CHAPTER – 4
RESEARCH METHODOLOGY

The previous chapter dealt with the scope and objectives of the research along with the conceptual research framework and hypotheses. This chapter describes the research methodology adopted in the study, covering the research design to answer the research questions raised in the study, research instrument and the sources and approaches of data collection. It incorporates the pilot study, sample size determination and sampling methods followed. It sets out the specific statistical techniques adopted for data analysis and finally presents the profile of the respondents and their organizations.

This chapter is divided into the following sections:
Section 4.1 Describes the research design for the study
Section 4.2 Variables Operationalization
Section 4.3 Describes the sources from which the data was collected
Section 4.4 Explains the survey instrument developed to measure the variables included in the model
Section 4.5 Discusses the pilot study
Section 4.6 Presents the mode of data collection and sampling methods
Section 4.7 Lists the types of statistical techniques adopted to test hypotheses
Section 4.8 Sets out the limitations of the present research study
Section 4.9 Presents the profile of the respondent and their organizations

4.1 Research Design
Research design entails the conceived plan and structure of investigation to ensure that evidence obtained through research provides unambiguous answers to the research questions raised in the study. The focus of this research is to increase understanding about the significance of key factors that impact the competitive marketing performance (CMP) of firms. The research approach consisted of six phases: literature review and hypotheses setting, initial validation of research model, development of the questionnaire, identification of research sample, administration and evaluation of the questionnaire and hypotheses testing and conclusions. The unit of
analysis was the downstream supply chain in manufacturing companies and in each company; managers across functions (see Section 4.8) were the respondents. The study has adopted single cross sectional survey research design.

4.2 Variables Operationalization

The variables for this study were operationalized based on prior research in performance measurement in IT enabled supply chains that had established scales for these constructs and from identifying them through literature review.

The individual constructs for IT Advancement, IT Alignment and Supply chain capabilities were drawn from Wu et al (2006), Kim et al (2006) and Li et al (2006). The items for the constructs Extent of IT use was adapted from Anderson and Segars (2001) and for Competitive Marketing performance from Venkataraman and Ramanujam (1986) and Green and Whitten (2008). The items in the operational benefit construct were identified from Beamons (1999), Gunasekaran et al (2001 & 2004) and Fawcett et al. (2008). The items in the competitive business environment and strategic marketing benefits were identified from the articles in the literature review chapter and also based on discussion with industry experts. The items used in the questionnaire are set out in the Appendix A.

4.3 Data Sources

Primary data based on responses from downstream supply chain managers from Indian manufacturing companies has been the source of data for this study. A survey type questionnaire was adopted to accommodate the broad and detailed range of hypothesis. This empirical study was done with reference to manufacturing companies in India.

The primary respondents of the study are supply chain managers. However, it was observed in personal visits for the pilot study that many firms did not have supply chain managers. In many firms, supply chain managements is still seen as the domain of purchase and logistics and are still conducting supply chain activities either as a procurement or logistics function. Therefore in the absence of supply chain managers, particularly downstream supply chain managers, the sample respondents were
sales/marketing managers, logistics managers, operations managers, production managers and corporate executives connected with supply chain activities.

4.4 Survey Instrument

In keeping with the scope of the research framework, a comprehensive questionnaire was designed to capture the responses of respondents on the perceived operational and marketing benefits and the marketing performance of their organizations. The responses were measured using a 5-point Likert Scale for statements relating to the Business Environment, IT advancement, IT alignment and Supply chain capabilities. Extent of use/benefits, were measured with a 5 point scale (1 indicating minimal extent use /significance and 5 indicating extensive use/significance).

In developing measures, the current study adapted existing scales from the literature wherever possible as stated in Section 4.2. Some scale development was necessary for the constructs Competitive Business Environment, Operational Benefits and Strategic Marketing Benefits. In drawing up a scale for each construct, the procedures suggested by Churchill (1979) and DeVellis (1991) were used. First the domain of the construct was clearly defined delineating what would be included in and excluded from the definition. (For example downstream operational benefits implied purchase related metrics were to be excluded). Second, the literature was searched to locate the relevant scales available for the current study. Existing scales were adopted in the study wherever possible, and new scales were adapted from literature.

Multiple items were used for each construct to increase reliability. Then the developed instrument was examined and vetted with experienced SCM researchers and practitioners before it was pre-tested in a pilot study. As a result of pre-test some scales and items were modified for better comprehension by respondents.

The final survey questionnaire found in Appendix A consists of four sections:

SECTION A – The organization’s business environment
SECTION B – The organization’s investment in Information Technology
4.5 **Pilot Study**

A pilot survey was conducted to assess the appropriateness of the questionnaire by mailing it to supply chain professionals from the database of the CII Institute of Logistics. The respondents were asked to fill out the questionnaire where quantitative responses were measured using a five-point scale. Forty-eight responses were collected through mail and personal visits. Appropriate changes to the questionnaire-content were done, based on the responses and interactions during personal visits.

The data collected was subjected to statistical analysis. The results of reliability analysis confirmed the internal consistency of the scales adopted and gave the desired results to continue with the main study.

4.6 **Data Collection**

This study is based on the sampling frame criteria obtained from Prowess; the leading corporate financial database in India maintained by Centre for Monitoring Indian Economy (CMIE) which is extensively used by academic researchers as well as practitioners in India. 1615 companies across various industry segments in India have an asset base of Rs.500 crores and above and represent 7% of the total companies on the database. (Information obtained from CMIE Prowess Data Base, accessed on June 17th 2009) which is used as the sampling frame for this study. It was opined by SCM academic researchers and practitioners during the pilot study that such large sized companies would have gone in for extensive investments in Information Technology in the downstream supply chain. Out of the 1615 companies, 975 companies were in manufacturing and the rest were from the service industry.

4.6.1 **Minimum Sample Size**

The sample size was calculated using the formula  

\[ N = \frac{Z^2 \cdot p \cdot (1-p)}{e^2} \]

Where \( N \) = Sample Size  

\( Z \) = Standard Normal Distribution Value for the 95% Confidence Level
P = Restricted population for the study (Companies with asset base over Rs. 500 crores – 7% of total companies in India (CMIE database)
q = 1 - p.
The sample size was therefore arrived at as:
\[ N = \frac{(1.96)^2 \times (0.07) \times (0.93)}{(0.03 \times 0.03)} = 278 \]
Estimated incomplete responses 15% = 42
Total = 320

4.6.2 Sampling Method
Two stage and simple random sampling method was adopted. Out of the 1615 companies with assets of Rs. 500 crores and above, (identified from CMIE database), 975 of them were manufacturing companies. The questionnaire was deployed primarily through a web survey and the link emailed to managers randomly in 730 manufacturing companies. There are numerous advantages of web surveys (Kaye and Johnson 1999; Sills and Song, 2002) – low costs and fast response are the major ones. Yet, low response rates are cautioned by researchers (Crawford, Couper and Lamias, 2001; Sills and Song 2002). A mail survey was also administered to support the web survey.

With the concerted efforts of combined e-mails, mails phone calls and personal visits, a total of 320 responses were obtained from the managers. Of these 13 responses were discarded for being incomplete. The 307 complete responses were from managers in 226 companies (23% of companies in the sampling frame of 975 companies), belonging to eight different manufacturing industry segments.

4.6.3 Period of Research and data collection
This research on the IT impact in the downstream supply chain has been undertaken in the period 2005 to 2010. The data has been collected from managers working in Indian companies in the manufacturing sector during the period October 2009 to February 2010.

4.7 Statistical techniques used in the study
The independent variables are business environment, extent of IT usage, IT advancement, IT alignment and supply chain capabilities. The dependent variables are
operational benefits, strategic marketing benefits and competitive marketing performance. Since, the proposed theoretical model involves dependent variables which become independent variables in subsequent relationships; it gives rise to the interdependent nature of a structural model. The researcher’s choice has therefore been to use Structural Equation Modeling (SEM) since this technique estimates multiple interrelated dependence relationships simultaneously. Statistical Package for Social Sciences SPSS18 and Analysis of Moment Structures AMOS 16 were the software packages used for analysis of data. Factor analysis, Multiple regression and Anova were also used to test the hypotheses. Multi dimension scaling (MDS) was used to analyze the responses for IT objectives.

Reliability and validity of all the variables was examined by computing Cronbach’s alpha coefficient of reliability, and through Confirmatory Factor Analysis in SEM. Hypotheses 1 to 7 were tested using the Structural Model in SEM. Hypothesis 8 and the sets of Hypotheses 9- 16 were tested using regression analysis. Finally canonical correlation was employed using NCSS 2007 statistical package, to study the interrelationships among the multiple dependent variables (in Competitive Marketing Performance) and multiple independent variables (in Operational Benefits and Strategic Marketing Benefits).

4.8 Limitations of the study

This research has extended the past research by focusing on the downstream supply chain from the seller perspective, building on past theoretical and empirical studies. Although this research has found that there has been a favourable impact of IT investments in the downstream supply chain on competitive marketing performance and pointed out the implications for managers and academicians, it has some limitations which are described below. The examination of these limitations will assist future researchers to overcome such problems.

First, due to the limited number of observations (307), the revalidation of the model through split run tests or retaining a holdout sample to reassess the model could not be carried out in the research. This needs to be addressed in future research.
Second, the data collection in this study was limited by resource constraints. The effective response rate from web survey was only 14% and the response rate could be increased only by phone calls, mails and personal contact. A better response rate could provide a better platform for insightful findings and implications from the study. Top management support is needed to get more number of responses from organizations.

Third, in this research, individual respondents were from marketing, sales, and distribution, logistics and operations functions. They were asked to respond to complex SCM issues dealing with all participants in the downstream supply chain. A single person cannot have a holistic view of the supply chain and asking responses from single respondents in a particular function may generate some measurement inaccuracy, for instance strategic marketing benefits may have been inaccurately assessed by logistics function respondents.

Fourth, this study is limited to manufacturing industries. This could limit its generalizability of results to the service sector for example. Future research can extend/replicate the study for other industry types to enhance generalizability.

4.9 Sample characteristics of the respondents and organizations

This section will discuss sample characteristics in terms of respondents who have responded to the survey questionnaire.

4.9.1 Job function

33% of the respondents were from the distribution/logistics function. Managers working in Marketing/Sales were 28% of the respondents. 16% of the respondents belonged to the supply chain area, 4% belonged to the manufacturing area and 8% to the Operations area. 11% of the respondents were from corporate office from across the functions (See figure 1 in Appendix D). The distribution of respondents implies that the responses were received from executives with relevant expertise in the area of downstream supply chain operations.

4.9.2 Work experience of respondents

44% of the respondents have indicated that they have been with the organization over 15 years, 27% have indicated that they have worked between 10 to 15 years and
17% state they have been employed by the organization for 5 to 10 years. Managers with work experience of less than 5 years form only 12% of the sample respondents (See figure 2 in Appendix D). Since majority of the respondents (71%) have stayed in the organization for more than 10 years their perceptive responses can be relied upon and the data collected through the questionnaire is reliable.

The following sections presents the sample characteristics of the organizations in which the respondent managers are working.

4.9.3 Primary manufacturing strategy

73% of the organizations use ‘make-to-stock” as their primary manufacturing process, while 14% assemble to order and 13% “make to order” (See Figure 3 in Appendix D).

4.9.4 Industry classification

The 307 responses have come from 225 companies across different industry segments engaged in manufacturing in India with no one sector dominating the sample respondent industry profit. The broad industry classification of the respondents is presented here.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>52 (17%)</td>
</tr>
<tr>
<td>Oil and gas</td>
<td>23 (8%)</td>
</tr>
<tr>
<td>Chemicals</td>
<td>34 (11%)</td>
</tr>
<tr>
<td>Automotive</td>
<td>49 (16%)</td>
</tr>
<tr>
<td>Electrical</td>
<td>26 (8%)</td>
</tr>
<tr>
<td>Durables</td>
<td>51 (16%)</td>
</tr>
<tr>
<td>FMCG</td>
<td>60 (20%)</td>
</tr>
<tr>
<td>Textiles</td>
<td>12 (4%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>307</strong></td>
</tr>
</tbody>
</table>

Figure 4 in Appendix D depicts the responses have thus been received from a cross section of industries in the manufacturing sector.
4.9.5 Number of employees

Figure 5 in Appendix D shows that 19% of the responses were received from organizations with employees between 1000-2500, 32% of the organizations had employee strength of 2500-5000 and 49% of the organizations employed more than 5000 workers. The respondent companies were therefore fairly large sized companies across the country.

4.9.6 Manufacturing locations

Of the 307 respondents, 50 (16%) have reported having their manufacturing location in a single location and 257 (84%) have reported having multiple locations (See Figure 6). Organizations with multiple locations had reported the number of locations where their manufacturing activities were being carried out. Of the 307 respondents, 71 (23%) had two locations, 98 (32%) had 3-5 locations, 42 (14%) had 6-10 locations, 29 (9%) had 11-20 locations and 17 (6%) had more than 20 locations for manufacturing (See figure 7 in Appendix D).

4.9.7 Number of Stock keeping units (SKUs) handled

The respondents had indicated the number of stock keeping units they carried. 14% (43) of the respondents had to maintain inventory of 1-10 SKUs, another 14% (43) had 11-50 SKUs, 6% (18) carried 51-100 SKUs, 13% (41) had 101-200 SKUs and 53% (162) had more than 200 SKUs to be managed (See figure 8 in Appendix D).

4.9.8 Distribution channels

64% (197) of the respondents said that their organization had an indirect channel of distribution and 36% (110) said that they had a direct channel of distribution to reach their end consumers. Of the 197 respondents who operated through indirect channels 126 (64% of total 197) have reported that they deal through wholesalers/distributors and 71 (36% of total 197) have said they sell to retailers directly. Among the companies with direct distribution channels 83 (75% of 110) sold directly to manufacturers and 27 (25% of total 110) sold directly to consumers. Figures 9 and 10 in the Appendix D represent the two channels graphically.

The above three sections fairly indicate the complexity of managing the downstream supply chain with a majority of the companies having manufacturing in
multiple locations, having large SKUs to manage and therefore having to reach their end consumers through long distribution channels with intermediaries like distributors and retailers, with only 8% selling directly to end consumers. Production system complexities, multiple locations for manufacturing and sourcing, handling of large stock keeping units and long distribution channels create supply chain complexities which have led to the scenario of Indian companies making substantial investments in IT in recent times to better manage the downstream supply chain.

4.9.9 Usage of Information Technology

The respondents have indicated their years of implementation of four key software viz. ERP, CRM, SCM and Real time Electronic linkage with their branch offices. 212 (69%) respondents indicated they have implemented ERP for more than 3 years, 85 (28%) have implemented CRM for more than 3 years, 138 (45%) have implemented SCM for more than 3 years and 204 (66%) have implemented electronic linkage with their branch offices. (See Figure 11 in Appendix D for the years of implementation). This indicates that many of the respondent organizations have good experience with the usage of IT and the data submitted by them can be relied upon to measure the IT impact on Competitive Marketing Performance.
REFERENCES


