CHAPTER IV

DESIGN OF RESEARCH

4.0 Introduction

The purpose of this chapter is to provide the rational for adopting scientific method as a source for deriving knowledge about the problem under study. Therefore, the research rigour followed in such pursuit has been elaborated in the following sections.

Cohen, Manion and Morrison (2000) state that methodology in research refers to a systematic way of gathering data from a given population so as to understand a phenomenon and to generalise facts obtained from a larger population. Methodology embraces the research design, population, instruments used to collect data, ethical considerations, data analysis and its interpretation. Methodology therefore helps the researcher and the reader to understand the process of the research thus giving it scientific merit.

Van De Ven and Johnson (2006) examine three related ways in which the gap between theory and practice has been framed. One approach views it as a knowledge transfer problem. Practitioners fail to adopt the findings of research in fields, such as management because the knowledge is produced in a form that cannot be readily applied in practical contexts.

A second approach views knowledge of theory and practice as distinct kinds of knowledge. Each reflects a different fundamental approach for addressing different questions. To say that the knowledge of theory and practice are different is not to say that they are in conflict, or that they substitute for each other; rather, they complement one another.

This leads to a third view – namely, that the gap between theory and practice is a knowledge production problem which questions the traditional mode of research practised in business and professional schools and has led to the proposal that a key defining characteristic of management research is its applied nature. Utilizing all of these approaches, this research is undertaken.

As research method focuses on the background of research and enlists the steps followed in carrying out the study scientifically, this chapter presents the details of the study area, research design, sampling procedures, sampling frame, methods and tools of data collection, data collection procedure, the standard measures used, data analysis and the statistical tests used for testing of the hypotheses.

4.1. The Hypotheses

Supply Chain Management deals with the management of material, information, and financial flows in a network consisting of vendors,

manufacturers, distributors, and customers (Anupindi and Bassok 1999). Exchange of flows can be regarded as a routine transaction, occurring between any pair of suppliers and buyers in the network. Ideally, the quantity and pricing decisions in the supply chain would be made by a single decision maker who has all information at hand. Researchers in Supply Chain Management generally refer to this situation as the centralized or integrated supply chain and call the single decision maker the integrated firm. Respectively, a supply chain is called decentralized if the network consists of multiple decision makers having different information and incentives.

Due to globalization and outsourcing, decentralized supply chains are prevalent today. Outsourcing of production, for example, automatically spreads decision rights among multiple decision makers. And often, even highly vertically integrated firms decentralize decision rights to set incentives and structure the flow of information. Thus, the supply chain management as a practice is assumed to be at variance across all types of firms. Therefore, it is hypothesized that,

H_o1. There is no variation in Supply Chain Management agreement Practices according to type of outlets.

There has been a massive surge of interest in supply chain management (SCM) due to its innovation approach to business and

competitive advantage. Large companies are well recognized the benefits of SCM, but small and medium enterprises (SMEs) are lagging behind in appreciating how integrated supply chain drives remarkable changes in business processes and work with positive results in better quality services, cost reduction and efficiency (Thoo et.al,2012).

Supply chain management (SCM) systems have many benefits to firms, including minimizing the bullwhip effect, maximizing the efficiency of activities, reducing inventories, lowering cycle times, and achieving an acceptable level of quality. The key to realizing the benefits is the sharing of information among members of supply chain network via SCM systems (Qing, 2013)

A survey of more than 200 firms and the results show that firms tend to adopt SCM systems if they fit their major business processes and that there is a network externality to adopting such systems. Moreover, the aforementioned two forces interact with each other as the benefits of SCM system will be amplified in the supply chain network as the number of system users increases. Likewise, the problems of SCM system caused by the misfit between SCM system and major business processes will be exacerbated as the number of users in the network increases (Qing,2013). Thus, the adoption of

SCM has sufficiently proved be beneficial to a varied group of industries and their companies, it is hypothesized that,

H_o2. There is no variation in Supply Chain Management Adoption practices according to type of outlets.

Organizations began to realize that it is not enough to improve efficiencies within an organization, but their whole supply chain has to be made competitive. The understanding and practicing of supply chain management (SCM) has become an essential prerequisite for staying competitive in the global race and for enhancing profitably (Childhouse, et.al, 2003; Moberg, et.al, 2002 ; Power , et.al, 2001; Tan et.al, 2002).

Many organizations have begun to recognize that SCM is the key to building sustainable competitive edge for their products and/or services in an increasingly crowded marketplace. The concept of SCM has been considered from different points of view in different bodies of literature such as purchasing and supply management, logistics and transportation, operations management, marketing, organizational theory, and management information systems.

Various theories have offered insights on specific aspects or perspectives of SCM, such as industrial organization and associated

transaction cost analysis resource-based and resource-dependency theory competitive strategy , and social–political perspective.

However, despite the increased attention paid to SCM, the literature has not been able to offer much byway of guidance to help the practice of SCM. This has been attributed to the interdisciplinary origin of SCM, the conceptual confusion, and the evolutionary nature of SCM concept. In literature, SCM practices are of various dimensions namely, i) strategic supplier partnership, ii)customer relationship, iii) level of information sharing, iv) quality of customer relationship, v) level of information sharing, vi) quality of information sharing and postponement.

As a result of such gap, there is a need to understand SCM practices in the FMCG companies of the area of study adopted in this study. Therefore, it is hypothesized that,

H_o3. There is no variation in Supply Chain Management practices according to level of functioning of respondents.

As we witness the way SCM is becoming a rage across the world, there is a need for more widespread adoption of supply chain management among firms, particularly in FMCG However, due to rising costs, there is an increasing trend to outsource lower function manufacturing processes to lower-cost locations but to retain high-

skill functions (such as R&D). This trend, together with other factors such as its peripheral location, suggests that supply chain management is critical. Therefore, the adoption and diffusion of such practices all depend upon the levels of management namely the senior, middle and the junior levels.

Top-down diffusion is a push by an authority to mandate the adoption of a specific solution it perceives as favourable. At the micro level, top-down diffusion occurs when senior management within an organization (irrespective of its size and location within the supply chain) mandates specific solutions to adopt or workflows to implement. Through these *coercive* pressures, technologies, processes and policies diffuse down the authority chain and – if coupled with education and incentives – are adopted (*DiMaggio, 1983)*.

Bottom-Up diffusion refers to the grass-root adoption of technologies, processes or policies without a coercive mandate. At the macro level, this occurs when small organizations or those near the bottom end of the authority/supply chain adopt an innovative solution or concept; the solution slowly becomes a common practice; and slowly diffuses up the supply/authority chain. Similarly at the micro level, bottom-up diffusion occurs when employees near the bottom end of the authority chain introduce an innovative

solution and – over time – this solution is acknowledged and then adopted by middle and senior management.

Although these two dynamics are easily noticeable, a third dynamic lies hiding in plain sight: the middle-out diffusion pattern. Middle-out diffusion applies to all those organizations and individuals occupying the median space separating the 'bottom' from the 'top'. At the micro organizational level, team managers, department heads and line managers push what they've personally adopted up and down the authority chain. At the macro market level, middle-out dynamic applies when mid-sized organizations influence the adoption of smaller organizations down the supply chain. They also influence or actively encourage larger organizations, associations and authorities up the supply/authority chain to adopt and eventually standardise their solution (*Cao, . and Wang., 2014)*. In view of such dynamics, there is a need to understand how SCM adoption practice is varying across FMCG companies as responded by their managers occupying various levels from top to the bottom. Therefore, it is hypothesized that,

H_o4. There is no variation in Supply Chain Management adoption practices according to level of functioning of respondents.

It is a well-accepted fact that supply chain management (SCM) has become a very prominent concern for both large and small companies as they strive for better quality and higher customer satisfaction (Mentzer et al. 2000; Chopra and Meindle, 2001). According to a recent Deloitte Consulting Survey, 91 percent of North American manufacturers rank supply chain management as very important or critical to their companies' success, yet only 2 percent of the manufacturers in the same survey rank their supply chains as world-class (Thomas 1999; Gulisano, 2000).

Supply chain management is a frequently encountered phrase these days, as managers strive to improve factory performance. The trouble is that all too often the real meaning is lost. Instead, a casual observer might interpret the activities at the factory as evidence of an intensive effort to improve supplier management. Good supplier management, while praiseworthy, does not constitute good supply chain management without a concurrent effort to manage the rest of the aspects of delivering products to customers.

Measuring effectiveness of supply chain management is wrought with many methodological limitations. The objective method of weighing the return-on-investment to the subjective method of assessing the perceptions of the SCM managers and their beneficiaries has their own advantages and disadvantages.

Successful firms found that integrated behavior between both the customer and supplier must exist and be a focal point of companies if they wish to remain competitive. In fact, integrated behavior is the most useful and contributing factor to their supply chain management effort. Sharing information with all levels of the supply chain is critical. The third factor and critical activity in supply chain management is cooperation. Cooperation and collaboration must occur throughout the supply chain, from planning to controlling activities and evaluating the performance of the chain. Supply chain management activities must be accomplished systematically, and with clear goals and expectations. Integration of processes of supply chain activities is essential to planning, sourcing, making, delivering, and consuming of specific goods or services (Gryna 2001). Building and establishing partnerships or alliances that will last is one of the most critical requirements to successful supply chain management. Sharing channel risks and rewards should be a long-term commitment because it is important for focus and teamwork among all members along the supply chain and results in a competitive advantage (Mentzer 2001).

Reducing response time across supply chain activities, making products easily adaptable to various markets, utilizing various quality suppliers from around the world through outsourcing of

products and services, producing quality goods or services, using ISO 9000 certifications or company specific standards, conducting accurate forecasting, fulfilling all orders in a timely and efficient manner, and flexibility in anticipating change in demand and supply were among the factors contributing to successful supply chain management projects (Wisner and Choon 2000; Mentzer et al. 2000; Mentzer 2001). Thus, effectiveness of orgnisations using SCM practices have been known for their mixed reactions, it is realized that it is worth understanding the effectiveness of SCM in various FMCG outlets. Therefore, it is hypothesized that,

H_o5. There is no variation in Supply Chain Management effectiveness practices by respondents according to type of outlets.

Studies regarding logistician competency have received considerable attention in the logistics literature (Thai, Cahoon & Tran, 2011; Borsch, 2011; Wu & Hou, 2010; Stank, Davis & Fugate, 2005). In logistics, such interest might be attributed to the belief that logistician competency is formed from several dimensions, namely a business, logistics and management (BLM) framework (see Murphy & Poist, 2007; 2006; 1991). Previous studies have used the BLM framework to study the competency of logistics managers (Thai et al., 2011; Esper, Defee & Mentzer, 2010; Razzaque & Sirat, 2001).

SCM managers competencies need to be effective and they can be explored through two dimensions; firstly, competencies as behavioral manifestations of talent, and secondly, competencies in a holistic theory of personality. In relation to logistician competency, logisticians" knowledge and skills are perceived as important factors for logistics firms to stay competitive in the 21st century (Chapman, Soosay & Kandampully,2002). In view of such, it is uniformly understood that the SCM managers will work towards effectiveness of SCM with all their competences. However, their contributions to effective SCM may vary according to their level of functioning. Thus, it is hypothesized that,

H_o6. There is no variation in Supply Chain Management effectiveness By respondents according to level of functioning

4.2 Study Area

Hyderabad city is known as one of the most emerging cities in India. A city is known for Nizam ruler being the king, and to the unique claims in the recent times by both Andhra Pradesh and Telangana states. It is known for its 400 years of tradition and heritage on one hand and the ultramodern infrastructure with technology parts,

knowledge hubs etc. there is a mushroom of FMCG outlets in this city owing to its population explosion.

With the penetration of their products reaching saturation levels in many urban markets, FMCG companies had to turn towards rural areas in order to sustain revenue growth and profitability. Since the disposable income in the hands of rural people had been increasing in the late-1990s and the early 21st century, it made sense for companies to focus their energies on this segment.

This study is carried out in the twin cities of Hyderabad and secunderabad in select FMCG outlets. Supply chain managers from 116 outlets have responded to a structured questionnaire consisting of standardized scales to measure SCM practices and SCM effectiveness. Using means, standard deviations and f-values, the null hypotheses are tested and the results are presented in the succeeding chapter.

4.3.Research Design

The researcher chose a survey research design because it best served to answer the questions and the purposes of the study. The survey research is one in which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group. In other words, only a part of the population is studied, and findings from this are

expected to be generalized to the entire population (Nworgu 1991:68). Similarly, McBurney (1994:170) defines the survey assessing public opinion or individual characteristics by the use of questionnaire and sampling methods.

Research design is the blue print of research work, which details the entire framework of research activities. There are various designs available. In this study Descriptive and Analytic Design is adopted. This design is considered most suitable for the Problem under study. Descriptive study is a fact-finding investigation process with adequate ability to describe the characteristics of the samples and help in analyzing various responses of subjects in relation to their profile. It is more specific as it focuses on particular aspects or dimensions of the problem being studied. It helps in gathering descriptive information and provides information for formulating more sophisticated studies (Zickmund, 2008; Cooper and Schindler 2009).

In this study the SCM managers' personal characters are described followed by their responses on SCM Practices and SCM Effectiveness. Further, SCM Practices and SCM effectiveness are analysed in relation to their personal characteristics. Thus Analytic and Descriptive Research Design is justified. The following are the SCM Practices studied in the present study.

4.4. Sampling Design

The target population is "the entire aggregation of respondents that meet the designated set of criteria" (Burns & Grove 1997:236). The target population of this study constitutes all the SCM managers across levels of functioning in the select FMCG outlets of the twin cities of Hyderabad and Secunderabad.

Sampling involves a process of selecting a sub-section of a population that represents the entire population in order to obtain information regarding the phenomenon of interest. A sample is a sub-section of the population, which is selected to participate in a study. There are two methods of sampling, one yields probability samples in which the probability of selection of each respondent is assured. The other yields non-probability samples in which the probability of selection is unknown (Polit & Hungler 1995:279).

The FMCG stores which are classified into various types were identified in the first place. Later, around 50 percent of outlets from each of the category have been decided to be the sample size. Details regarding sample frame and the sample size are presented in table 4.1. In all , 116 SCM functionaries designated as officers, supervisors and managers have responded to the structure questionnaire.

TABLE 4.1: SAMPLING DETAILS

		Designation			
Sno	Type of Outlet	Officer	Supervisors	Managers	Total
1	Chemists & Druggists	13	2	3	18
2	Personal Care Stores	5	7	5	17
3	Food and Beverages	8	3	9	20
4	Household Care	7	0	4	11
5	Supermarkets	4	4	3	11
6	Consumer Electronics	11	4	5	20
7	Others (Miscellaneous)	11	3	5	19
	Total	59	23	34	116

4.5. Methods and Tools of Data Collection

Data collection is "a systemic way of gathering information, which is relevant to the research purpose or questions" (Burns & Grove 1997:383). There are two methods of data collection namely primary and the secondary method. Through both methods have their respective advantages and disadvantages, they are considered in this study.

For the purpose of the study the researcher followed both the methods of data collection. Primary data was collected from the respondents who are the SCM officers/managers of retail outlets.

A structured questionnaire was prepared. It consists of three parts. Part A includes questions pertaining to the profile of respondents like age of the respondent, gender, experience of the respondent, basic qualification of the respondent, and the level of functioning of the respondent. Part B included a scale to measure SCM practices. Part D included a scale to assess the effectiveness of SCM in FCM companies. Details regarding the measures are mentioned in the following sections.

4.5.1 Measures

SCM practices scale :A 53-item scale developed by Renuka (2012) to measure SCM practices across two dimensions namely agreement and adoption of SCM practices has been adopted for this study. SCM agreement include, I. Coordination with supply chain partners i.e. suppliers and customers, II. Operational networking with suppliers and logistics service providers, III. Functional areas in joint action with suppliers and customers, IV. Mechanistic of SCM implementation, V. Sales planning and improving customer service, VI. Leanness of supply chain. Whereas SCM adoption include, I. collaborative planning, forecasting, customer service and relationship efforts, II. Operational networking with suppliers and logistics service provisions, III. Cross functionality of joint action with suppliers, IV. Strategic partnership and outsourcing in competitive

environment, V. Strategic supplier selection, evaluation and development. Each of the items was assessed with the help of likert's 5-point scale (where 5= strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree).

SCM Effectiveness: based on the suggestions of Borgström (2011), regarding measurement of SCM effectiveness, the following indicators of effectiveness of SCM has been identified. I) The Agility of a supply chain, ii) The Resilience of a supply chain , iii) The Reliability of a supply chain, iv) The Responsiveness of a supply chain, v) Supply chain costs decomposes into Assets, Expense, and Revenue. A 17-item scale has been developed exclusively for this study. Each of the items was assessed with the help of five-point scale (where 5=very effective, 4=just effective, 3=neutral, 2=less effective, 1= very less effective). Details of all the scales are presented in the following table.

TABLE 4.2: DETAILS OF SCALES EMPLOYED

S.No	Dimension	Conceptualisation	No. of Items	Alpha Coefficients
1	SCM Practices - Agreement Continuum	It is conceptualized as the extent to which the SCM functionaries perceived that there is a constant need for Coordination with supply chain partners i.e. suppliers and customers, through Operational networking with suppliers and logistics service providers, besides joint action with suppliers and customers in Functional areas with the objective of Sales planning and improving customer service, using Mechanistic SCM implementation resulting in Leanness of supply chain.	26	.93
2	SCM Practices – Adoption Continuum	It is conceptualized as the extent to which the SCM functionaries has adopted collaborative planning, forecasting, customer service and relationship efforts, through operational networking with suppliers and logistics service provisions, using Cross functionality of joint action with suppliers, and Strategic partnership and outsourcing in competitive environment, with Strategic supplier selection, evaluation and development.	27	.95
3	Effectiveness of SCM	It is conceptualized as the extent to which the SCM as a system of management has accomplished its purpose for which it was designed. Such purpose is expressed in terms of the Agility, The Resilience, The Reliability, The Responsiveness of a supply chain, and the Supply chain costs decomposes into Assets, Expense, and Revenue.	17	.74

Reliability relates to the precision and accuracy of the instrument. If used on a similar group of respondents in a similar context, the instrument should yield similar results (Cohen et al 2000:117). Accurate and careful phrasing of each question to avoid ambiguity and leading respondents to a particular answer ensured reliability of the tool.

The respondents were informed of the purpose of the interview and of the need to respond truthfully Based on the cronbach alpha coefficients of reliability, all the scales used in this study are highly reliable and internally consistent, qualifying for the further analysis of the data for the presentation of the results. However, the scale to assess effectiveness of SCM is developed exclusively for this study; further reliability analysis was carried out particularly, the item analysis (in which case the item-item and item-scale correlations were carried out). Results in this regard are presented in the following table.

TABLE 4.3: ITEM-ITEM, ITEM-SCALE CORRELATIONS

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	Overall Scale
V1	1	.554**	.412**	.402**	.256**	.253**	.251**	.434**	.382**	.402**	.221*	.207*	.283*	.303*	.229*	.274*	.201*	.467**
V2		1	.565**	.526**	.349**	.382**	.404**	.404**	.238*	.236*	.265**	.243**	.256*	.207*	.268*	.201*	.265*	.582**
V3			1	.509**	.434**	.356**	.329**	.440**	.215*	.295*	.272*	.211*	.215*	.246*	.229*	.230*	.204*	.538**
V4				1	.416**	.353**	.271**	.423**	.220*	.216*	.398**	.266**	.313**	.243**	.221*	.210*	.241*	.587**
V5					1	.343**	.590**	.348**	.208*	.349**	.295**	.339**	.292**	.400**	.263**	.253*	.234*	.627**
V6						1	.429**	.642**	.211*	.209*	.294*	.290**	.291*	.220*	.277*	.224*	.282*	.536**
V7							1	.478**	.234*	.286**	.249**	.349**	.226*	.329**	.207*	.292*	.219*	.615**
V8								1	.344**	.240**	.264**	.347**	.239**	.295**	.270*	.266*	.226*	.643**
V9									1	.698**	.680**	.651**	.523**	.658**	.529**	.436**	.320**	.670**
V10										1	.686**	.689**	.606**	.747**	.506**	.389**	.333**	.681**
V11											1	.658**	.653**	.736**	.641**	.468**	.322**	.741**
V12												1	.669**	.734**	.622**	.533**	.312**	.755**
V13													1	.722**	.535**	.486**	.242**	.637**
V14														1	.599**	.428**	.268**	.718**
V15															1	.569**	.309**	.618**
V16																1	.421**	.510**
V17																	1	.319**
Overall Scale																		1

From the table above, it is quite evident from all the items that their correlation coefficients are positive and statistically significant, indicating that all of these items are related to each other and therefore they are in agreement with each other for the purpose for which they are made. To be more specific, all of these seventeen items have inter-item agreement.

Further, as regards item-scale reliability analysis, it was found that all the seventeen items have yielded positive and significant correlation with the overall scale score indicating that all of these items are in unison capturing the essence of effectiveness of supply chain management in the FMCG outlets. The range of correlation coefficients is 0.31 to .75. The sum of item-scale correlations is 10.24. The average of correlation 0.60. Thus, in conclusion, it indicates that all these seventeen items attempt at capturing 60% of the effectiveness of SCM. The remaining 40 percent may be attributable to the exogenous variables which need to be further analysed in future research efforts. Interestingly, the cronbach alpha coefficient of the scale yielded a value of 0.74 as presented in table 4.2, indicate that the scale is highly internally consistent.

4.6. Data Processing

Data processing and analysis is "the systematic organisation and synthesis of the research data and the testing of research hypotheses, using those data" (Polit & Hungler 1995:639). It also entails "categorising, ordering, manipulating and summarising the data and describing them in meaningful terms" (Brink 1996:178).

Data collected from respondents has been entered in the computer with the help of a code book. The data was entered in a spreadsheet format. The coded data were processed and analyzed using Statistical Package for Social Sciences (SPSS) software. In order to examine the pattern of response to each of the independent and dependent variables under investigation, the data were divided into frequency distributions of certain variables were prepared and presented.

4.7. Statistical analysis

Statistics is the study of the collection, organization, analysis, interpretation and presentation of data.It deals with all aspects of data including the planning of data collection in terms of the design of surveys and experiments. When analyzing data, it is possible to use one of two statistics methodologies: descriptive statistics or inferential statistics. In this study, both descriptive and inferential statistics were used to test the hypotheses and for presentation of the results.

1. Descriptive Statistical Test like means and standard deviations were computed to present the degree of HRD Climate and HRD Practices prevalent in the Banking Sector.

2. In order to test the association of attributes chi square test was also computed.

3. With regard to the inferential statistics t-test was used. This t-test was used in order to find out the significance of the means difference on study variables using the formula.

$$t = \frac{\bar{x}_A - \bar{x}_B}{\sqrt{(SE_A)^2 + (SE_B)^2}}$$

Where:

$\bar{X}$= means of groups A and B, respectively, and

$$SE = \frac{SD}{\sqrt{N}}$$

N = Sample size of sample

4. Correlation analysis and Regression analysis was used in order to examine the relationship between the study variables like SCM practices and SCM effectiveness for testing of the hypothesis.

The following formulae were used; Correlation coefficient was computed with the help of the following formula to establish the

significance of relationships among study variables (SCM practices and SCM effectiveness).

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{N})(\sum Y^2 - \frac{(\sum Y)^2}{N})}}$$

Where x is SCM practice

Y is SCM effectiveness

xy is

5. Regression analysis was computed with the help of the formula for examining the independent or combined effects of independent variables (SCM practices) on the dependent variable (SCM effectiveness).

Y= (a+bx1+bx2+bx3.....bxn))

Where a= constant

b= standardized beta coefficient

x=independent variable

4.8. Scheme of the Report

The present study has been presented into seven chapters. Chapter I presents introduction. Chapter II presents a detailed note on the Indian Retail Industry : Retrospect And Prospects. Chapter III presents a detailed note on supply chain management, particularly

the literature review on supply chain management. Chapter IV deals with the design of the study. Chapter V presents the Results pertaining to the profile of the SCM functionaries from the select FMCG outlets and SCM practices ad SCM effectiveness. Chapter VI presents the Discussion related to findings, While Chapter VII presents the Findings, implications, recommendations and conclusions.

4.9. Summary

This chapter presented a detailed picture about the research method utilized for the collection of the data and for analysis of the data collected. Specifically, the research design which forms the backbone of the study has been elaborated, focusing on the sampling design, the methods and tools of data collection, the scales adopted and used in the study, the reliability details of the scale and the statistically design used in this study.