm is managed by the owner manager, performance is the poorest. Lack of the formal forecasting and formal practices of scheduling and production planning have resulted in the poor production. Unscientific methods and the informal record keeping have caused inordinate delays and ineffective planning. The case B has an improved usage of the PPC than the firm mentioned in the Case A. The firm B has used the formal forecasting system to plan its production effectively. Also the firm B has used the participative planning and the controlling system to overcome the constraints due to the non availability of the raw material and the high seasonality effects.

The case C showed a better use of planning and controlling over the case A and the case B. The Firm C is reported to have an improved firm performance over firm A

and firm B due to an improved use of forecasting and planning. Even then the manual and the subjective forecasting used in the firm C create some problems that are found affecting the planning process. The poor shop floor control system and the informal practices have prevented the firm C from stepping up the production. The case D had showed a better use of forecasting, planning and controlling over the firm A, firm B and firm C, by means of the formal operations, good forecasting, effective information processing and scheduling. The firm D has indicated a good firm performance with the support of PPC system. The firm D can improve its performance further by using the learning tips in order to utilize the resources effectively and to use the forecast choice suited best. The practice of the ISO 9000 helped the firm D in using the formal methods for record keeping, retrieval of records, planning and controlling.

The case E, is the best among those that are studied. Here the proper identification and the use of the forecasting, planning and control by firm E resulted in its best firm performance. Use of the software packages in forecasting, planning, scheduling and communication has helped the firm E to reach the performance goals already set. Education of the key person and the better training in the firm E have supported the attainment of improved PPC use and thereby improving the firm performance. Good IT usage by firm E has reduced the delays and enables the fast dissemination of information.

All the findings mentioned above do agree with the hypotheses tested and accepted earlier. The case studies could also bring to light the industry specific issues related to the PPC.

From the case analysis it can be inferred that:

- Forecasting is very important in PPC and major errors in forecasting bring down the effectiveness of planning and reduces firm performance.
- The use of IT and IS are to be improved as the use of computer helps save time and also it will lead to the formal way of performing the operations.
- The standardization procedures such as ISO 9000 are to be promoted because such procedures result in more formal practices.

- The current system of BOM processing i.e. the manual processing is to be modernized.
- More learning opportunities, especially the knowledge on the use of the software packages are to be given.
- The real-time cost estimation and effective shop floor controlling are to be practiced, for which the external help and input must be sought.

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Chapter 8

THE SUMMARY AND THE CONCLUSIONS

Contents

8.1. Introduction

The objective of this work was the identification of the factors that influence the use of PPC in small and medium enterprises (SMEs) and examining the nature of the linkage of the use of forecasting, planning and controlling with the SME performance. The use of PPC methods do grow over years. However, its use and consequent benefits are enjoyed by the large firms. The SMEs even today follow crude the thumb rules. The economic recession, compulsions of globalization and increased diffusion of technology invited more attention to modernize production in SMEs.

The liberalized policies of the government and the relaxation in the import-export regulations have offered wider opportunities to the competent SMEs operating in the developing countries. In many situations, the SME has to act as an extension of large firms and operate in sync with it. The advantages of the traditional SMEs in most cases were the flexibility (being small) and the lower cost, and not the quality. Today, the demand for quality is increasing. This increased quality has to be attained without increased cost or loss of efficiency.

This research work is focused on the study of the usage of forecasting, planning and controlling in the SMEs. It does study their role in improving the firm performance. The data was collected from the selected SMEs, as per the research framework, design and methodology. Statistical analysis was carried out to study the nature of influence by the independent variables on the firm performance. Suitable hypotheses were formed and tested, as part of the study. The construct relationships established by various models were confirmed by the confirmatory factor analysis. The test results were cross-

analyzed with the help of the case studies selected from the sample. The findings of the study and recommendations are detailed in the following sections.

8.2. The Findings from the Study

The results of the bivariate tests that link the firm performance with the independent variables (selected in the study) reveal the following:

- The firms using higher order forecasting methods do perform better than the firms which use the lower order forecasting methods. That is the lower order forecasting methods, like the salesmen forecasting, committee forecasting and individual forecasting are inferior to the higher order models, such as time series forecasts, regression, exponential smoothing and Winter's forecasting.
- The case studies that supported the results of the hypotheses mentioned above, indicates the positive influence of higher order forecasting methods on the SME performance.
- A Significant difference in the firm performance was observed among the firms headed by professional managers, first generation owners (entrepreneurs) and the next generation owners. Among the three types of key persons mentioned above, the firms run by the professional managers are the best performers.
- Of the three demographic characteristics of the key person studied i.e. the age, education and professional experience the education of the key person is found positively associated with the firm performance.
- The firm with the ISO 9000 certification support higher performance scores than those firms which do not use such standardization measures.
- IT usage and the learning orientation are found positively correlated with the firm performance and they play a vital role in improving the performance of the firm.
- A better firm performance is observed in the firms with more employees. This finding supports the theoretical proposition, that the team work and collective decision making contributes much to improve the performance.

The results of the bivariate tests that link the "use of forecasting" with the independent variables selected in the study reveal the following:

- The firms headed by the professional managers have reported good scores of the perceived use of forecasting than the firms headed by entrepreneurs and next generation owners. This finding agrees with the theoretical proposition, that the increased awareness and use of forecasting tools by professional managers do make sense.
- The firms with the younger and more educated key persons are found using forecasting in a better manner than the firms with older and less educated key persons.
- Firms with more employees are reported with high scores in using the forecasting. This finding is in agreement with the theoretical proposition, that the use of forecasting is enhanced by team work and involvement of more people.
- IT usage and learning orientation of the SME do exert a positive influence on the use of forecasting.
- Good use of forecasting is reported from the SMEs which use the certification like ISO 9000 than the SMEs which do not use the ISO 9000.

The results of the bivariate tests that link the "use of planning" with the independent variables selected in the study reveal the following:

- Better use of planning is observed in the firms headed by the professional managers than the firms headed by entrepreneurs and the next generation owners.
- Standardization procedures, such as ISO 9000 take a major role in improving the use of planning. More formal practices are reported from the SMEs with the ISO 9000 certification.
- IT usage and learning are positively associated to the use of planning in SMEs.
- Firms headed by the professional managers are reported with a good use of planning.

- Firms with more employees report a better use of planning. This finding supports the use of participative planning and team work in such firms.
- The younger and educated key persons are reported to bring good use of planning.

The results of the bivariate tests that link the "use of controlling" with the independent variable selected in the study have revealed the following:

- Firms headed by the professional managers are reported with good scores of controlling than the firms headed by the entrepreneurs and the next generation owners.
- IT usage and learning orientation by the firm is positively associated with the use of control.
- Education of the key person is positively associated with the use of control.
- Firms with ISO 9000 certification are reported as good users of control than the firms which do not use the ISO 9000 certification.
- Firms with more number of employees do report good scores of the use of control.

From the results of the logistic regression the following can be seen:

- Logistic regression model successfully classified low performing and high performing firms with acceptable levels of classification accuracy.
- "Use of Forecasting", "Use of Planning", "Standardization" and "Use of Controlling" do exert a combined influence on the SME performance.
- "IT usage" and "Learning" are not included in the regression equation, because their influence on "Firm Performance" has already been established by the positive influence of the variables, namely "Use of Forecasting", "Use of Planning", "Standardization" and "Use of Controlling".
- "Use of Forecasting" is observed to be more important than the use of planning and use of control.

The results of the "Confirmatory Factor Analysis" (CFA) are the following:

- The positive and significant influence of use of forecasting, planning and control on firm performance has been observed.
- Theoretical proposition of bivariate tests are confirmed by the CFA.
- The firm performance is influenced mainly by the "Use of Forecasting". "Use of Planning" and "Use of Controlling" are approximately loaded with equal weightage on firm performance.
- The cross validation shows that professional managers use the PPC functions in a better manner than entrepreneurs and next generation owners.
- When the score of planning decreases, (due to less formal practices, lack of knowledge, resources etc) it is being compensated by the increased score of use of controlling.

Table 8.1: Difference between Large Firms and SMEs observed from the study

Attributes	SMEs	Large Firms
Customer requirement collection	No formal procedure or very little use of software package such as MS Excel	Formal and standard methods using software packages and forecasts results in better use of PPC
Product configuration management	Order configuration has to be improved	Better usage by means extensive order configuration o using modern tools
Final cost estimation	Mainly based on past orders	Improved usage by current SW Package
Production and supply planning	Manual Planning. Single and multi project environment	Semi- manual and fully computerized planning, which is more effective
BOM generation and job routing	Traditional BOMs	Satisfied by current Software Package
MRP	Seldom used	Satisfied by current SW Package
Scheduling	Infinite capacity scheduling using crude heuristics	Made more efficient by current SW Package
Cost-time monitoring	Real- time shop floor control is absent, which is a limitation	Real-time control is enforced using latest tools
Standardization	Practices are very scarce	Frequently practiced, which result in better use of PPC
IT and IS	Less used	Used extensively

The results of the case studies have revealed the following:

- Case studies have showed the manner in which the firm performance does improve with the improvements in the use of PPC introduced.

- Each case studied does underline the positive association between the use of PPC and the firm performance.
- Reasons for the poor use of the PPC in the respective cases are identified and the alternatives for improving the performance are proposed.

8.3. Managerial Implications of the Study

This study observes that there is lack of adequate technology, resource and awareness of the latest management methods in SMEs. This resulted in the low level use of PPC. What benefits/ insights, the SME key persons can derive from this study is listed below:

- Forecasting is the most influencing PPC function. SME key persons have to identify the role of forecasting and practice the appropriate type of forecasting.
- Better firm performance is reported by the SMEs that are using higher order forecasting than those that are using lower order forecasting. Managers can better manage the issues of trend/ seasonal or cyclic fluctuations by incorporating the features of exponential smoothing or Winter's model, for which little exposure to the IT and IS (such as familiarity with M S Excel or MS Word) are needed.
- The study confirmed the positive and significant linkage between forecasting, planning, controlling and firm performance. Micro firms (less than 10 employees) can rely on the knowledge, awareness and capabilities of the key person, in which the service of a consultant or sharing of information among the industry may be helpful. Small firms (employees up to 50) can improve their PPC by following formal procedures, knowledge sharing, participative planning, team work and training. Medium firms (number of employees between 50 and 150) can improve PPC by means of educating the key persons about the latest PPC developments. Also the support from a consultant and effective training given to the workers can improve the PPC. Certification procedures such as ISO 9000 will bring better outcome by means of formal and systematic procedures.
- Study confirms the leading role of professional managers to bring improved firm performance than the entrepreneurs and conventional owners. The benefits of education and exposure to IT and IS are observed among the professional managers, which are found well correlated with SME performance.

- Conventional owner managers and entrepreneurs are following the traditional practices. However, it will not improve the firm performance because in the modern business environment, awareness of latest PPC techniques, formal practices, team work and use of IT and IS are inevitable. This study recommends that the SME owners and entrepreneurs have to adapt to the modern techniques of PPC.
- Use of knowledge repositories and information sharing are to be promoted among SMEs.
- Firms with more number of employees reported better performance because of team work and professional approach. In the case of micro firms, where team work is not possible, managers/owners have to gain exposure/ expertise in formalizing their activities, rather than rely on thumb rules.
- Sector wise studies indicate that the reduction in the usage of planning when occurs due to the lack of knowledge or resources are compensated by the increased usage of controlling function. SME managers are found as better planners, while entrepreneurs and owners compensate with more controlling.

8.4. Recommendations for Improving the PPC usage and SME Performance.

In the light of the findings and conclusions, the following recommendations are made to improve the PPC usage and the SME performance.

- The usage of the correct forecasting method is very important, because it is the most important factor that influences the firm performance.
- Formal forecasting methods (higher order methods) are found more effective than the informal methods of forecasting (judgmental and convenience type), to manage the demand in a dynamic and competitive environment. SMEs should not shy away from using appropriate statistical forecasting techniques since it could make a positive significant impact on firm performance.
- When the effect of the seasonality and trend are high, SMEs are recommended to avail the service of a technical expert or consultant to improve the usage of forecasting, planning and control.

- The certifications such as ISO 9000 are recommended as it will result in the standardized formal practices, which in turn will improve the PPC usage and the firm performance.
- The low use of planning is reported from the SMEs headed by the owners, than the firms managed by the professional managers. Awareness of the use of planning is to be provided.
- Imparting education and training to the key person and the supporting staff are recommended.
- Importance of IT to improve the PPC usage and the firm performance is to be highlighted.
- The study has revealed that the use of planning tools is very limited. Awareness of the proper usage of the PPC tools should be given to the people concerned.
- Wherever possible, team work and participative PPC are to be encouraged.

8.5. Limitations of the Study.

The items in the questionnaire were adapted from those mentioned in the PPC theory and from the previous research conducted in this field. Even though the survey instrument was developed from the standard references and the research works, conducted in this field and are validated reasonably, the instrument can still be improved. The demographic and institution specific changes are applicable to the instrument used.

This study was conducted among the selected SMEs of the manufacturing sector in the state of Kerala in India. In the SME research, because of the difficulty in following the absolute random sampling, and because of the difficulty in getting the quantitative data filled by the respondents, the self reported type questionnaire surveys are often used to collect the data. This form of data collection is influenced by perception of the respondent. Errors arising from the usage of convenience cum cluster sampling are applicable to this research.

The data base includes micro, small and medium firms, with the employees that vary in strength from a few to the order of hundreds. This study was limited to SMEs

engaged in engineering goods manufacturing, food processing, packaging, plastics, rubber and electronics related businesses.

8.6. The Scope for further Research.

A sector wise study is recommended as an extended work, in which, the use of PPC in micro, small and medium firms can be studied separately. More extensive study can be conducted to characterize the impact of demand, production volume and number of organization levels on firm performance. A detailed study linking the use of forecasting and the firm performance can be conducted by including different types of forecasting as another variable. This study has used the subjective measures, based on a self reported rating scale. A descriptive study can be conducted more accurately by including more quantitative performance measures. The mediating role of the demographic and organizational characteristics on PPC functioning and firm performance can be studied using other dimensions like the gender, experience, standardization etc. The model used in this research work can be explored further.

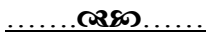
8.7. Conclusion

The research set out with the objectives of identifying the factors that influence the use of forecasting, planning, controlling and SME performance and studying their interrelationship has been fulfilled by conducting the data collection, the analysis and the interpretation of the data, as per the research model and framework. The factors that influence the use of PPC in SMEs and firm performance are identified. The nature of the influence of these factors on the use of forecasting and SME performance is analyzed, and recommendations to improve the use of forecasting and SME performance are made. Findings of the hypotheses tests are confirmed by detailed case studies. Also the identification of alternatives for improving the use of forecasting and firm performance is made. Similarly the linkages between use of planning and use of controlling, with the firm performance have also found. The interrelationship of the variables is explained and recommendations to improve the PPC usage in SMEs are made. Therefore all the objectives set for the research have been achieved, subject to the limitations stated in the previous section.

The study has provided a new learning experience to the researcher. The extent of the use of PPC in Indian SMEs is found not much explored in the earlier research

works. The identification of the factors that influence the PPC usage of the SMEs and the development of the measuring instrument, for measuring the use of PPC have increased the knowledge horizon of the researcher on the working of the SMEs and their PPC usage. The case studies have motivated the researcher to concentrate on the performance improvement of the SMEs by improving their PPC usage. The manner in which the SMEs manage their PPC functions and the management of the SME performance, as revealed from the field has contributed some valuable insights to the researcher, other than that which is gained from the literature review.

Finally, this research work contributes something to the industry and academia. This research shows the key persons of the SMEs, how they can improve their PPC functions and thereby improve the firm performance. For the academic people, this research work provides empirical evidence of the functioning of PPC in the SMEs, their interrelationship and contribution to improve the firm performance. Also this research work provides ample scope for modifying the models proposed, for measuring the extent of the use of PPC in SMEs.



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LIST OF PUBLICATIONS

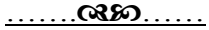
(A) Conference papers

1. Biju Augustine; Bhasi, M. and Madhu, G. (2010), "*Use of Forecasting, Owner Characteristics and SME Performance: Empirical Findings*", Presented at the International Conference on Operational Research for Urban and Rural Development, Thiagarajar College of Engineering, Madurai, 15-17th Dec, 2010.
2. Biju Augustine; Bhasi, M. and Madhu. G. (2010), "*Use of Production Planning and Control by Small and Medium Manufacturing Enterprises in India: research issues*", Paper presented in the National Conference on Recent Innovations in Technology held at Rajiv Gandhi Institute of Technology, Kottayam, 13-15th November 2010.
3. Biju, Augustine; Bhasi, M. and Madhu. G. (2011), "*Firm Characteristics and Performance of Indian SMEs : an empirical study*", Paper presented in the International Conference on Recent Innovations in Technology held at Rajiv Gandhi Institute of Technology, Kottayam on 10-12th February 2011.
4. Biju Augustine and Meera Madhu (2012), "*Planning and Performance: Empirical studies on small and medium rubber and plastic sector firms*", International Conference on Industrial Management held at TOC H Institute of Technology on September 2012.
5. Biju Augustine and Meera Madhu (2012), "*Use of Forecasting in SMEs*", National Conference on Modern Trends in Mechanical Engineering, Department of Mechanical Engineering, SNGCE Kadayiruppu, 14-16 June 2012.
6. Biju Augustine and Jisha P Sainuddeen (2012), "*An exploratory study to link the influence of planning and control on SME performance*", National Conference on Modern Trends in Mechanical Engineering, Department of Mechanical Engineering, SNGCE Kadayiruppu, 14-16 June 2012.
7. Biju Augustine and Meera Madhu (2012), "Testing the use of a questionnaire survey instrument to link planning with SME performance: findings from rubber and plastic sector firms", Conference paper presented at the National Technological Congress (NATCON) organized at Rajiv Gandhi Institute of Technology, Kottayam on 9th February 2013.

Refereed Journal Papers

1. Biju Augustine; M. Bhasi and G. Madhu (2012), "*Linking SME's performance with the use of forecasting, planning and control: empirical findings*", European Journal of Scientific Research, (1SSN 1450-216X), Vol. 73, No. 1, pp 86-105.

2. Biju Augustine; M. Bhasi and G. Madhu (2012), ".*Exploring the Forecasting Behaviour: Findings from Indian SMEs*", International Journal of Emerging Technology and Advanced Engineering, (1SSN 2250-2459), Vol. 2, No. 3/42, 2012, pp 260-267.
3. Biju Augustine; M. Bhasi and G. Madhu (2012), "*Use of planning and controlling in manufacturing industries: a review*", International Journal of Operations Management and Information Technology, Vol. 2, No.1 (2012), pp 1-38.
4. Meera Madhu, Biju Augustine and Bhasi M, "*Planning and Performance: Exploratory findings from Small and Medium Rubber and Plastic sector Firms*", International Journal of Mechanical and Industrial Engineering, (ISSN 2231-6477), Vol 1 (October 2012).
5. Biju Augustine; M. Bhasi and G. Madhu, "A structural equation model to link the use of forecasting, planning and controlling with SME performance", paper submitted to the "*Journal of Small Business and Enterprise Development",* under review.



APPENDIX I

QUESTIONNAIRE

PURPOSE OF THE SURVEY

This survey is meant to study the accuracy of forecast, efficiency of planning and extent of control used in small and medium firms in selected industry segments. Data will be used for academic purpose only, more specifically to gather the firm's exposure to forecasting methods and the extent of use of production planning & control (which will be kept confidential). Individual company analysis will not be done.

SECTION I. FIRMS BASIC INFORMATION

1. Firms name and address :

2. Type of industry/sector: Chemical ☐ Food Products☐

Packaging/Automotive/Machinery (Manufacturing) ☐ Leather/Plastic/Rubber ☐

Electrical/ Electronic ☐ Others (please specify) ☐

3. Name of product/category : Make to stock ☐ Make to order ☐ Assemble to order ☐

4. Nature of production: Mass/Flow production ☐ Batch ☐ Job order ☐

5. Please tick appropriate boxes:

(1) Nature of inventory: Dependent demand ☐ Independent demand ☐

(2) Demand variability: Trend ☐ Cyclic ☐ Seasonal ☐ Level ☐

(3) Business environment: Competitive ☐ Monopoly ☐ Growth ☐ Decline ☐

(4) Volume/ frequency of demand: Low 1☐ 2 ☐ 3☐ 4 ☐ 5☐ High

(5) Age of the firm: years 1-3 ☐ 4-7 ☐ 8-10 ☐ 9-15 ☐ more 15> ☐

6. Nature of ownership: Proprietary☐ Joint stock ☐ New venture (entrepreneur) ☐

Co operative ☐ Others (please specify) ☐

7. Number of employees: < 10☐ 10-50☐ 50-100☐ >100☐

8. Does the firm follow any standard practice such as ISO/BIS etc: Yes☐ No☐

9. The firm is managed by: Owner ☐ Manager☐ First time owner (Entrepreneur) ☐

10. Please tick the particulars of the key person:

Age (years) < 30☐ 30 – 40 ☐ 40 – 50 ☐ 50 – 60 ☐ >60 ☐

Educational level: School education ☐ Pre degree☐ Graduate ☐ Engineering☐ MBA☐

Experience: < 5 years☐ 5 – 10 years ☐ 10 - 15 years☐ 15 - 20 years ☐ > 20 years☐

11. Number of levels in your organization is: < 3 ☐ 3 –5 ☐ > 5☐

12. Furnish the details of following health indicators of your firm:

Sales increase/decrease (last year): much decrease ☐ decrease ☐ nil ☐ increase ☐ much increase☐

Investment plan on fixed assets for next year: nil☐ not decided☐ somewhat ☐ good☐ very good ☐

Target achievements last year: very poor ☐ poor☐ neutral☐ good☐ very good☐

Profitability: Very low☐ Low☐ Neutral ☐ Good☐ Very good☐

On time delivery: Very low ☐ Low ☐ Neutral☐ Good☐ Very good☐

Promised lead time: Much more ☐ More ☐ Neutral☐ Less☐ Very less☐

SECTION II FIRMS EXPOSURE TO MODERN MANAGEMENT TECHNIQUES

This section is used to explore the firm's awareness about modern management methods and techniques, which mainly include operations management and PPC methods.

13. What is your opinion about modern techniques of forecasting, planning and control?

Only know about the techniques ☐ Feel that it is useful ☐

Used some of them ☐ Used and found them effective ☐

14. Please tick whether the firm uses / aware of any of the following techniques:

Forecasting techniques ☐ MRP/ MRP II ☐

Budgetary control ☐ Worker performance reviews☐

Inventory control system ☐ ABC Analysis/ classification techniques ☐

15. During the last three years, in which area and how often have you used any of the above methods?

	Never	**Seldom**	**Sometimes**	**Often**	**Very Often**
Finance	☐	☐	☐	☐	☐
Marketing	☐	☐	☐	☐	☐
Human resources	☐	☐	☐	☐	☐
Materials	☐	☐	☐	☐	☐
Strategic planning:	☐	☐	☐	☐	☐

16. Please furnish the importance given to the following PPC approaches in your firm.

Rank 1.Least important 2. Not important 3. Neutral 4.Important 5. Very important

Forecasting ☐ Planning ☐ Controlling☐

SECTION III (Forecasting)

17. Rank the reasons for using forecasts: Rank (specify the priority)

Rank 1.Very low 2. Low 3. Neutral 4.High 5. Very high

a) To improve planning ☐ d) Competitive advantage ☐

b) To reduce cost ☐ e) To reduce risk ☐

c) To maintain goodwill ☐ f) Others (specify) ☐

18. Mention the method of trend projection:

Individual forecasting ☐ Committee forecasting☐ Salesmen forecasting ☐

Expert opinion ☐ Moving average ☐ Regression Analysis ☐

Exponential smoothing☐ Market Survey ☐ Others (please specify) ☐

19. Rank the reasons for using higher order methods (Moving average, Regression and Smoothing)

Rank 1.Very low 2. Low 3. Neutral 4.High 5. Very high

Demand complexity ☐ Product variety ☐ Use of modern management practices☐

Introducing innovative methods☐ Management initiative ☐ For better accuracy ☐

Use of higher technology ☐ Due to external help☐

20. Rank the reasons for not using higher order methods (Moving average, Regression and Smoothing)

Rank 1.Very low 2. Low 3. Neutral 4.High 5. Very high

a) No expertise ☐ b) No exposure ☐ c) No need felt☐

d) Demand is too easy to predict ☐ e) No managerial initiative ☐ f) Others (please specify) ☐

21. Rate the forecasting method followed in your firm on the basis of following indicators, also add your ideal ratings (what it is suppose to be)

Rating scores 1. Very low 2. Low 3. Neutral 4. High 5. Very high

a)	Simplicity:	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
b)	Understandability:	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
c)	Ease of use:	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
d)	Effectiveness:	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
e)	Comprehensiveness:	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
f)	Timeliness:	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
g)	Accuracy:	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
h)	Overall satisfaction:	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐

SECTION IV PLANNING

22.i) Does plan figures and forecast figures agree? Yes ☐ No ☐

ii) If disagree, reason for that: a) Forecast inefficiency☐ b) Management policy☐

c) Resource limitations ☐ d) Time lag ☐ e) Others (please specify) ☐

23. Please tick the indicator related to degree of formalization in aggregate planning:

No plan (1) Informal plan based on trial and error (2) Informal plan based on experience (3) Written plan based on guidelines (4) Written plan based on detailed discussion (5)

Marketing ☐ Production ☐ HR ☐ Finance ☐

24. Please tick appropriate indicators related to preventive action:

1) Maintaining safety capacity: Low extent 1☐ 2☐ 3☐ 4☐ 5☐ High extent

2) Maintaining safety stock of final assembly: Low extent 1 ☐ 2☐ 3☐ 4☐ 5☐ High extent

3) Maintaining safety stock of raw inventory: Low extent 1 ☐ 2 ☐ 3☐ 4☐ 5☐ High extent

4) Compare actual performance with
Business goals : Low extent 1 ☐ 2☐ 3☐ 4☐ 5☐ High extent

5) Compare business performance (profit and sales
with that of competitors) : Low extent 1 ☐ 2☐ 3☐ 4☐ 5☐ High extent

25. i)Please tick appropriate indicators related to operational (shop floor) planning: Degree of formalization: No plan (1) Informal plan based on trial and error (2) Informal plan based on experience (3) Written plan based on guidelines (4) Written plan based on detailed discussion (5)

Marketing ☐ Production ☐ HR ☐ Finance ☐

ii) Use of operational planning instruments: Not known (1) Heard but not used (2), Planning to adopt (3), Known and using it (4) , Known and used frequently (5)

MRP, ERP, Kanban ☐ Sequencing algorithm ☐ Scheduling algorithm☐

Budgetary planning ☐ PERT/CPM ☐

26. Planning activities are headed by: (please tick appropriate options)

Separate planning department ☐ Proprietor (owner) ☐

Salesmen (sales Dept) ☐ Production dept ☐ Others (specify) ☐

27. What is the education level of people involved in planning?

No formal education ☐ School education☐ Graduate ☐ Engineering ☐ MBA☐

28. Overall satisfaction level of planning: Low 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ High

29. Accuracy of planning: Low 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ High

SECTION V (CONTROL)

30. Mention the area, where control has been exercised:

(Rank 1. Main 2. Ordinary 3. Least important)

Production control ☐ Excess capacity utilization ☐ Overtime ☐ Subcontracting ☐

Material control ☐ Overheads ☐ Outsourcing ☐ Follow up and expediting ☐

31. Computers are used for controlling:

a) Labor ☐ b) Funds ☐ c) Demand ☐ d) Capacity ☐ e) Not being used ☐

32. Rate the following indicators of your firm with reference to control function.

	Low end ◄——► High end				
1) Degree of control (Aggregate planning)	☐	☐	☐	☐	☐
2) Degree of control (Shop floor planning)	☐	☐	☐	☐	☐
3) Accuracy of control	☐	☐	☐	☐	☐
4) Overall satisfaction	☐	☐	☐	☐	☐
5) Rolling percentage(Reservation breaking)	☐	☐	☐	☐	☐

33. Please tick the indicators related to decision making style:

Owner / manager decides ☐ Decisions made by respective departments ☐

Collective decisions by the team ☐ Decisions approved after concurrence by different departments ☐

34. Computers are used for:

Billing only ☐ Data storage ☐ Communication ☐ Analysis ☐ Decision making ☐

35. Number of computers used in your firm;

Nil ☐ 1 – 2 ☐ 3-5 ☐ 5- 10 ☐ more than 10 ☐

36. Percentage of people has computer proficiency:

Nil ☐ up to 5% ☐ 5- 10% ☐ 10- 20 % ☐ more than 20% ☐

37. Nature of communication from top to bottom (power distance)

Strict and formal ◄——► Informal and participative

1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐

38. Please select suitable indicators regarding learning/training opportunities in your firm:

	Not agree ◄——► Very much agree				
1) Learning is beneficial	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
2) Enough learning opportunities are provided	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
3) Outside exposure is provided	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
4) In house training opportunities are adequate	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐

5) External training facilities are adequate 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐

6) There is lack/ need of training 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐

39. (i) Percentage of the time production stopped due to low or no orders

a). >30% ☐ b). 30-20% ☐ c). 20-10% ☐ d). >10% ☐ e). Never ☐

(ii) Strategies used for managing low demand period:

a) No definite plan ☐ b) Lay off ☐ c) M/C planning ☐ d) Manage with buffer ☐ e) Combined methods ☐

(iii) Strategies used for uniform/continuous production:

a) Own distribution/sales ☐ b) Lay off) ☐ c) Sub contracting ☐ d) Outsourcing ☐ e) Overtime ☐

40. Factors influence the control method adoption:

Rank 1.Very low 2. Low 3. Neutral 4.High 5. Very high

a) Order uncertainty ☐ **b)** Low production capacity ☐ **c)** Labor availability ☐

d) Material availability☐ **e)** Power ☐ **f)** Machinery ☐ g) Subcontract/overtime ☐

41. (i) Machine loading/sequencing is based on:

a) No awareness ☐ b) Heuristics ☐ c) Trial and error ☐ d) Standards/estimates ☐ e) Advanced algorithm ☐

(ii) Aggregate plan is based on:

a) Owners discretion ☐ b) Present data ☐ c)Trial and error ☐ d) Rough cut capacity ☐ e) Higher order methods ☐

(iii) Production scheduling is based on:

a) Heuristics ☐ b) Trial and error ☐ c) Priority rules ☐ d) Master production schedule ☐ e) Detailed schedule ☐

42 (i) Critical ratio (ratio between demand time and supply lead time) is:

a) Unable to judge ☐ b) Fluctuating ☐ c) Close to unity ☐ d) Above unity ☐ e) Much above unity ☐

(ii) Percentage of the time schedules are violated:

a). >30% ☐ b). 30-20% ☐ c). 20-10% ☐ d). >10% ☐ e). Never ☐

(iii) Quick response schedule followed is:

a) No idea ☐ b) Below the level ☐ c) Unable to judge ☐ d) Good ☐ e) Very good ☐

(iv) Gap between forecast and actual demand is:

a). >30% ☐ b). 30-20% ☐ c). 20-15% ☐ d). 15-10% ☐ e). 10% ☐

(v) Gap between forecast and planned figure is:

a). >30% ☐ b). 30-20% ☐ c). 20-15% ☐ d). 15-10% ☐ e). 10% ☐

(vi) Gap between planned and produced is:

a). >30% ☐ b). 30-20% ☐ c). 20-15% ☐ d). 15-10% ☐ e). 10% ☐

APPENDIX II

Classification Scheme of Forecasting, Planning, Controlling and SME based Literature

PPC literature has been classified according to a scheme (Dangayach & Deshmukh 2001, Malhotra *et al.*1998). Break up of literature on content area is given in figure A2:1.

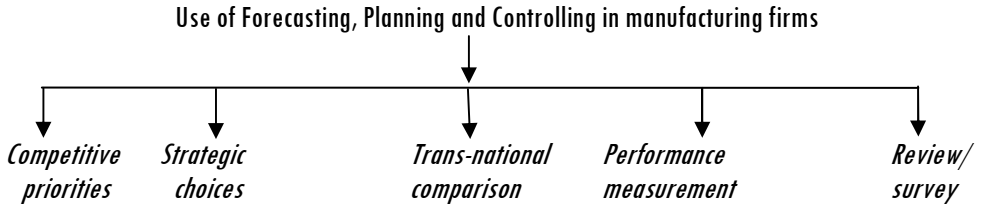


Figure A2:1 Classification scheme of PPC Literature

PPC literature has been classified according to the content, as given below:

- Content A: *Competitive priorities*: Aspects covering the focus and attainment of quality, accuracy, cost, delivery, flexibility etc.
- Content B: *Strategic choices*: Key aspects of structural and infrastructural criteria (such as IT, IS and HR) and managerial and environmental aspects.
- Content C: *Trans-national comparison*: Practices of forecasting, planning and controlling by firms in different countries are compared.
- Content D: *Performance measurement*: Selection, design, development and measurement of various PPC system performance measures. (Including empirical studies, survey and scale development).
- Content E: *Review/survey* of literature.

The research literature has been categorized according to a five category classification scheme (Dangayach *et al.* 2001; Malhotra *et al.* 1998) as indicated below:

- Conceptual: Fundamental concepts of PPC are reviewed.
- Descriptive: The characteristics of PPC in the industrial context are portrayed.
- Empirical: Existing data bases, case study or taxonomy are utilized to validate the theory formed by the researcher. This is classified into two:
  - Exploratory cross sectional: Survey or observation with one aspect in time and information is used for arriving on conclusions it is denoted as empirical.
  - Exploratory longitudinal: Two or more points in time are observed for the firms covered under the study and take much more time to arrive on results.

A quantitative analysis of the literature is given (table A2:1 and table A2:2) below:

Table A2:1 Classification of Forecasting Literature

	Classification according to the content of the literature			Classification according to research methodology		
Functional area	**Content**	**Number of papers**	**%**	**Content**	**Number of papers**	**%**
Forecasting	Content A: *Competitive priorities*	30	45	Conceptual	13	19
	Content B: *Strategic choices*	7	8	Descriptive	27	42
	Content C: *Trans-national comparison*	11	19	Empirical	22	33
	Content D: *Performance measurement*	14	21	Exploratory	4	6
	Content E: *Review/survey*	4	7			
	Total	66	100	Total	66	100
Linking with firm performance	Content A: *Competitive priorities*	21	40	Conceptual	8	12
	Content B: *Strategic choices*	7	12	Descriptive	26	38
	Content C: *Trans-national comparison*	10	20	Empirical	26	50
	Content D: *Performance measurement*	18	26	Exploratory	--	--
	Content E: *Review/survey*	4	3			
	Total	60	100	Total	60	100

Table A2:2 Classification of Planning and Controlling Literature

	Classification according to the content of the literature			Classification according to research methodology		
Functional area	**Content**	**Number of**	**%**	**Content**	**Number of**	**%**
Planning & controlling	Content A: *Competitive priorities*	40	35	Conceptual	28	14.3
	Content B: *Strategic choices*	35	32	Descriptive	85	43.3
	Content C: *Trans-national*	12	9	Empirical	73	37.2
	Content D: *Performance*	8	6	Exploratory	10	5.2
	Content E: *Review/survey*	21	18			
	Total	116	100	Total	179	100
Linking with firm performance	Content A: *Competitive priorities*	4	7	Conceptual	28	14.3
	Content B: *Strategic choices*	2	3	Descriptive	85	43.3
	Content C: *Trans-national*	19	30	Empirical	73	37.2
	Content D: *Performance*	34	54	Exploratory	10	5.2
	Content E: *Review/survey*	4	6			
	Total	63	100	Total	179	100

Table A2:3 and table A2:4 describe the details of the research articles reviewed.

Table A2:3 Content wise Classification of Forecasting related Literature

Sl no	Researchers	Year	Approach	Methodology	Contributions to research
1	Chalmbers *et al.*	1971	Content[A]	Conceptual	Guidelines for choosing forecasting methods.
2	Fischhoff	1994	Content[A]	Conceptual	Reviewed the concepts of forecasting.
3	Ibrahim *et al.*	1998	Content[A]	Conceptual	Linked planning sophistication and SME performance
4	Makridakis	1996	Content[A]	Conceptual	Role of forecasting in planning and strategy.
5	Makridakis	1986	Content[A]	Conceptual	Assessed the future directions of forecasting.
6	Makridakis	1977	Content[A]	Conceptual	Forecasting issues in Marketing Management
7	Mentzer *et al.*	1984	Content[A]	Conceptual	Analyzed the performance of sales forecasting.
8	Naylor	1983	Content[A]	Conceptual	Linked strategic planning and forecasting.
9	Sanders *et al.*	1995	Content[A]	Conceptual	Managing the forecasting function.
10	Wacker *et al.*	2002	Content[A]	Conceptual	Role of sales forecasting for strategic planning.
11	Carbone *et al.*	1982	Content[A]	Descriptive	Evaluated extrapolative forecasting methods.
12	Dalrymple	1987	Content[A]	Descriptive	Analyzed sales forecasting practices in firms.
13	Forslund *et al.*	2007	Content[A]	Descriptive	Impact of forecast information quality.
14	Howard *et al.*	1998	Content[A]	Descriptive	Approach for generating MPC systems.
15	Islam, M *et al.*	2011	Content[A]	Descriptive	Manufacturing practices and performance
16	Li, L.X	2000	Content[A]	Descriptive	Competitiveness and performance of firms.
17	Kim *et al.*	1993	Content[A]	Descriptive	Framework for manufacturing strategy.
18	Luscombe	1991	Content[A]	Descriptive	Design of integrated PPC system.
19	Makridakis S	1999	Content[A]	Descriptive	Forecasting Methods and Applications
20	Martin *et al.*	1988	Content[A]	Descriptive	Forecasting performance in tourism field.
21	McHugh *et al.*	1983	Content[A]	Descriptive	Reviewed the forecasting dilemma.
22	McLaughlin *et al.*	1979	Content[A]	Descriptive	Organizational forecasts and limitations.
23	Pan *et al.*	1977	Content[A]	Descriptive	Sales forecasting practices of large US firms.
24	Remus *et al.*	1995	Content[A]	Descriptive	Accuracy of judgmental forecasts.
25	Ritzman *et al.*	1993	Content[A]	Descriptive	Forecast errors in multistage manufacturing.
26	Saunders *et al.*	1986	Content[A]	Descriptive	Practical Business Forecasting
27	Sanders *et al.*	1994	Content[A]	Descriptive	Forecasting practices in US Corporations.
28	Weinstein	1987	Content[A]	Descriptive	Forecasting of industrial products
29	Lee *et al.*	1986	Content[A]	Descriptive	Forecast error evaluation in MRP systems.
30	Dalrymple	1975	Content[A]	Descriptive	Sales forecasting methods and accuracy.
31	Annastiina *et al.*	2009	Content[A]	Empirical	Impact of demand forecasting errors.
32	Cagliano *et al.*	2001	Content[A]	Empirical	Operations management and SME performance.
33	Herbig *et al.*	1994	Content[A]	Empirical	Forecasting of industrial product firms.
34	Jonsson *et al.*	2003	Content[A]	Empirical	Fit between planning environments and MPC.
35	Makridakis	1982	Content[A]	Empirical	Studied the accuracy of time series methods.
36	Rothe *et al.*	1978	Content[A]	Empirical	Effectiveness of sales forecasting methods.
37	Wacker *et al.*	1995	Content[A]	Empirical	Institutional factors on forecasting accuracy.
38	Staelin *et al.*	1973	Content[B]	Conceptual	Reasons for the error in judgmental forecasts.
39	Steiner *et al.*	1988	Content[B]	Conceptual	Factors for success in small firms.
40	Cochran *et al.*	1984	Content[B]	Conceptual	Corporate social responsibility and performance.
41	Burns	1997	Content[B]	Descriptive	Identified factors for management in action.
42	Hornaday *et al.*	1971	Content[B]	Descriptive	Characteristics of successful entrepreneurs.
43	Dangayach *et al.*	2005	Content[B]	Empirical	Advanced Manufacturing Technology.
44	Daily *et al.*	1992	Content[B]	Empirical	Family and professionally managed firms.
45	Kotey	1997	Content[B]	Empirical	Owner/manager values and performance.
46	Perez *et al.*	2007	Content[B]	Empirical	Studied the managerial behaviour of SMEs.
47	Swamidas *et al.*	2000	Content[B]	Empirical	Advanced manufacturing technology
48	Ahmed *et al.*	1995	Content[B]	Empirical	Manufacturing strategy with firm performance.
49	Ahmet *et al.*	1995	Content[B]	Empirical	Key internal factors with firm performance.

50	Forza C	1995	Content[B]	Empirical	Impact of information systems on performance.
51	Sharma *et al.*	2006	Content[B]	Empirical	Practice of information systems of SMEs.
52	Berry *et al.*	1995	Content[C]	Descriptive	Links manufacturing and marketing choice.
53	Fliedner *et al.*	2001	Content[C]	Descriptive	Formed guide lines for hierarchical forecasting.
54	Jolson *et al.*	1974	Content[C]	Descriptive	Analyzed the salesman's career cycle.
55	Wheelwright	1976	Content[C]	Descriptive	Discussed forecasting aspects for firms.
56	Karami *et al.*	2006	Content[C]	Descriptive	CEOs characteristics and SME's strategy.
57	Alasadi *et al.*	2008	Content[C]	Descriptive	Small business performance in Syria.
58	Todd *et al.*	2007	Content[C]	Descriptive	Internationalization of SMEs in India.
59	Winterton *et al.*	2002	Content[C]	Descriptive	Forecasting skill needs in clothing industry.
60	Anna Michna	2009	Content[C]	Empirical	Link between learning and SME performance.
61	James *et al.*	1994	Content[C]	Empirical	Forecasting: Trials and tribulations
62	Berry *et al.*	1992	Content[C]	Empirical	Linking systems to manufacturing strategy.
63	Cromie *et al.*	1995	Content[C]	Empirical	Investigated the management of family firms.
64	Drury	1990	Content[C]	Empirical	Issues in forecasting management.
65	Miller *et al.*	1976	Content[C]	Empirical	Forecasting strategies for inventory systems.
66	Smith *et al.*	1996	Content[C]	Empirical	Forecasting behaviour of large and small firms.
67	Bhutta *et al*	2008	Content[C]	Empirical	Owner characteristics of SMEs in Pakistan.
68	Dincer *et al.*	2006	Content[C]	Empirical	Strategic planning in Turkish firms.
69	Eloranta *et al.*	1998	Content[C]	Empirical	Delivery performance of SMEs.
70	Greenley	1995	Content[C]	Empirical	Market orientation and company performance.
71	Rosa *et al.*	1996	Content[C]	Empirical	Gender and small firm performance.
72	Biggs *et al.*	1982	Content[C]	Exploratory	Effect of forecast error on production.
73	Wacker *et al.*	1998	Content[C]	Exploratory	Forecasting accuracy in seven countries.
74	Mentzer *et al.*	1995	Content[D]	Conceptual	Forecasting familiarity and application.
75	Newman *et al.*	1996	Content[D]	Conceptual	Linking time and operations performance.
76	De Meyer *et al.*	1990	Content[D]	Conceptual	Improvement programmes and performance.
77	Peel *et al.*	1998	Content[D]	Conceptual	Planning and capital budgeting.
78	Roper S	1999	Content[D]	Descriptive	Small business growth and profitability
79	Azzone *et al.*	1991	Content[D]	Descriptive	Performance measures for companies.
80	Delaney	1996	Content[D]	Descriptive	Impact of HRM practices on firm performance.
81	Denison *et al.*	2004	Content[D]	Descriptive	Culture in family owned enterprises.
82	Kim	1993	Content[D]	Descriptive	Model for assessing manufacturing competence.
83	Poza *et al.*	2004	Content[D]	Descriptive	Cost implication on the family business.
84	Richbell *et al.*	2006	Content[D]	Descriptive	Owner managers and the small business.
85	Smith	2007	Content[D]	Descriptive	Differences between family and non family firms.
86	Wiklund *et al.*	2005	Content[D]	Descriptive	Entrepreneurial orientation and performance.
87	Bracker *et al.*	1986	Content[D]	Empirical	Planning and financial performance of firms.
88	Mantrala	1990	Content[D]	Empirical	Sales incentive plan with sales forecasting
89	Neely *et al.*	1995	Content[D]	Empirical	Performance measurement system.
90	Plossl *et al.*	1973	Content[D]	Empirical	Use and outcome of business forecasts.
91	Sharma *et al.*	2006	Content[D]	Empirical	Performance measurement in SMEs.
92	Wathen *et al.*	1995	Content[D]	Empirical	Production process and performance in firms
93	Barker *et al.*	1993	Content[D]	Empirical	Time based performance measurement.
94	Boohene *et al.*	2008	Content[D]	Empirical	Gender, personal values and SME performance.
95	Bracker	1988	Content[D]	Empirical	Planning and financial performance in SMEs.
96	Carol Yeh *et al.*	2007	Content[D]	Empirical	SMEs innovation with performance.
97	Chowdhury *et al.*	1993	Content[D]	Empirical	Short term performance improvement.
98	Jorisson *et al.*	2001	Content[D]	Empirical	Difference between family and non family firms.
99	Kotey *et al.*	2005	Content[D]	Empirical	Goals and performance of family SMEs.
100	Narver	1990	Content[D]	Empirical	Market orientation on business profitability.

101	Shrader *et al.*	1989	Content[D]	Empirical	Links strategic planning and firm performance.
102	Barker	1993	Content[D]	Empirical	Time based performance measurement
103	Barnea *et al.*	1980	Content[D]	Exploratory	Use of disaggregated forecasts.
104	Azzone *et al.*	1998	Content[E]	Descriptive	Performance measures for green manufacturing.
105	Godwin *et al.*	1993	Content[E]	Descriptive	Reviewed judgmental time series forecasting.
106	Armstrong	1984	Content[E]	Empirical	Research on forecasting for the last 25 years
107	Mahmoud	1996	Content[E]	Empirical	Surveyed the accuracy in forecasting.
108	Hogarth *et al.*	1981	Content[A]	Descriptive	Evaluated forecasting and planning process.
109	Sparks *et al.*	1984	Content[C]	Empirical	Studied forecasting techniques in British firms.
110	Gelper *et al.*	2010	Content[A]	Descriptive	Compared Holt –Winters model with smoothing.
111	Billah *et al.*	2006	Content[A]	Descriptive	Selection methods for exponential smoothing.
112	Fitzsimmon *et al.*	1975	Content[B]	Descriptive	Attitude, belief and purchase behaviour.
113	Gardner	2006	Content[A]	Empirical	Accuracy of exponential smoothing.
114	Gelper	2010	Content[A]	Empirical	Exponential and Holt-Winters smoothing.
115	Gray	2002	Content[D]	Conceptual	Entrepreneurship and resistance to change.
116	Graman *et al.*	2009	Content[A]	Conceptual	Purchase and forecast accuracy.
117	Downing *et al.*	2011	Content[A]	Empirical	Forecasting in airforce applications.
118	Morwitz *et al.*	1992	Content[A]	Empirical	Purchase and forecast accuracy.
119	Pack	1990	Content[A]	Empirical	Studied ARIMA Models.
120	Pagels	1969	Content[A]	Empirical	Variations of exponential smoothing.
121	Sanders *et al.*	2004	Content[A]	Conceptual	Judgmental and quantitative forecasting.
122	Shahabuddin,	2009	Content[A]	Empirical	Forecasting of automobile sales.
123	Sniezek	1989	Content[A]	Empirical	Judgmental and quantitative forecasting.
124	Collopy *et al.*	1992	Content[A]	Empirical	Judgmental and statistical forecasting.
125	Lobo &Nair	1990	Content[A]	Empirical	Judgmental and statistical forecasting.
126	Webby *et al.*	1996	Content[E]	Descriptive	Judgmental and statistical forecasting.

Table A2:4 Content wise Classification of Planning and Controlling Literature

Sl no	Researchers	Year	Approach	Methodology	Contributions to research
1	Shishir Bhatt *et al.*	2008	Content[A]	Descriptive	Framework for PPC in Cellular manufacturing.
2	Neil Towers *et al.*	2008	Content[A]	Empirical	Framework for supply chain management
3	Stevenson.M	2009	Content[A]	Descriptive	Reviewed the PPC for MTS and MTO type firms.
4	Monfared *et al.*	2007	Content[A]	Empirical	New PPC framework for automation.
5	Kraus *et al.*	2006	Content[A]	Empirical	Strategic planning in small enterprises.
6	Persona *et al.*	2004	Content[A]	Descriptive	Integrated reference model for PPC in SMEs.
7	Porter *et al.*	1999	Content[A]	Empirical	Manufacturing systems with production control.
8	Jonsson *et al.*	2003	Content[A]	Empirical	Fit between planning environments and MPC.
9	Towers *et al.*	2003	Content[A]	Empirical	Supply chain production planning in SMEs.
10	Chang *et al.*	2003	Content[A]	Descriptive	Model for MTO and MTS environment.
11	George *et al.*	2002	Content[A]	Empirical	Analyzed the strategic planning in SMEs.
12	Olhager	2002	Content[A]	Descriptive	Manufacturing planning and control system.
13	O' Regan *et al.*	2002	Content[A]	Descriptive	Studied the effective strategic planning in SMEs.
14	Howard *et al.*	2002	Content[A]	Descriptive	Rule base for the specification of MPC activities.
15	Hameri *et al.*	2001	Content[A]	Empirical	Production management strategies in Paper mills
16	Cagliano *et al.*	2001	Content[A]	Empirical	Production management and performance
17	Harrison *et al.*	2000	Content[A]	Empirical	Manufacturing strategy and manufacturing
18	Spring *et al.*	2000	Content[A]	Descriptive	Degree of design and volume of manufacturing.
19	Howard *et al.*	1999	Content[A]	Conceptual	MPC system in medium sized manufacturing.
20	Keith Porter *et al.*	1999	Content[A]	Conceptual	Complied different manufacturing classifications.
21	Mc Garrie *et al.*	1998	Content[A]	Exploratory	PPC Selection, improvement and implementation.
22	Howard *et al.*	1998	Content[A]	Descriptive	Approach for generating the specification of MPC
23	Ibrahim *et al.*	1998	Content[A]	Conceptual	Relationship between planning and performance
24	Olhager & Wikner	2000	Content[A]	Descriptive	Studied the role of PPC tools in industry.
25	Newman & Sridharan	1995	Content[A]	Conceptual	Manufacturing planning and control

26	Harhalakis *et al.*	1995	Content[A]	Descriptive	Rule-based specifications in CIM.
27	Kochhar *et al.*	1995	Content[A]	Descriptive	Implementation of manufacturing control systems.
28	Sheu *et al.*	1994	Content[A]	Empirical	PPC framework for non- profit humanitarian firms.
29	Bregmen *et al.*	1994	Content[A]	Conceptual	Framework for comparing MRP to ROP system.
30	Harrison *et al.*	1994	Content[A]	Descriptive	Studied the developments of MRP II.
31	Fransoo *et al.*	1994	Content[A]	Conceptual	PPC systems in process industries.
32	Kim *et al.*	1993	Content[A]	Descriptive	Manufacturing strategy and production systems.
33	Lyles *et al.*	1993	Content[A]	Descriptive	Formalized planning in small business.
34	De Toni *et al.*	1992	Content[A]	Descriptive	Conceptual model of operations management.
35	Buecher *et al.*	1992	Content[A]	Descriptive	Effective capacity planning in firms.
36	Luscombe	1991	Content[A]	Descriptive	Implementation of integrated PPC system.
37	Sweeney	1991	Content[A]	Empirical	Taxonomy on manufacturing methods.
38	Mohanthy *et al.*	1989	Content[A]	Empirical	PPC system for a tool room.
49	Fuller J A	1985	Content[A]	Descriptive	LPP Approach to Aggregate Scheduling.
40	Naylor T	1983	Content[A]	Conceptual	Linked strategic planning and forecasting.
41	Lau *et al.*	1982	Content[A]	Empirical	Protection level and demand of inventory system.
42	Sitompul *et al*	2011	Content[B]	Conceptual	Integrated hierarchical PPC model
43	Kanet & Stoblein	2011	Content[B]	Conceptual	Integrated PPC model for capacitated ERP.
44	Gustavsosn *et al.*	2009	Content[B]	Conceptual	Information quality management in MPC systems.
45	Chakrovarty *et al.*	1995	Content[B]	Conceptual	Compared JIT with conventional manufacturing.
46	Rajeev	2008	Content[B]	Descriptive	Inventory management in SMEs.
47	Wacker *et al.*	2006	Content[B]	Descriptive	MPC systems on manufacturing competitiveness.
48	Dangayach *et al.*	2005	Content[B]	Empirical	Advanced Manufacturing Technology.
49	Louis Raymond *et al.*	2005	Content[B]	Descriptive	Operations management and AMT in SMEs.
50	Soman *et al.*	2004	Content[B]	Descriptive	Make-to-order and make-to-stock systems
51	Jonsson *et al.*	2002	Content[B]	Descriptive	Selection and application of MRP methods.
52	Jonsson *et al.*	2002	Content[B]	Descriptive	Use of capacity planning methods.
53	Naief Turki *et al.*	2002	Content[B]	Empirical	Construction and manufacturing management
54	Petroni	2002	Content[B]	Empirical	MRP implementation in small and medium firms.
55	Ariss *et al.*	2000	Content[B]	Empirical	Factors affecting the adoption of AMT in SMEs.
56	Lecompte *et al.*	2000	Content[B]	Descriptive	Generalized scheduling for virtual enterprises.
57	Swamidas *et al.*	2000	Content[B]	Empirical	Advanced manufacturing technology
58	Suresh *et al.*	1999	Content[B]	Empirical	Integrated process planning and PPC for FMS.
59	Amaro *et al.*	1999	Content[B]	Descriptive	Provides taxonomy for non make to stock firms.
60	Abdul-Nour *et al.*	1998	Content[B]	Empirical	JIT philosophy to a small sized manufacturing firm.
61	Ang *et al.*	1997	Content[B]	Conceptual	Generation of IDEFO models.
62	Kathuria and Igoba	1997	Content[B]	Empirical	IT applications with manufacturing strategy.
63	Harrison *et al.*	1996	Content[B]	Conceptual	Reviewed new wave manufacturing strategies.
64	Karacapilidis *et al.*	1996	Content[B]	Descriptive	Studied the PPC in textile industry.
65	Sprague *et al.*	1996	Content[B]	Descriptive	Conducted macroeconomic analysis of inventories.
66	Udo and Ehie	1996	Content[B]	Descriptive	AMTs determinants of implementation success.
67	Mechling *et al.*	1995	Content[B]	Descriptive	AMT in small manufacturing firms.
68	Spencer *et al.*	1994	Content[B]	Descriptive	Production Planning in make to order environment.
69	Bonney	1993	Content[B]	Descriptive	Trends in inventory management.
70	Zapfel *et al.*	1993	Content[B]	Descriptive	New concepts for PPC
71	Jacobs *et al.*	1992	Content[B]	Empirical	Made a comparison of ROP and MRP.
72	Karmarkar *et al.*	1989	Content[B]	Descriptive	Analyzed the control of just in time.
73	Voss *et al.*	1986	Content[B]	Descriptive	Discuss the aspects of manufacturing functions.
74	Schonberger *et al.*	1983	Content[B]	Empirical	Applications of single card and dual-card kanban.
75	Huang *et al.*	1982	Content[B]	Descriptive	Simulation of the Japanese JIT techniques.
76	Anna Michna	2009	Content[C]	Empirical	Learning and SME performance.
77	Gustavsson *et al.*	2009	Content[C]	Descriptive	Information quality in manufacturing planning and
78	Thuy Uyen	2009	Content[C]	Empirical	Framework for the IT adoption in SMEs.
79	Anderson *et al*	2008	Content[C]	Conceptual	Managerial behaviour in small international firms.
80	Perez *et al.*	2007	Content[C]	Empirical	Managerial behaviour of SMEs
81	Sharma *et al.*	2006	Content[C]	Empirical	Performance measurement in SMEs.
82	Barnes *et al.*	2002	Content[C]	Descriptive	Manufacturing strategy formation in SMEs
83	Macri D M	2001	Content[C]	Descriptive	Sociometric location and innovation.

84	Kimura *et al.*	2000	Content[C]	Conceptual	integration of management control systems
85	Rauch *et al.*	2000	Content[C]	Descriptive	Cultural differences in planning of SMEs
86	Li LX	2000	Content[C]	Exploratory	Transition from planning to markets need
87	Mohanthy *et al.*	1999	Content[C]	Exploratory	Manufacturing strategy for a learning organization.
88	Lau *et al.*	1999	Content[C]	Empirical	Relates manufacturing flexibility and infrastructure.
89	Roper S	1999	Content[C]	Descriptive	Modelling small business growth and profitability
90	Azzone *et al.*	1998	Content[C]	Descriptive	Deployment of green manufacturing strategy.
91	Kotey & Meredith	1997	Content[C]	Empirical	Owner/manager personal values and performance.
92	Muhamad *et al.*	1997	Content[C]	Empirical	Requirements in manufacturing system design
93	Newman *et al.*	1996	Content[C]	Conceptual	Time and productive operations performance.
94	Smith *et al.*	1996	Content[C]	Empirical	Differences in forecasting behaviour .
95	White *et al.*	1996	Content[C]	Empirical	Meta analysis model of manufacturing capabilities.
96	Berry *et al.*	1995	Content[C]	Descriptive	Links manufacturing and marketing choice.
97	Cromie *et al.*	1995	Content[C]	Empirical	Investigated the management of family firms.
98	Wathen *et al.*	1995	Content[C]	Empirical	Production process focus and performance in firms
99	Lussier R	1995	Content[C]	Empirical	Business success versus failure prediction model.
100	Mathews	1995	Content[C]	Empirical	Uncertainty and planning in small firms.
101	Neely *et al.*	1995	Content[C]	Empirical	Performance measurement system.
102	Mantho V	1994	Content[C]	Empirical	Inventory management in Northern Greece
103	Jaworski *et al.*	1993	Content[C]	Descriptive	Antecedents of market orientation.
104	Kim *et al.*	1993	Content[C]	Descriptive	Individual and organizational learning.
105	Meredith J	1993	Content[C]	Exploratory	Manufacturing technology and business strategy.
105	Bozarth *et al.*	1993	Content[C]	Descriptive	Conceptual model of manufacturing focus.
107	Berry *et al.*	1992	Content[C]	Empirical	Linking systems to manufacturing strategy.
108	Daily *et al.*	1992	Content[C]	Empirical	Family and professionally managed firms.
109	Meyer H	1991	Content[C]	Exploratory	Eight step approach to inventory accuracy.
110	Steiner *et al.*	1988	Content[C]	Conceptual	Factors for success in small manufacturing firms.
111	Bracker *et al.*	1986	Content[C]	Empirical	Planning and financial performance of SMEs.
112	Hornaday *et al.*	1971	Content[C]	Descriptive	Characteristics of successful entrepreneurs.
113	Swapnesh,S	2011	Content[D]	Empirical	Inventory related user model for SCM.
114	Anderson *et al*	2009	Content[D]	Descriptive	Manager and growth in small firms.
115	Bhutta *et al*	2008	Content[D]	Empirical	Owner characteristics and health of SMEs.
116	Rami Alasadi *et al.*	2008	Content[D]	Descriptive	Small business performance in Syria.
117	Smith M	2007	Content[D]	Descriptive	Differences between family and non family firms.
118	Todd *et al.*	2007	Content[D]	Descriptive	Studied the internationalization of SMEs
119	Carol Yeh *et al.*	2007	Content[D]	Empirical	Study of SMEs innovation with performance.
120	Carrol M G *et al.*	2007	Content[D]	Exploratory	Culture, learning, and employee background.
121	Lema D	2007	Content[D]	Empirical	Managerial behaviour of family businesses.
122	Richbell *et al.*	2006	Content[D]	Descriptive	Owner managers and the business planning
123	Karami *et al.*	2006	Content[D]	Descriptive	CEOs characteristics and strategy development
124	Dincer *et al.*	2006	Content[D]	Empirical	Strategic planning process in Turkish firms.
125	Sharma *et al.*	2006	Content[D]	Empirical	Information systems of Indian SMEs.
126	Kotey *et al.*	2005	Content[D]	Empirical	Practices and performance of family SMEs.
127	Eleni *et al.*	2005	Content[D]	Descriptive	Characteristics of CEOs.
128	Bob Ritchie *et al.*	2005	Content[D]	Exploratory	Cultural determinants of competitiveness
129	Wiklund *et al.*	2005	Content[D]	Descriptive	Entrepreneurial orientation and small business
130	Denison *et al.*	2004	Content[D]	Descriptive	Culture in family owned enterprises.
131	Poza *et al.*	2004	Content[D]	Descriptive	Cost implication on the family business interaction.
132	Beaver *et al.*	2002	Content[D]	Exploratory	Management strategy and policy
133	Gray *et al.*	2002	Content[D]	Empirical	Entrepreneurship and growth
134	Jorisson *et al.*	2001	Content[D]	Empirical	Difference between family and non family firms.
135	Paucer *et al.*	2000	Content[D]	Descriptive	Use of system methodologies in UK and Spain.
136	Hanna *et al.*	2000	Content[D]	Empirical	Operational improvement through employee
137	Eloranta *et al.*	1998	Content[D]	Empirical	Delivery performance of SMEs
138	Peel *et al.*	1998	Content[D]	Conceptual	Planning and capital budgeting with performance.
139	Harrison *et al.*	1997	Content[D]	Empirical	Adoption of information technology.
140	Swartz *et al.*	1997	Content[D]	Descriptive	Information management in SMEs.
141	Delaney J T	1996	Content[D]	Descriptive	Human resource management on organizational

142	Rosa *et al.*	1996	Content[D]	Empirical	Gender as a determinant of SME performance.
143	Forza C	1995	Content[D]	Empirical	Impact of information systems on quality.
144	Ahmet *et al.*	1995	Content[D]	Empirical	Key internal factors with firm performance.
145	Ahmed et al.	1995	Content[D]	Empirical	Manufacturing strategy with firm performance.
146	Greenley G E	1995	Content[D]	Empirical	Market orientation and company performance
147	Zhang *et al.*	1995	Content[D]	Descriptive	Business difficulties for small businesses.
148	Kean R	1994	Content[D]	Descriptive	Competitive strategies on rural retail performance.
149	Kim JS	1993	Content[D]	Descriptive	Model for assessing manufacturing competence.
150	Barker *et al.*	1993	Content[D]	Empirical	Time based performance measurement approach.
151	Cromie *et al.*	1992	Content[D]	Conceptual	Entrepreneurial tendencies of managers.
152	Azzone et al.	1991	Content[D]	Descriptive	Performance measures for time based companies.
153	De Meyer *et al.*	1990	Content[D]	Conceptual	Improvement programmes and firm performance.
154	Narver J C	1990	Content[D]	Empirical	Market orientation on business profitability.
155	Shrader *et al.*	1989	Content[D]	Empirical	Linked strategic planning and firm performance.
156	Bracker J S	1988	Content[D]	Empirical	Planning and financial performance among SMEs.
157	Cochran *et al.*	1984	Content[D]	Conceptual	Corporate social responsibility and performance.
159	Childe S. J.	2010	Content[E]	Conceptual	PPC developments for the last 20 years.
159	Land &Gaalman	2009	Content[E]	Conceptual	Reviewed the PPC developments in SMEs.
160	Erkan *et al.*	2007	Content[E]	Conceptual	Evolution of Operations management.
161	Floren *et al.*	2006	Content[E]	Descriptive	Research agenda on managerial work in SMEs.
162	Geraghty *et al.*	2005	Content[E]	Descriptive	Hybrid and pull type production control
163	Shehab *et al.*	2004	Content[E]	Descriptive	The enterprise resource planning.
164	Stevenson *et al.*	2004	Content[E]	Descriptive	Review of PPC in the make to order industry.
165	Schonsleben *et al.*	2000	Content[E]	Descriptive	Concepts of PPC in enterprise logistics.
166	Bititci *et al.*	2000	Content[E]	Descriptive	Dynamics of performance measurement systems.
167	Daniel V	2000	Content[E]	Conceptual	Reviewed PPC for remanufacturing industry
168	Jeroen *et al.*	1999	Content[E]	Conceptual	Planning and control of warehousing systems.
169	Bolden *et al.*	1997	Content[E]	Empirical	Taxonomy of modern manufacturing practices
170	Bergamaschi *et al.*	1997	Content[E]	Empirical	Order review and strategies in a job shop.
171	Collins *et al.*	1997	Content[E]	Descriptive	Methodology issues in manufacturing strategy.
172	Porter *et al.*	1996	Content[E]	Descriptive	Reviewed PPC Developments in Germany.
173	Miller *et al.*	1994	Content[E]	Empirical	Provided taxonomy of manufacturing strategy.
174	Ardishvili *et al.*	1993	Content[E]	Descriptive	Surveyed manufacturing practices.
175	Neely *et al.*	1993	Content[E]	Empirical	Operations management during the 1980s.
176	Jordan *et al.*	1993	Content[E]	Descriptive	Production activity control for SMEs.
177	Singh and Brar	1992	Content[E]	Descriptive	Modelling and analysis of JIT systems.
178	Chikan *et al.*	1990	Content[E]	Descriptive	Production and inventory management practices.
179	Gelders *et al.*	1981	Content[E]	Descriptive	Reviewed the production planning by firms.

APPENDIX: III

Frameworks and Models used in PPC and SME based research

A) Model linking the PPC methods and PPC environment (Ref: Patrick Jenson *et al.* 2004).

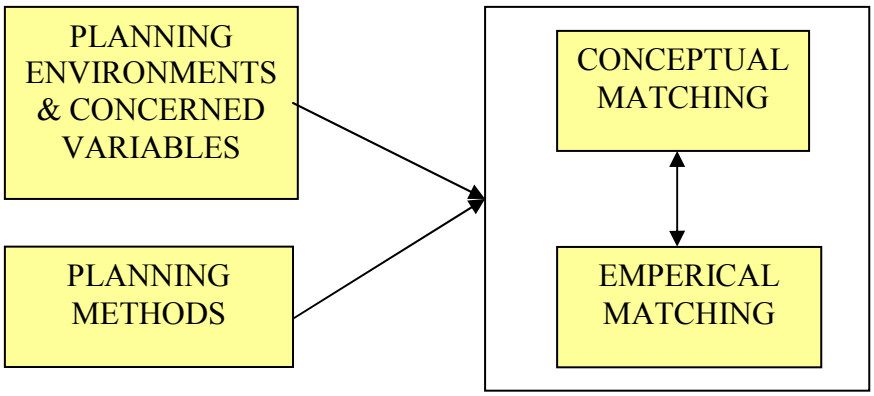


Figure A3:1 Linking PPC Methods and Environment

B) Model of Small Firm management Process (Ref: Beaver and Prince).

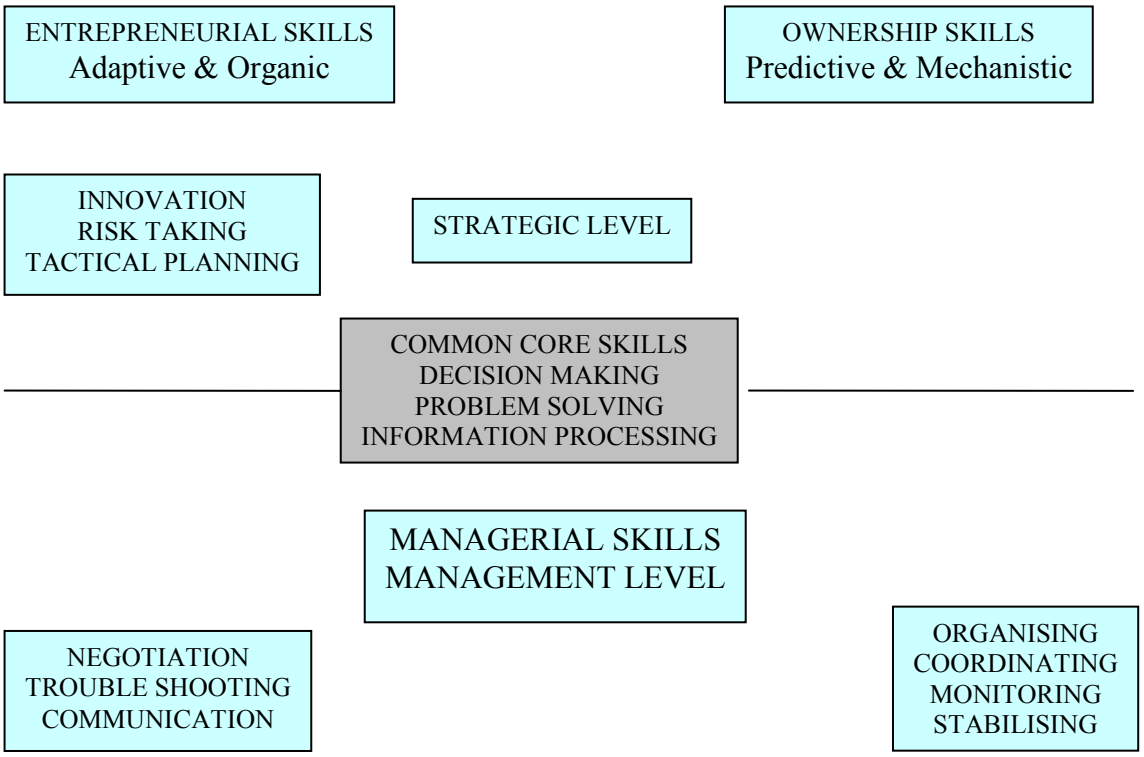


Figure A3:2 Small Firm Management Process

C) Framework for measuring information system performance in SMEs (Ref: Sharma *et al.* 2001).

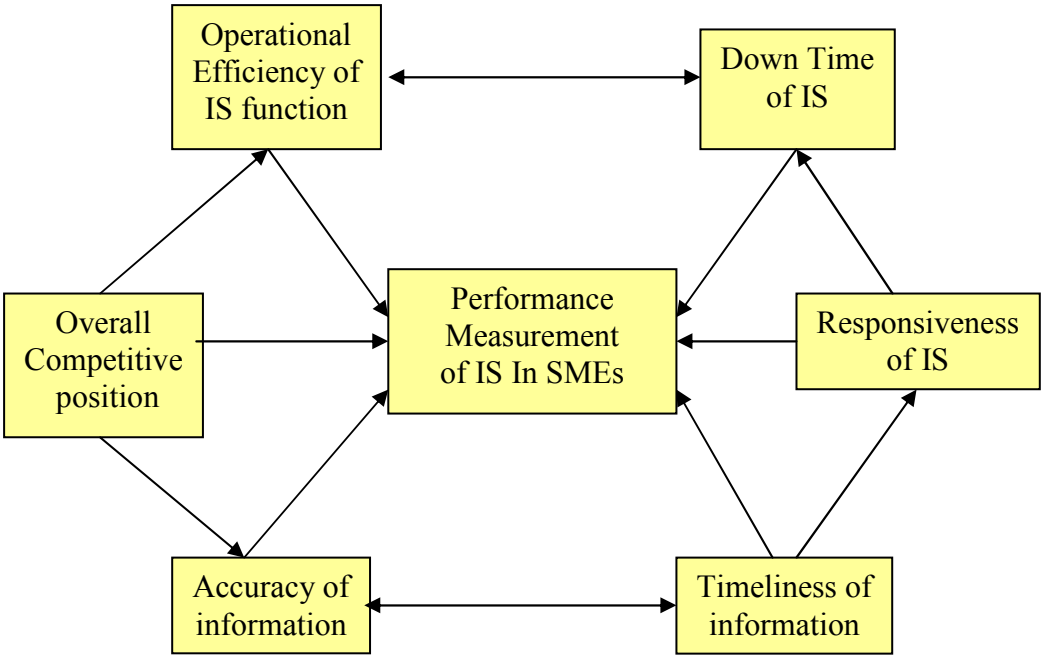


Figure A3:3 Measurement of Information System Performance in SMEs

D) Model of manufacturing strategy in SMEs (Ref: Singh, Garg and Deshmukh 2007).

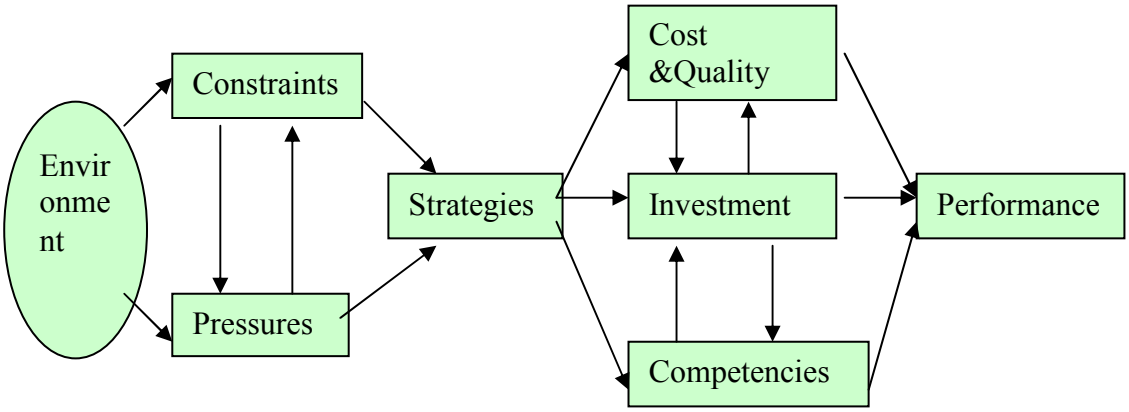


Figure A3:4 Linking Manufacturing Strategy with Performance

APPENDIX IV

DATA COLLECTION METHODS

Table A4:1 Different Types of Questionnaire Instruments, their Merits and Demerits

Mode of distribution	Strength	Weakness	References
Mail	Cost effective Wide coverage Anonymity Lesser response time Interviewer cannot shape questions	Limited length Question must be brief and self explanatory. No control on the surveyor. Interviewer cannot clarify the doubts Poor response rate Difficult to check non response biases	de vaus Fehily *et al* McGurik *et al* Parfitt Dearne Bird
e-mail	Cost effective Less response time Strong response rate More complex questions can be asked	Interviewer cannot clarify doubts Distribution shaped by age, class and gender biases	Cecic *et al* Parfitt Dearne Bird
Telephone	Cost effective compared to face-to-face. More anonymity Encourage participation Can motivate participant Question can be clarified Vague response can be probed Longer verbal responses compared to written Question sequence controlled	Time consuming so limits the length of the questionnaire Simple format needed Class or gender bias	Cecic *et al* Parfitt Dearne Bird Nicolaos Syndrino Patrik Bonnel *et al*
Face-to-face	Complex question can be asked Can motivate participant Long verbal responses Question can be clarified Visual prompts can be used Vague response can be probed High response rate Question sequence controlled	Costly Time consuming Spatially restricted Interviewer bias Answers may be censored	Cecic *et al* Parfitt Dearne Bird

Table A4:2 Questionnaire Parameters to be considered during the Trial

Aspect	Description	Reference
Question design and format	▪ Clarity and understandability ▪ Necessity of rewording ▪ Necessity of prompts to question ▪ Appropriateness of question sequence ▪ Any question to be omitted?	Volker *et al*, Cecic *et al* Parfitt, Dearne Bird Nicolaos E Syndrino Patrik Bonnel *et al*
Classification of questions	▪ Sufficiency and adequacy of classification ▪ Any problem with classification ▪ Do the classification actually necessary	
Purpose of the survey	Whether the questionnaire fulfills the aim of the investigation?	
Length of the questionnaire	▪ Time taken for each investigation ▪ Comment of the participant about length (appropriateness by participants to reveal the data)	Volker *et al*, Cecic *et al*, Parfitt, Dearne Bird Nicolaos Syndrino Patrik Bonnel *et al*
Output from the questionnaire	▪ Adequacy and appropriateness of data format ▪ Adequacy of coding scheme in connection with multiple response	Volker Stroke *et al*, Cecic et al , Parfitt , Dearne Bird Nicolaos Syndrino Patrik Bonnel *et al*

References for the above

1. Cecic I *et al.,* (2004) "Macro seismic surveys in theory and practice". *Nat Hazards*, 31: 39-61.
2. Comrey, Andrew L, Howard B, (1992), "*A first course in factor analysis*", Hillsdale, NJ: Lawrence Erlbaum Associates.
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6. Kothari C.R (2004). Research Methodology, New Age International, Delhi.
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8. Nicolaos E Synodinos (2003), "The art of Questionnaire construction: Some important consideration for manufacturing studies" 14/3, pp 221-237.
9. Pannerselvam: Research Methodology, S Chand, and New Delhi (2005).

10. Parfitt *et al.* (2005), "Questionnaire Design and Sampling", Methods in Human Geography. *Pearson Education* England.
11. Patrick Bonnel *et al.*, "The quality of survey data: Telephone versus face-to-face interviews". *Transportation*, 25: 147-167.
12. Volker Stroke *et al.*, "Attitude towards surveys, attitude accessibility and the effect on respondents susceptibility to non response", *Quality and Quantity*, 40: 459- 488.

APPENDIX V

Comparison of Different Types of Sampling Methods

Table A5:1 Sampling Methods Compared

Type of sampling	Advantages	Limitations	Applicability	Reference
Random Sampling	Bias Free method	Impractical due to non availability or non cooperation	Quantitative analysis of production data Descriptive research	Hair *et al.* Appa Iyer *et al.*
Convenience/ Judgmental Sampling	Used due to easy availability and convenience	More Bias Less accurate	Used in exploratory research. Useful in situations of non cooperation and no prior experience	Hair *et al.* Pannerselvam Kothari *et al.*
Quota Sampling	Useful in field research Better method, if similar data is available	Quota deviates from random assumption. Bias or asymmetry will be more.	Better for agriculture based or field based studies. Used in statistical research.	Kothari *et al.* Alasadi *et al.*
Convenience cum cluster Sampling	Bias due to non random effect can be reduced	Bias resulted from demographics of the clusters.	Exploratory research h in which, high tech methods are not viable due to the ignorance of respondent	Rosa *et al.*, Bhutta *et al.*

Determination of Sample Size

Preliminary calculation of the sample size for the study undertaken is described below:

Proportion of SMEs use PPC method as that of large firms: p = .5

Proportion of SMEs with low performance: q = .5.

It is assumed Binomial distribution of data (with Normal Approximation).

Confidence level = 95%, Standard Normal Variates z = 1.96, infinite sample size

Error assumed, e = ±5%

Sample Size $\mathbf{N = z^2pq/e^2}$ = 1.96X1.96X.5X.5/.05X.05 = 384

Sample Size, N for different values of error "e" are given in table A 5.2 as below:

Table A5:2 Sample size determined under different conditions

Infinite sample size is assumed				
Confidence level	**p**	**q**	**Error e**	**Sample size N**
.95	.5	.5	5%	384
.95	.5	.5	4%	600
.95	.5	.5	3%	1067
.95	.6	.4	5%	369
.95	.6	.4	4%	576
.95	.6	.4	3%	1024
.95	.7	.3	5%	323
.95	.7	.3	4%	504
.95	.7	.3	3%	896

Sample size is also calculated for finite population (assumed population size of 30000) using the equation $\mathbf{n = N^2 z^2 / (N e^2 + z^2 \sigma^2)}$

As the population size assumed was very large, no significant difference in sample size was observed. It was decided to select the sample size as 384 with p value .5 and error assumed as $\pm 5\%$.

Sample size required for conducting Statistical Tests

For t-tests and factor analysis, separate sample adequacy tests are used. Table A5:3 illustrate the variation in actual Type I error with the increase in sample size for significance level .05 (shown in second column) and .01 (shown in third column) respectively. Values are estimated with AMOS program for testing the hypothesis that two variables were uncorrelated (Courtesy: IBM SPSS – AMOS 19 Manual). When the sample size approaches 300 or more, normality of data is observed.

Table A5:3 Variation of real probability of Type I error with sample size

Sample Size	Nominal Significance Level	
	0.05	0.01
3	0.250	0.122
4	0.150	0.056
5	0.115	0.038
10	0.073	0.018
20	0.060	0.013
30	0.056	0.012
40	0.055	0.012
50	0.054	0.011
100	0.052	0.011
150	0.051	0.010
200	0.051	0.010
500	0.050	0.010

For Exploratory Factor Analysis (EFA), K-M-O criterion of sample adequacy and Bartlett's Sphericity tests were used to evaluate the sample adequacy. As a rule of thumb, sample size is calculated with a ratio of 1:15 per indicator variable. In CFA, this criterion was followed in the initial stages (Reference: Hair *et al.* 2011)