CHAPTER 4

Design of Questionnaire, Data Collection and Univariate Analysis

4.1 Introduction

In social science research, it is critical to select which type of survey is to be used. The judgement to use a particular type of survey depends on various issues related with research and advantages and disadvantages of survey methods. Surveys are considered an important and effective tool in social research. Questionnaires are also used in experiments, field research and other data collection activities (Babbies, 1989).

The study aims to establish the relationship between research variables identified in chapter three based on the experiences of senior executives of upstream oil companies in India about implementation of comprehensive enterprise performance management system and its effectiveness in driving performance improvement. This chapter presents questionnaire design, validation, pre-testing, administering the questionnaire, and univariate analysis of data collected through this survey.

4.2 Design of Questionnaire

The survey is used to collect measurable, observable and empirical evidence, subject to specific principles of reasoning. The foundation of all questionnaires is the questions and statements with which a researcher intends to seek answers or opinions in terms of level of agreement (Nachmias and Nachmias, 1981). The questionnaire is “basically a collection of questions that fits the research topic and its objectives, and the answers to which will provide the data

necessary to test the hypotheses formulated for the study" (Kothari, 1985). The research design for survey is given in Figure 4.1.

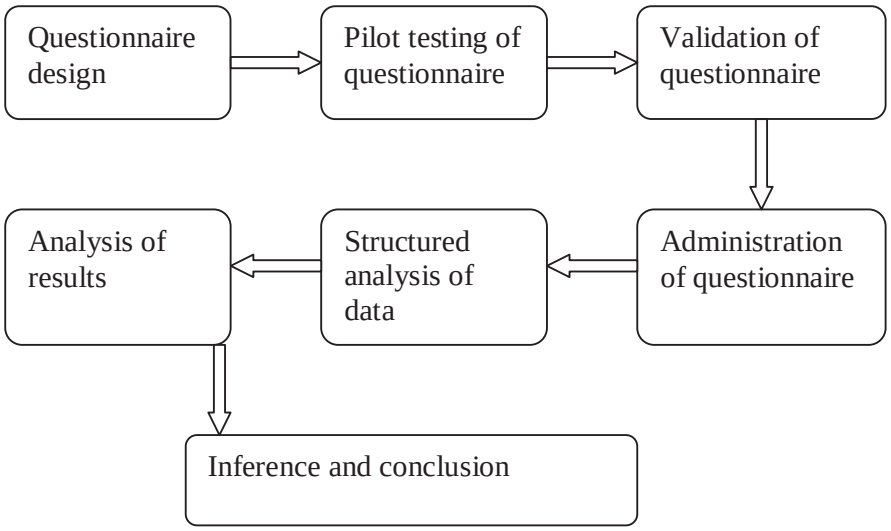

Figure 4.1: Research Design for Survey

Framing of questions, need a deep understanding of the subject matter (Yin, 2002). The questionnaire design is multi-phased from clear definition of research topic, issue identification, definition of research variables, questions, and statements based on conceptual model developed by the researcher. It uses structured questions, where respondent selects only one option based on his experience/views and he does not have to write explanations. Questions are framed in a language easily understandable, concrete and un-ambiguous and convey only one thought at a time. Each set of questions are preceded by small explanation regarding frame of reference. A cover note describing objective of the study and direction to fill up the questionnaire was also attached.

The research objectives have been translated into hypotheses, which then are defined as relationships of guiding variables and this further being

divided into measurable components referred to as micro variables. The questionnaire aims to measure the study variables to test the hypotheses.

The study involves qualitative variables and therefore qualitative assessment of magnitude of variables on comparative basis has been done. Likert scale has been used for measurement of variables where a respondent is asked to express/mark his/her position on a continuum, which has two extremes opposite to each other. In present study, a scale of 1-6 with options, 1-strongly disagree to 6-strongly agree, has been used. With the assumption that equal intervals on scale indicate equal measure of variable/property, the scale may be assumed to be approximately close to interval scale (Kothari, 1985; Thakur, 1993). The statistical measures like mean, median, standard deviation, correlation analysis, t-test, and F-test, and regression analysis have been used.

4.3 Validation of Questionnaire

High degree of validity reflects the reasonable approximation to the real value. The questionnaire validation exercise has been carried out in three parts, viz. content validity, criterion validity, and construct validity.

4.3.1 Content Validity

Content validity refers to the representativeness or sampling adequacy of the content (Kerlinger, 1986). Also known as face validity, which is the degree of match between researchers' perception, and the concept of the variables. It is operationalized through the questionnaire. The other names of this technique are expert-judge content validity, logical validity and definitional validity (Benz and Newman, 1998). For this purpose, 3 professors and 3 senior executives

from industry were selected as judges and were given the questionnaire along with operational definitions of the variables and objectives of the study. During these sessions, several definitions of variables were written down, refined and common constructs were worked out. The idea was to bring out the mental image for the variables into the common acceptable language. The judges gave their expert view and accordingly some questions were reframed or were split for better clarity and completeness of inquiry. The repeated validation sessions helped in evolving operational definitions of the variables and in modifying the language of questions to simple, complete and correct expression. They also helped in re-sequencing the questions so as to represent natural flow of thoughts and logical relationship of variables.

4.3.2 Criterion Related Validity

Criterion related validity helped in understanding the questionnaire, its objective, purpose, language, context and feasibility of answering from the respondent's point of view. Five senior executives from industry were involved in this validation process. Based on their experience and knowledge, they commented on size, time required in responding, wordings of the questions and their suggestions were incorporated.

4.4 Questionnaire Format

The questionnaire used for the purpose of study has been divided into 8 independent study parts which include; strategy planning, strategic flexibility, strategy implementation, enterprise performance measurement system (EPMS) design, performance analysis and feedback, information system flexibility, EPMS implementation issues, and EPMS effectiveness. An additional part

showing EPMS in use, its rating and periodicity of use has also been added. The areas and number of questions in each area/section of the questionnaire is presented in Table 4.1.

Table 4.1: Identified Research Variables and Related Question Nos.

S. No.	Research Variable	No. of Questions	Question Nos.
1	Strategy Planning	4	1-4
2	Strategic Flexibility	13	5-17
3	Strategy Implementation	10	18-27
4	Performance Measurement System Design	15	28-42
5	Performance Reporting and Feedback	5	43-47
6	Information System Flexibility	7	48-54
7	EPMS Implementation Issues	16	55-70
8	EPMS Effectiveness	37	71-107
8.1	(i) Strategic Alignment	4	71-74
8.2	(ii) Strategic Monitoring	6	75-80
8.3	(iii) Financial Perspective	5	81-85
8.4	(iv) Customer Perspective	5	86-90
8.5	(v) Internal Process Perspective	10	91-100
8.6	(vi) Learning and Growth Perspective	7	101-107
9	EPMS models in-use, Rating of EPMS models, Periodicity of use	3	a-c

The questionnaire had 107 questions to which responses were sought. Additional questions on EPMS in-use, its rating, periodicity of measurement/review and planning period were also incorporated. On top of the questionnaire, optional demographic information such as name, designation, age, qualification, department, organisation, and years of experience was also sought from the respondents.

4.5 Questionnaire Testing

After questionnaire validation, it was pre-tested through pilot survey of small sample of respondents. The respondents for pre-testing were selected from same population from which actual survey was to be done. Their suggestions were incorporated into the questionnaire.

4.5.1 Pre Testing

The objective of pre-testing was to eliminate possibilities of confusion, biasness, and misunderstanding to ensure that the questionnaire is easy to understand by respondents. Sixteen responses were received out of twenty questionnaires administered to senior executives from one organization. Each respondent was requested to identify difficulties in filling up the questionnaire regarding format, length, language, sequencing and context for further improvement. Their suggestions have been incorporated and questionnaire was redesigned. The final version of questionnaire is exhibited in Appendix-II.

4.5.2 Construct Validity

Construct validity and empirical scientific inquiry are closely allied. It does not seek to test the test, but aims to validate the theory behind the test (Kerlinger, 1973). A measure is said to posses construct validity to the degree that it confirms to predict correlation with other theoretical propositions.

Factor analysis is a method for determining the number and nature of the underlying variables among larger number of measures (Kerlinger, 1973). It facilitates understanding of the structure of correlation matrix and studying correlation among a large number of inter-related quantitative variables by grouping them into new factors. The variables within a factor are highly correlated than the variables in other factors. Principal component factor analysis with varimax rotation has been used as it provides a clear separation of factors (Dhillon and Goldstein, 1984). Rotation makes larger loading larger and smaller loading even smaller. Loading for entire construct has been checked in construct validity. According to Hair et al. (2006), factor loading of 0.3 is considered minimal level, 0.4 more important and 0.5 or greater very significant. In this research, factor loading of 0.7 has been used as cut off point.

Factor Analysis

There are two types of factor analysis; exploratory and confirmatory. The exploratory factor analysis using principal component extraction with varimax rotation has been used to test construct validity of effectiveness variables of enterprise performance management system with various eigen values. After extraction the researcher must decide how many factors to retain for rotation. Both over extraction and under extraction of factors retained for rotation can have deleterious effects on the results. The factor with eigen value greater than 1 is to be retained is a thumb rule and is default in most statistical software Packages but as per broad consensus in the literature, this is among the least accurate methods for selecting the number of factors to retain (Velicer and Jackson, 1990). Alternate methods for factor retention are scree test, Velicer's MAP criteria, parallel analysis, a priori theory, and retaining the number of factors that gives a high proportion of variance accounted for or that gives the most interpretable solution (Velicer & Jackson,1990). Various scenarios were tested and finally factors with 70 per cent variance have been retained in this study. While factor loading of 0.30 has been suggested as sufficient, loading greater than 0.7 were used in this study. The factors retained after varimax rotation are given in Table 4.2. The details of factor analysis are given in Annexure III.

It is seen from Table 4.2 that all the sixteen independent micro variables with eigen value loading of equal or greater than 0.7, are retained for EPMS effectiveness. As envisaged in the study, seven dependent macro variables have been selected and included in the construct. Thus, the confirmatory factor analysis of variables impacting enterprise performance management system effectiveness, confirms the validity of the constructs.

Table 4.2: Factor Analysis of Independent Micro Variables Influencing EPMS Effectiveness

Macro Variables	Factor	Factor Name	Eigen value	Per cent of Variance	Cumulative Per cent
Strategy Planning (SP)	SP1	Vision and Mission Clarity	2.387	59.668	59.668
	SP2	Setting of Strategic Goals	0.724	18.090	77.758
Strategic Flexibility (SF)	SF1	Impact of Globalization/ Liberalization	6.456	49.658	49.658
	SF2	In-house Capabilities	1.229	9.453	59.112
	SF3	External Drivers	1.086	8.353	67.465
	SF4	e-Business Impact	0.858	6.596	74.061
Strategy Implementation (SI)	SI1	Alignment with Operational Goals	6.048	60.478	60.478
	SI2	Resources Allocation	0.973	9.725	70.203
Performance Measurement System Design (SM)	SM1	Selection of Dimensions and Measures	10.610	70.731	70.731
	SM2	Customised EPMS	0.808	5.387	76.118
Performance Reporting and Feedback (PR)	PR1	Performance Reporting and Feedback	3.965	79.299	79.299
Information System Flexibility (IF)	IF1	EPMS Functionalities	4.608	65.831	65.831
	IF2	IT Flexibility	0.823	11.750	77.581
EPMS Implementation Issues (MI)	MI1	Effective EPMS Implementation	11.066	69.161	69.161
	MI2	Top Management Support	0.703	4.395	73.556
	MI3	Quality of Data Flow	0.702	4.386	77.942

4.5.3 Reliability Assessment

The reliability analysis of measuring instrument determines its ability to yield consistent measurement (Flynn et al., 1994). It is defined as the extent to which measurements of particular test are repeatable. Among the methods, internal consistency method works quite well in the field studies as it requires only one administration. Internal consistency is an indicator of how well the different items measure the same concept (Seraph et al., 1989). Internal consistency can be estimated using a reliability coefficient known as Cronbach's alpha (Cronbach and Meehl, 1955).

The Cronbach alpha for macro and micro variables of EPMS has been calculated and the details are provided in Annexure IV. Factor analysis facilitated reduction in number of questions related to the variables; Cronbach alpha for reduced factors (micro variables) was also found to be more than cut off level (0.5) is presented in Table 4.3. The reliability ranges are from 0.751 to 0.973, which implies that the instrument is highly reliable.

Table 4.3: Cronbach's Alpha for Macro and Micro Variables

Micro Variables of EPMS	**Cronbach's alpha**
Vision and Mission Clarity	0.773
Impact of Globalization/ Liberalization	0.909
In-house Capabilities	0.825
External drivers	0.751
Alignment with Operational Goals	0.916
Resources Allocation	0.816
Selection of Dimensions and Measures	0.973
Performance Reporting and Feedback	0.933
EPMS Functionalities	0.911
IT Flexibility	0.807
Effective EPMS Implementation	0.954
Top Management Support	0.947
Strategic Alignment	0.957
Strategic Monitoring	0.961
Financial Perspective	0.943
Customer Perspective	0.956
Internal Business Process Perspective	0.958
Learning and Growth Perspective	0.926
Independent Micro Variables (16)	0.928
Dependent Micro Variables of EPMS Effectiveness (6)	0.915

4.6 Questionnaire Administration

The questionnaire has been administered with a brief introductory write up on the research study objectives, purpose of the questionnaire and directions to fill up the questionnaire. The questionnaires were mailed, emailed and hardcopy personally distributed to respondents. The unit of analysis for the study is the Indian upstream oil industry organization.

For the research survey, the population or universe is small and therefore, all companies in the upstream oil sector/industry were taken for the survey. The respondents were selected based on snow-ball random sampling from middle and senior level executives from oil companies in India.

A total of more than 500 questionnaires were mailed, emailed and hardcopy distributed across 15 oil companies including both government owned and private (which included MNCs) alongwith covering letter signed by research supervisors. After an intense follow up, 139 filled up questionnaires were received from respondents. Few private organisations and MNCs did not respond even after repeated requests. Response rate varied from 5 to 30 per cent from company to company.

For multiple correlations, the sample size can be decided by the formula N>= 50 + 8 M, where N is the needed sample size, M is number of independent variables (Green, 1991). In the present study independent macro variables are 7 and so the sample size should atleast be 106. The respondents are executives from senior level, upper middle level and lower middle level management. Some respondents have not mentioned their personal details such as names, qualification, managerial level, total experience etc. due to

personal reasons. The company-wise survey responses and profile of respondents are summarized in Tables 4.4 and 4.5 and Figure 4.2.

Table 4.4: Company-wise Respondents

S. No.	Name of Oil Company	No. of Responses
1	Oil & Natural Gas Corporation Ltd. (ONGC)	62
2	Oil India Limited (OIL)	24
3	Gujarat State Petroleum Corporation (GSPC)	22
4	Gas Authority of India Ltd. (GAIL)	13
5	Cairn Energy India Ltd (CEIL)	7
6	Essar Oil Ltd. (EOL)	5
7	Bharat Petroleum Corp. Ltd. (BPCL)	2
8	Hindustan Petroleum Corp. Ltd. (HPCL)	2
9	Hindustan Oil Exploration Corp. Ltd. (HOECL)	1
10	Heramec Ltd.	1
	Total	**139**

Table 4.5: Respondents' Profile

Level of Managerial Executives	Average Years of Experience	No. of Respondents	Percentage Respondents (%)
Senior Management	29.4	45	32.37 %
Upper Middle Management	24.3	55	39.57 %
Lower Middle Management	9.8	39	28.06 %
Total	21.9	139	100 %

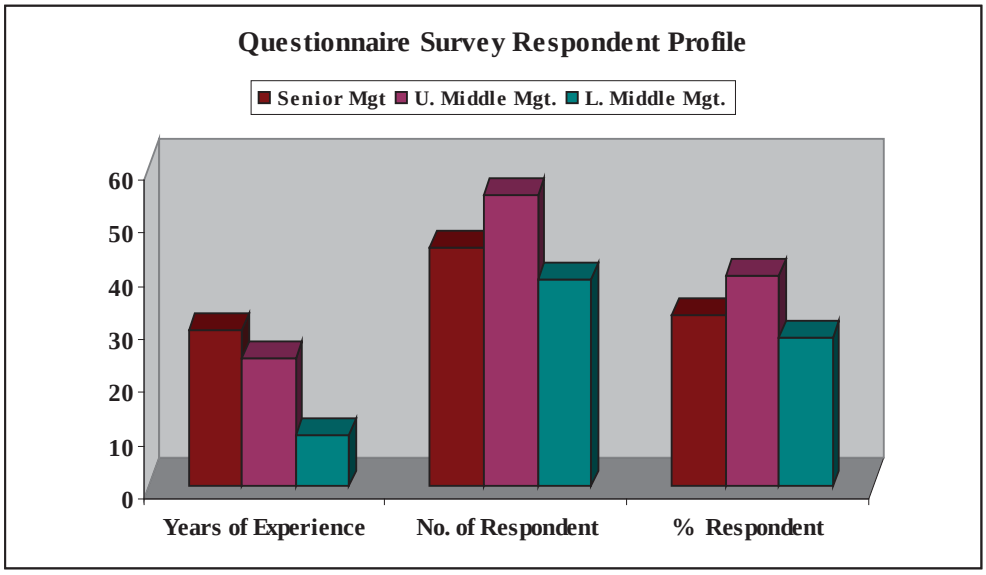

Figure 4.2: Respondents' Profile

The number of respondents from senior management, upper middle management, and lower middle management is 45, 55, and 39 respectively. The average years of experience of respondents from senior management, upper middle management, and lower middle management is 29.4, 24.3, and 9.8 respectively.

Table 4.5 (a): Comprehensive Enterprise Performance Management System Being Used in the Organizations Surveyed

Organization	Strategic Plan	Periodicity of Review	EPMS Tools Used
ONGC	Yearly, 5-Yearly	Annual	MOU, BM, ISO, BSC, SLA, MA, RA
OIL	Yearly, 5-Yearly	Annual	MOU, BM, ISO, BSC, SLA, MA, RA
GSPC	Yearly	Annual	MOU, BM, ISO, MA, RA
GAIL	Yearly, 5-Yearly	Annual	MOU, BM, TQM, ISO, MA
CAIRN India Ltd.	Yearly	Annual	MOU, SLA, MA, RA
Essar Oil Ltd.	Yearly	Annual	MOU, BM
HPCL	Yearly, 5-Yearly	Annual	MOU, BM, ISO, BSC, SLA, MA
BPCL	Yearly, 5-Yearly	Annual	MOU, ISO, BSC, MA
HOECL	Yearly	Annual	MOU, BM, BSC, SLA, MA, RA
Heramec Ltd.	Yearly, 5-Yearly	Annual	MOU, TQM, MA

Legend: MOU: Memorandum of Understanding for Targets, BM: Benchmarking, TQM: Total Quality Management, ISO: ISO Certification, BSC: Balanced Scorecard, SLA: Service Level Agreement, MA: management Audit, RA: Risk Assessment

The comprehensive enterprise performance measurement and management tools and methodologies being used, the types of plans, and periodicity of review in the organizations surveyed are exhibited in Table 4.5 (a).

4.7 Data Processing and the Univariate Analysis

The data processing and analysis has been done using SPSS package ver. 12.0. The data from the questionnaire has been examined to see any omission and error in responses. The data was entered in excel and re-checked with original responses for any data entry error. The data was loaded into SPSS

package and univariate analysis was done. The detailed descriptive statistics is given in Annexure V.

A total of 139 filled-in questionnaires were received from 139 respondents from 10 upstream oil organizations. The responses to various questions varied from 120 to 139. Coding and classification of data was not required as responses are in quantitative form on a likert scale from 1-6 and no grouping was envisaged. There was another section of qualitative data on usage of enterprise performance management system used, its ranking by the respondents, and periodicity of measurement in each organization. The qualitative data was to see that respondents are representative of population in terms of managerial level, experience etc.

4.7.1 Univariate Analysis of Macro Variables

The result of univariate analysis of independent macro variables of EPMS is presented in Table 4.6 and Figure 4.3. The value of standard deviation indicates the dispersion around mean and the higher value means larger variations in range of opinions of respondents. The mean, on 6-point scale, are in the range of 3.77 to 4.53 and standard deviation ranges from 0.80 to 1.18, which gives enough confidence in mean values.

Table 4.6: Descriptive Statistics for Independent Macro Variables
(6-point scale) N=139

S. No.	Variables	Mean	Median	Std. Dev.
1	Strategy Planning (SP)	4.53	4.50	0.80
2	Strategic Flexibility (SF)	4.47	4.54	0.77
3	Strategy Implementation (SI)	4.35	4.50	0.83
4	EPMS Design (SM)	3.82	3.87	1.00
5	Performance Reporting and Feedback (PR)	3.85	4.00	1.18
6	Information System Flexibility (IF)	4.27	4.29	0.92
7	EPMS Implementation Issues (MI)	3.77	4.00	1.06

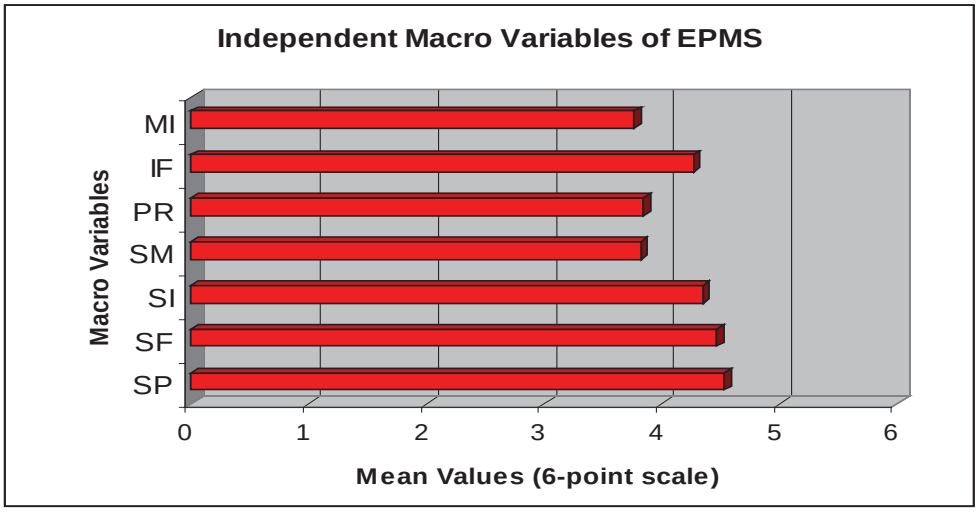

Figure 4.3: Mean Values of Independent Macro Variables

From Table 4.6 and Figure 4.3, it is seen that among the independent macro variables, organizations emphasize more on strategy planning, strategy implementation, strategic flexibility, and information system flexibility for EPMS.

The univariate analysis of dependent macro variables of effectiveness of EPMS is presented in Table 4.7 and Figure 4.4.

Table 4.7: Descriptive Statistics for Dependent Macro Variable (6-point scale) N=139

S. No.	Variable	Mean	Median	Std. Dev.
1	EPMS Effectiveness	4.06	4.24	0.90

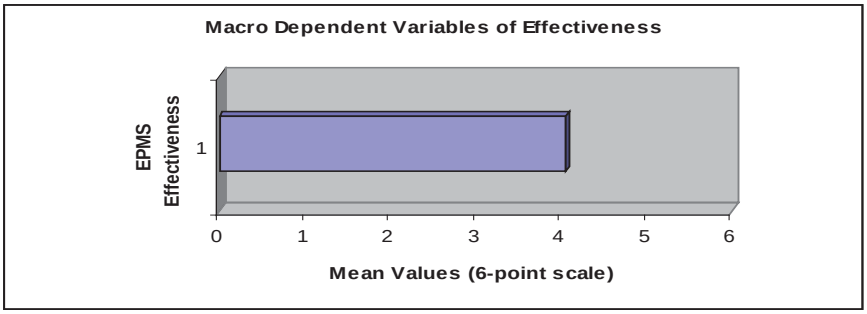

Figure 4.4: Mean Value of Dependent Macro Variable of EPMS Effectiveness

It is evident from the Table 4.7 and Figure 4.4 that mean and median are close to normal distribution and greater emphasis is being placed on dependent macro variable EPMS effectiveness (mean 4.06).

4.7.2 Univariate Analysis of Micro Variables

The univariate analysis of independent micro factors of EPMS is portrayed in Tables 4.8 and Figure 4.5. The mean values are in the range of 3.42 to 4.71. There is high spread around mean value as standard deviations are ranging from 0.82 to 1.40.

Table 4.8: Descriptive Statistics for Independent Micro Variables (6-point scale) N=139

S. No.	Variables	Mean	Median	Std. Dev.
	Strategy Planning			
1	Vision and Mission Clarity (SP1)	4.71	4.67	0.82
2	Setting of Strategic Goals (SP2)	3.96	4.00	1.20
	Strategic Flexibility			
3	Impact of Globalization/ Liberalization (SF1)	4.60	4.80	0.90
4	In-house Capabilities (SF2)	4.50	4.67	0.98
5	External drivers (SF3)	4.32	4.33	1.01
6	e-Business Impact (SF4)	4.54	5.00	1.09
	Strategy Implementation			
7	Alignment with Operational Goals (SI1)	4.34	4.57	0.87
8	Resources Allocation (SI2)	4.35	4.67	0.93
	EPMS Design			
9	Selection of Dimensions and Measures (SM1)	3.85	4.00	1.03
10	Customised EPMS (SM2)	3.42	4.00	1.40
	Performance Feedback			
11	Performance Reporting and Feedback (PR1)	3.85	4.00	1.18
	Information System Flexibility			
12	EPMS Functionalities (IF1)	4.27	4.40	0.97
13	IT Flexibility (IF2)	4.26	4.50	1.05
	EPMS Implementation Issues			
14	Effective EPMS Implementation (MI1)	3.78	4.00	1.06
15	Top Management Support (MI2)	3.69	4.00	1.19
16	Quality of Data Flow (MI3)	4.09	4.00	1.21

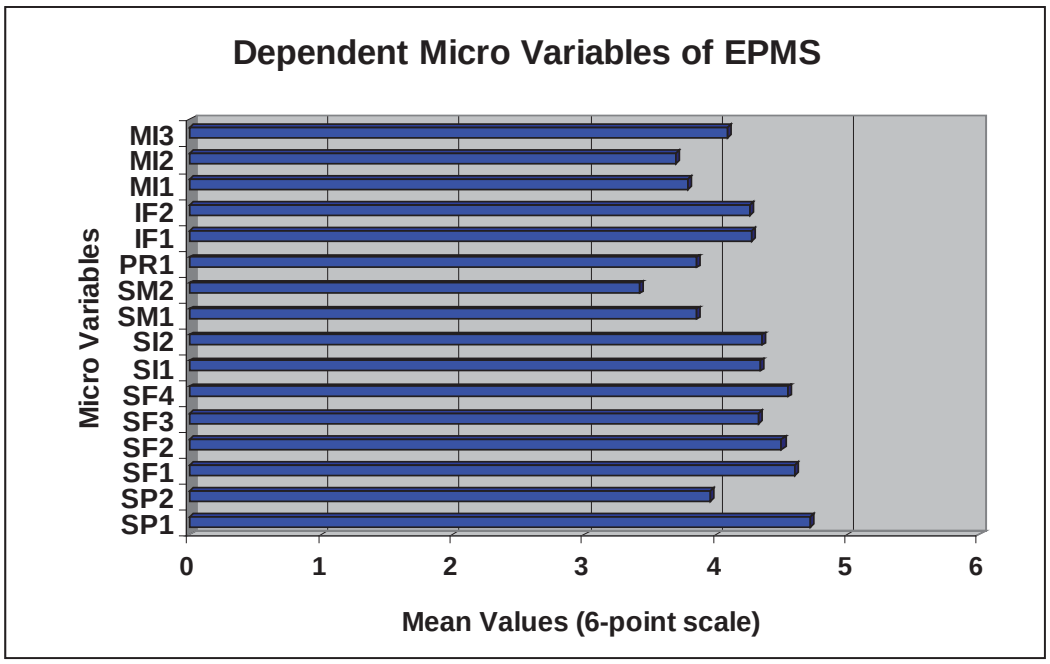

Figure 4.5: Mean Values of Independent Micro Variables

From Table 4.8 and Figure 4.5, it is seen that all independent micro variables/factors, have mean value more than 3.69, except Customised EPMS (3.42). It implies that all the above factors are contributing to EPMS effectiveness in the organization. There is more emphasis on vision and mission clarity, alignment with operational goals, resource allocation, impact of globalization/ liberalization, in-house capability, external drivers, e-business impact, EPMS functionality, IT flexibility, and quality of data in the organisations under study. This is in-line with independent macro variables result given in Table 4.6.

The univariate analysis of dependent micro variables of effectiveness of EPMS is given in Tables 4.9 and Figure 4.6. The mean values are more than 3.90 and spread around mean value is high (standard deviations ranges from 0.82 to 1.40). All six micro variables are measuring EPMS effectiveness in the

organization, though there is more emphasis on financial and customer perspectives.

Table 4.9 : Descriptive Statistics for Dependent Micro Variables
(6-point scale) N=139

S. No.	Variables	Mean	Median	Std. Dev.
1	Strategic Alignment (ESA)	3.92	4.00	1.12
2	Strategic Monitoring (ESM)	4.02	4.33	1.09
3	Financial Perspective (EFP)	4.26	4.40	1.13
4	Customer Perspective (ECP)	4.19	4.40	1.33
5	Internal Business Process Perspective (EBP)	3.98	4.10	0.96
6	Learning and Growth Perspective (ELP)	4.07	4.14	0.89

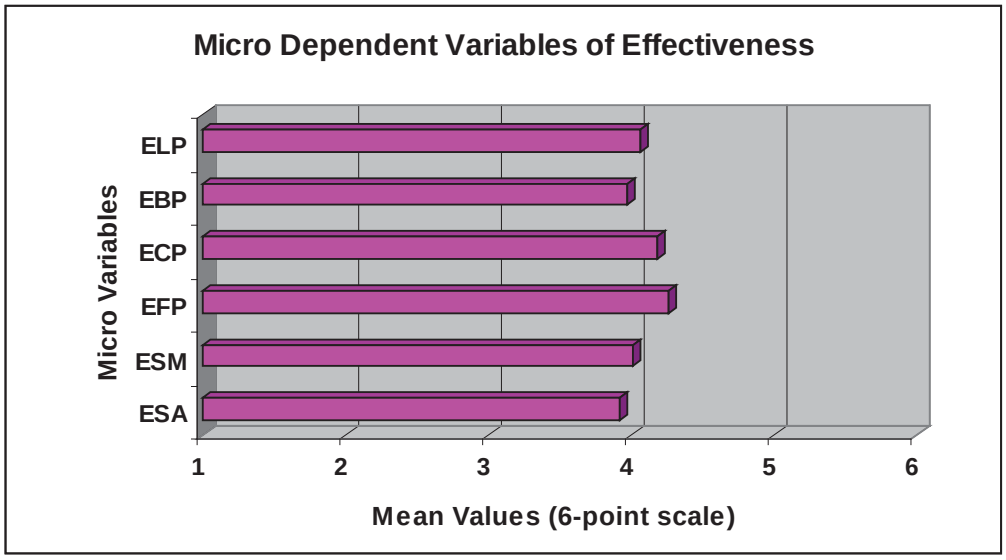

Figure 4.6 : Mean Values of Dependent Micro Variables

4.8 Concluding Remarks

In this chapter, the process of questionnaire design, validation, administration, and data processing has been presented. The questionnaire, after having been designed to measure independent and dependent variables of enterprise performance management system effectiveness, has gone through a rigorous validation process. The questionnaire has been administered for data collection from the respondents from upstream oil industry in India. The principal

component factor analysis for construct validation and univariate analysis are presented and discussed in this chapter. The bivariate and multivariate analysis of data collected through survey is presented in next chapter.

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