CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Overview

Research Design provides the blueprint of the research study and can be classified into two types namely exploratory research and conclusive research. The exploratory research is related to qualitative methods while conclusive research is related to quantitative methods. Conclusive research is further divided into casual and descriptive research. In this thesis, both the exploratory and conclusive research methods have been used, though exploratory research (qualitative) method has been used to a larger degree and used for the important part of the study. The exploratory research (qualitative) method was employed for surveys. Conclusive research (Quantitative) was used to identify the digital enablers responsible for increased operational efficiency and employee productivity in Indian Public Sector Retail Oil Outlets.

3.2 Rationale of the Study

India's economy is ranked third among all the economies of the world (Kaka, Madgavkar, Manyika, Bughin, & Parameswaran, 2014) and is currently the fastest growing economy with a large young growing population. India is expected to clock over 7% GDP growth rate (PwC, 2015) during the next five years as shown in Figure 3.1. The growth of economic activities is directly proportional to the rise in consumption of energy in the next few years (PwC, 2015). India is

ranked third among all the oil consuming nations (Economic Times, 2016). With the increase in population and growth of the Indian economy, the demand for oil consumption will increase significantly.

Figure 3.1: Projected GDP growth rate (%) of India vis-à-vis China (PwC, 2015)

It is predicted that India's demand for energy will rise to 1.24 billion tonnes of oil equivalent in 2025. The country accounts for 17.01 percent of the earth's population, however, it constitutes only 0.59 percent and 0.39 percent of proven oil and gas reserves respectively. It is ranked third among the countries in terms of energy imports. 29.9 percent of India's annual energy requirement is imported.

The country buys $179.9 billion annually worth of oil and gas which constitutes 39.9 percent of the total annual imports (Kaka, Madgavkar, Manyika, Bughin, & Parameswaran, 2014). It imports 80 percent of its oil, 18 percent of its gas and 23 percent of its coal (Tuli & Khera, 2014). It is estimated that by 2030, imports would rise to 52.9 percent of annual energy requirements thus making it among the topmost importers of energy (Kaka, Madgavkar, Manyika, Bughin, & Parameswaran, 2014).

Mckinsey identified 12 globally disruptive technologies, which include IoT that will impact India during the next few years as shown in Figure 3.2. In 2013, nine billion "objects" were joined through the internet. This number is estimated to

increase to around fifty billion to one trillion things by 2025 of which India would constitute between two billion to ten billion objects (Kaka, Madgavkar, Manyika, Bughin, & Parameswaran, 2014).

	Metric	Current estimates	Realistic aspiration for 2025
Mobile Internet	Mobile Internet penetration in India	~8–10%	50–60%
	Mobile Internet users in India	100–130 million	700–900 million
Cloud technology	Percent of SMEs with a Web presence	<10%	50–55%
	Number of SMEs that are potential cloud users	~2 million	~20 million
	Extent of cloud-based government services to citizens	Nascent	Virtually universal
Automation of knowledge work	Number of smartphone users (potential intelligent app users)	~60 million	700–900 million
	Nature of applications	Basic, such as online information and booking	Adaptive, across sectors such as agriculture, health, education
Digital payments	Number of retail electronic and card transactions per year	1.5 billion	12 billion
	Number of retail establishments accepting digital payments (% of total)	0.6 million (6%)	>6 million (>60%)
Verifiable digital identity	Share of India's population with Aadhaar unique identity	~50%	~100%
	Share of financial and non-financial transactions linked to verifiable digital identity	<1%	~100% for all transactions needing identity verification
Internet of Things	Number of connected devices globally	9 billion	>50 billion
	Potential number of connected devices in India	n/a	2–10 billion
Intelligent transportation and distribution	Penetration of smart grid technology in India	<1% of grid	60–80% of grid
	Number of cities in India with some form of smart transport	<5	At least 50 (all current Tier 1 and Tier 2 cities)
Advanced geographic information systems (GIS)	Scope of GIS assets in India	Basic satellite images of forests, ground-water, soil, minerals from multiple agencies	Integrated, up-to-date, easy-to-use maps overlaid with diverse geo-tagged data including 3D, under-ground, and crowdsourced data
	GIS-based applications in India	Used by a few state governments; few apps for citizens	Ubiquitous GIS apps for decision support by all segments
Next-generation genomics	Hectares under hybrid and genetically modified crops in India (% of total planted area)	18 million ha (9%)	40 million ha (20%)
	Medical therapies based on advanced genomics	Nascent	Personalised therapies for 0.5–1.5 million patients; prenatal screening of 5–10 million births
Advanced oil and gas exploration and recovery	Unconventional gas production	~10 billion cubic feet	~235 billion cubic feet

Figure 3.2: Potential adoption of 12 empowering technologies in India (Kaka, Madgavkar, Manyika, Bughin, & Parameswaran, 2014)

The Government of India released its first Draft Internet of Things (IoT) policy document in 2014 that aims to make the IoT market worth $14.9 billion by the year 2020; the networked and connected objects are expected to grow from the current 200 million to 2.69 billion by the year 2020 (Livemint, 2014). It is predicted by Gartner that $300 billion worth of revenue would get generated apart from 26.9 billion connected objects from IoT globally by the year 2020. As per Gartner, India's share in the world's IoT industry would be between 5 to 6 percent (GOI, 2015).

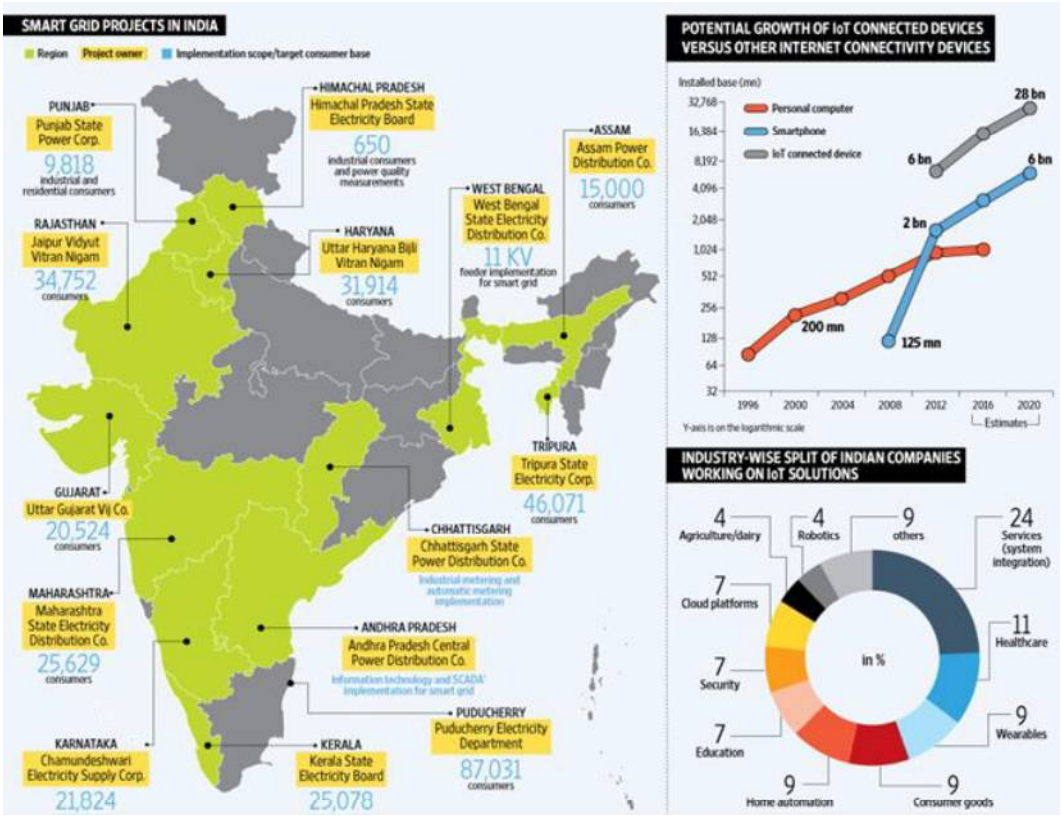

Figure 3.3: IoT Ecosystem in India – Current vs Future (Livemint, 2014)

IOCL, HPCL and BPCL together account for 94% of the total Retail Oil Outlets in India (Ministry of Petroleum and Natural Gas, 2016). With the entry of global giants such as Rosneft and BP in the Indian retail oil outlet sector, the Indian Public Sector OMCs are going to face increased competition from the private players. BP has received license for setting up 3,500 petrol stations in India while Rosneft has inherited 2,700 petrol pumps as a result of its agreement to acquire Essar Oil (Economic Times, 2016). The OMCs need to adopt new technological innovations, increase operational efficiency, employee productivity and customer satisfaction at their retail oil outlets to stay ahead of competition and maintain their dominance. IoT, which is a next generation disruptive technology, can play a significant role to help the OMCs achieve their objectives. This research work attempts to identify the key digital enablers along with an IoT business model suitable for the retail oil outlets.

3.3 Research Gaps

The research gaps mentioned below have been finalized on the basis of the literature review:

- The entire literature was unable to provide digital enablers for enhancing employee productivity and operational efficiency in Indian Public Sector Retail Oil Outlets
- The researcher could not find any IoT Business Model appropriate for Indian Public Sector Retail Oil Outlets
- The literature review on "Thing Theory" does not mention about the interrelation of Processes with People, Data and Things within integrated IoT

3.4 Research Problem

Based on the literature review, the researcher deduced the theoretical gap from the

"Thing Theory". The "Thing Theory" does not mention about the interrelation of Processes with Data, People and Things within integrated IoT. Based on this research gap the following Research Problem had been formulated:

"What is the interrelation of Processes with People, Data and Things within integrated IoT? "

3.5 Research Questions

The research questions mentioned below have been finalized on the basis of the research gaps:

- (RQ1) What are the digital enabling variables which will help increase employee productivity and operational efficiency in Indian Public Sector Retail Oil outlets?
- (RQ2) What business model on IoT needs to be developed for increasing employee productivity and operational efficiency in Indian Public Sector Retail Oil Outlets?

3.6 Research Objectives

The research objectives mentioned below have been finalized on the basis of the research questions:

- (RO1) To identify digital enablers responsible for increased operational efficiency and employee productivity in Indian Public Sector Retail Oil Outlets
- (RO2) To develop an IoT business model for increasing operational efficiency and employee productivity in Indian Public Sector Retail Oil Outlets

3.7 Scope of the study

The scope of the research work was restricted to the retail oil outlets of three state owned Indian OMCs – IOCL, BPCL and HPCL as they occupy 94% of the total dominant share of the retail oil outlets in India. The study was limited to the retail oil outlet business of these three OMCs and not their downstream operations. Extensive literature survey was conducted on Global Retail Oil Outlets for identification of the digital enablers that increase operational efficiency and employee productivity. The IoT business model developed is only applicable to the retail oil outlets of these three OMCs in India - IOCL, BPCL and HPCL and not the private sector players.

3.8 Research Methodology

Objective 1 - To identify digital enablers responsible for increased operational efficiency and employee productivity in Indian Public Sector Retail Oil outlets.

Research Methodology for Objective 1

The mode of inquiry used was 'survey' employing predominantly closed ended questions therefore the quantitative research methodology was used for analysis.

- Sampling Procedures
  - *Target Population*[15] - The target population for the survey were the employees and ex-employees of Indian Public Sector OMCs.
  - *Sampling Frame*[16] - The Sampling frame for the survey was defined as those who are/were involved in the downstream business of the OMCs.

[15] *The Target Population is the collation of elements that possess information on which inference need to be made*
[16] *The Sampling Frame is a representation of elements of target population*

- *Sampling Unit*[17] - The sampling element was defined as those who are/were involved in the Retail Oil Outlet business of the OMCs.
- *Research Design* - The research design is Exploratory[18] in nature
- *Sampling Technique* – The information gathering process used non probabilistic[19] judgmental sampling[20].
- *Sample Size* - The sample size of 398 (Yamane, 1967) respondents was considered for this research work. This number was determined through Yamane formula (Yamane, 1967).

$$n = \frac{N}{1 + N * (e)^2}$$

Where

n – Sample size;

N – Population size;

e – Acceptable sampling error.

The population size (N) was taken as 150,000 and the acceptable sampling error 'e' was taken as 5% in the above equation, the sample size (n) was arrived at 398.

- Data Collection - Primary data was collected through 1) Mailing the questionnaire 2) One to one interaction (Questionnaire method) and filling up the questionnaire 3) Online mode (GoogleDOCS)
- *Instrument design*
  - Based on the published reports, case studies, research papers, annual reports etc. the key digital enabling variables for increased operational efficiency and employee productivity in Global Retail Oil outlets were identified (Appendix A).

[17] *A Sampling unit is a unit containing elements available for respondent selection during the sampling process*

[18] *Exploratory Research intends to determine the nature of the problem to have better understanding of the problem. It explores the research questions.*

[19] *Non Probabilistic sampling does not provide all persons in the population equal likelihood of getting selected*

[20] *Judgment sample utilizes an expert opinion and is one of the kinds of non-random sample*

- A semi-structured interview was conducted to finalize the list of variables by subjecting it to 15 (Guest, Bunce, & Johnson, 2006) respondents till data saturation[21] happened (Appendix B).
- The questionnaire was handed over predominantly in person. The following three variables were eliminated based on the responses of the 15 (Guest, Bunce, & Johnson, 2006) respondents.
  - ✓ *Sensor and hardware producers* – Tie-ups have to be set up with Service Providers for IoT adoption
  - ✓ *Mass Market* – Scalability of IoT adoption will address the broader mass market over a period of time
  - ✓ *Market Share* – IoT grows the market share for Indian Public Sector fuel retailers by adding more customers to the respective Company /Outlet

- The Seven point Likert scale (Vagias & Wade, 2006) was used to record the responses of the participants
- To ensure the quality of the instrument, the questionnaire was tested through pilot study by subjecting it to 30 respondents.
- The internal consistency was checked using Cronbach's Alpha test.
- The questionnaire, Appendix C, was finalized after the pilot study a couple of ambiguous questions were reworded as per the feedback received from the respondents. The questionnaire was administered to a total of 659 respondents, however, quite a few of them were incomplete responses. The incomplete responses were removed from the list while the completed responses received from 402 respondents were retained – 61% response rate[22] was reached which is allowed (Malhotra, 2010). To conduct factor analysis, eight participants per variable are required (Malhotra, 2010). For this survey, 26 variables are used which would

[21] *The enclosed questionnaire was sent to the 1st respondent and based on his/her inputs, the questionnaire was modified. Thereafter it was sent to the 2nd respondent and the same process was followed till the saturation of the variables occurred. Detailed questionnaire is attached as Appendix B.*

[22] *The response rate is the percentage of people who respond to a survey*

require 208 participants. The number 402 is higher than 208 (minimum number of respondents required), and hence the condition is satisfied to proceed with factor analysis.

- *Data Analysis* - Factor analysis was used to identify the significant variables. Available software (SPSS) was used for Factor Analysis. Variables, having factor loading greater than 0.3 (Hair, Anderson, Tatham, & Black, 1998), were considered significant for sample size of 398 (Yamane, 1967).

Objective 2 - To develop an IoT business model for increasing operational efficiency and employee productivity in Indian Public Sector Retail Oil Outlets

Research Methodology for Objective 2

- Literature review was done based on the keyword 'Business Models for IoT'. Those papers were identified which had literature on business model for IoT.
- The key components used by the 'Business Models for IoT' in these Research papers were noted.
- When developing the IoT business model for Indian Public Sector Retail Oil Outlets, the Business Model Canvas tool (Osterwalder & Pigneur, 2009) is taken as the beginning point as it is based on the results of multiple studies of business models.
- All the nine building blocks of the Business Model Canvas tool were used to develop the IoT business model for Indian Public Sector Retail Oil Outlets as depicted in Figure 3.4.

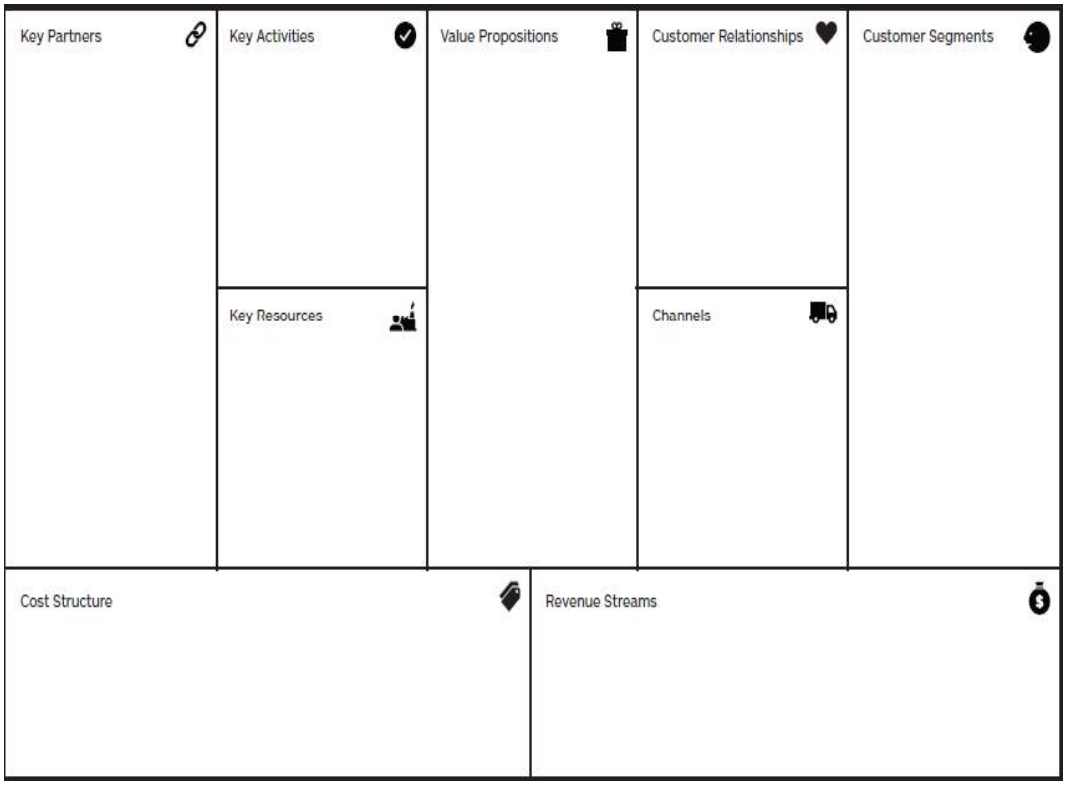

Figure 3.4: Business Model Canvas tool (Osterwalder & Pigneur, 2009) showing the nine building blocks

- The important variables identified from Objective 1 were subjected to a semi-structured interview which consisted of a few 'closed-ended questions' (Appendix D) and a few open-ended questions (Appendix E) for a sample size of 15 (Guest, Bunce, & Johnson, 2006).
- Research Methodology for the closed-ended questions of Objective 2 - The closed-ended questions (Appendix D) was used for grouping them under these 9 building blocks. For example: *"Automation of manual processes" would fall under the building block ___.*
    - For each of the identified variable, the mean score was computed. The relative importance of variables within each building block was computed through the mean score.

- The means of all the variables within each building block were measured against the average of all the variables and significant differences were searched for.
- In each building block, variables that got prominent scores higher than the average were marked 'Green', while variables that got scores fairly lower than the average were marked 'Red', and those variables that did not show any marked difference from the average were marked 'Yellow'. This was depicted through a figure which represented the IoT Business Model for Indian Public Sector Retail Oil Outlets.

- Research Methodology for the open ended questions of Objective 2 - 'Phenomenological[23]' Research Method was chosen as the Qualitative Research Methodology as an activity/phenomenon is being described. As the mode of inquiry used was 'interviews' employing open ended questions with the respondents, accordingly the qualitative research methodology was chosen for analysis.
  - **Sampling Procedures**
    - ***Sampling Unit*** - The sampling unit for the interviews were the Middle Management employees of the Indian Public Sector Retail Oil Outlet business.
    - ***Sampling Technique*** **–** Theoretical sampling was employed during the information gathering process
    - ***Sample Size*** – The sample size of 15 (Guest, Bunce, & Johnson, 2006) was considered for this research work
    - ***Data Collection Tool*** - Semi-structured interview
    - ***Instrument Design*** **–** The instrument that was used for this research was a questionnaire with open ended questions. An interview protocol was developed i.e. the rules that guided the management of the semi-structured interviews. These are the

[23] *The Phenomenological Research Method uses a combination of tasks such as conduction of interviews, going through documents, watching of videos and visiting different places of interest to get a better understanding*

implicit rules which were adhered to during the conduction of interviews. The following guidelines were included in the protocol:

- ✓ The purpose of the interview was explained to the interviewees along with the duration of the interview
- ✓ Informed consent of the interviewee was taken
- ✓ An interview guide was developed that listed the questions explored during the interview.

- ***Method of Administration*** – The questionnaire containing the open-ended questions was administered through personal interview.
- ***Pilot Testing*** **–** The open-ended questions was pre-tested with three stakeholders, this eliminated the weakness of the questions (if any).
- ***Process*** **–** The preliminary contact was initiated with people who agreed for interviews to be taken. A mutually acceptable date was agreed to for those who provided their consent for the subsequent interview. On the agreed date, the interview was conducted. Interviews were conducted in semi-structured mode, the respective respondent was asked about the nature and type of connection of the important variables (which were identified from Objective 1). The interview was conversational and the questions standardized. The key data points were summarized immediately following the interview.
- ***Tool of Approach used for Coding*** -The Modified Grounded Theory approach of coding was used for coding since the data collected involved repeated ideas, concepts or elements. The 'Modified Grounded Theory' leverages the experience of respondents.
- ***Evaluation*** **–** The interviews conducted were recorded, transcribed as well as coded with ATLAS.Ti software. The output of the

software was analyzed and incorporated in the IoT Business Model to identify the connection between the identified variables.

Research Methodology for Validation of IoT Business Model

The IoT Business Model developed was validated by subjecting it to an In-depth interview with 3 (Guest, Bunce, & Johnson, 2006) Senior Management employees of the Indian Public Sector Retail Oil Outlet business.

- **Sampling Procedures**
  - ***Sampling Unit*** - The sampling unit for the interviews were the Senior Management employees of the Indian Public Sector Retail Oil Outlet business.
  - ***Sampling Technique*** – Theoretical sampling was employed during the information gathering process
  - ***Sample Size –*** The sample size of 3 (Guest, Bunce, & Johnson, 2006) was considered for this research work
  - ***Data Collection Tool –*** In-depth interview
  - ***Instrument Design –*** The instrument that was used for this research was a questionnaire with open ended questions based on the IoT Business model developed. An interview protocol was developed i.e. the guidelines employed for the management of the in-depth interviews. The guidelines given below were included in the interview protocol:
    - The purpose of the interview was explained to the interviewees along with the duration of the interview.
    - Each interviewee's consent was taken.
    - An interview guide was developed that listed the questions to be explored during the interview.
  - ***Method of Administration*** – The questionnaire containing the open-ended questions was administered through personal interview.

- ***Process*** **–** The preliminary contact was initiated with the senior management people who agreed for interviews to be conducted. A mutually acceptable date was agreed to for those people who provided their consent for the subsequent interview. On the agreed date, the interviews was conducted. Interviews were 'in-depth', the respective participant was asked about his/her perspectives on the validation of the IoT Business Model for his/her organization. The interview was structured and focused to get his/her perspectives and views on the IoT Business Model. The key data was summarized immediately following the interview.
- ***Tool of Approach used for Coding*** -The Modified Grounded theory approach of coding was used for coding since the data collected involved repeated ideas, concepts or elements. The 'Modified Grounded Theory' leverages the experience of respondents.
- ***Evaluation*** **–** The interviews conducted were recorded, transcribed and coded with ATLAS.Ti software. The output of the ATLAS.Ti software was compared with the 'IoT Business Model for Indian Public Sector Retail Oil Outlets' which has been developed. Necessary corrections were incorporated in the IoT business model and recommendations provided.

3.9 Concluding Remarks

Research design plays a very important role in defining the entire blueprint of the study to be undertaken. It is similar to the route that the researcher identifies and prepares for prior to undertaking the journey. In the current chapter, the objectives of the research, research methodologies that were used, target population, sampling unit, sample size, information gathering procedures etc. were documented to highlight the path undertaken for the research study. The research methodologies for both the objectives along with the validation of the IoT

business model were elaborated. The variables identified from the various literatures along with the use of the Business Model Canvas (Osterwalder & Pigneur, 2009) tool in the development of the IoT business model have been elucidated in this chapter. The next chapter mentions about the findings of both the research questions, it also depicts the IoT business model for Indian Public Sector Retail Oil outlets apart from its validation. It also highlights the contribution to the Thing Theory as part of the research study.