CHAPTER 1

INTRODUCTION

1.1 Overview

Technologies have transformed various businesses and created immense value for the society. Some of these technologies are disruptive, their impact in society have been profound and have changed our daily lives in some way or the other. Technology drives value for businesses through improved connectivity, better decision making, automation of manual tasks and innovation of services and products (Olanrewaju & Willmott, 2013). Disruptive technologies have changed the business models of many industries and have changed the mode of making money (Manyika, Chui, Bughin, Dobbs, Bisson, & Marrs, Disruptive technologies: Advances that will transform life, business, and the global economy, 2013). Digitization is going to impact almost every function of the business in today's firms (Desmet, Duncan, Scanlan, & Singer, 2015). The industrial revolution of the 18th century has transformed economies of many countries. Physical objects which were isolated earlier are being connected to global networks. New technologies have brought in disruptive change apart from driving economic growth. We are in the midst of a digital revolution which is bringing ubiquitous and unprecedented change (Nanterme & Daugherty, 2016). Disruptive technologies such as internet, steam engines and microchips have transformed the livelihood of the common man. Joseph Schumpeter, the Austrian American economist observed that prominent growth in countries are associated with "creative destruction" that redefines industry economics, disrupts the existing businesses and brings in new players with new ways of working

(Manyika, Chui, Bughin, Dobbs, Bisson, & Marrs, Disruptive technologies: Advances that will transform life, business, and the global economy, 2013). Mckinsey has calculated the potential economic impact of 12 technologies across applications that could be achieved by 2025. The twelve potential economically disruptive technologies in terms of ranking (Manyika, Chui, Bughin, Dobbs, Bisson, & Marrs, Disruptive technologies: Advances that will transform life, business, and the global economy, 2013) are given below:

1. Mobile internet – Internet enabled mobile devices.
2. Automation of knowledge work – Autonomous systems capable of performing knowledge related tasks.
3. IoT – Objects connected to each other through the internet for data generation, evaluation and extraction of useful information.
4. Cloud technology – Programs and applications are stored and accessed over the internet.
5. Advanced Robotics – Intelligent robots used for performing various tasks.
6. Autonomous vehicles - Driverless vehicles capable of navigating without any human intervention.
7. Next-generation genomics – Sequencing of genes through the use of analytics which is faster and costs less.
8. Energy storage - Appliances capable of storing energy for use at a later stage.
9. 3D printing – Creating physical objects by using three-dimensional digital technology.
10. Advanced materials - Materials possessing better features based on tensile strength, conductivity etc.
11. Advanced oil and gas exploration and recovery – Newer and economical ways of recovery of unconventional oil and gas.
12. Renewable energy – Production of electric energy from renewables

As shown in Figure 1.1, IoT is expected to have a potential economic impact between $2.69 trillion and $6.19 trillion per year by 2025 (Manyika, Chui, Bughin, Dobbs, Bisson, & Marrs, Disruptive technologies: Advances that will transform life, business, and the global economy, 2013). It is estimated that there would be more than 7 trillion connected objects by 2025 (Borgia, The Internet of Things vision: Key features, applications and open issues, 2014). Following this global trend, present day companies need to re-evaluate their business strategies on how IoT can be adopted to develop and facilitate their businesses for sustainable development (Ke Rong, 2014).

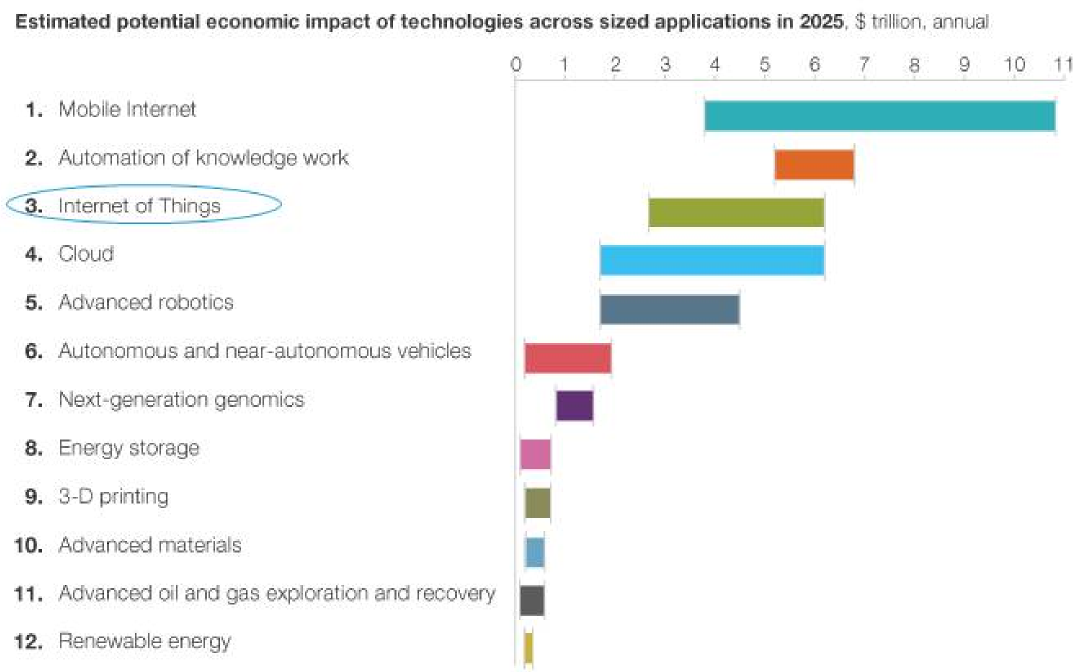

Figure 1.1: A gallery of disruptive technologies (Manyika, Chui, Bughin, Dobbs, Bisson, & Marrs, Disruptive technologies: Advances that will transform life, business, and the global economy, 2013)

In 1999, Kevin Ashton conceived the idea of IoT while devising ways through which Proctor & Gamble could bring about operational improvement in business by connecting the Radio Frequency Identification (RFID) enabled information to the internet (Lopez Research, 2013). The convergence of people, information and objects on the internet will bring about a huge opportunity for everyone – citizens, firms and nations. (Cisco, 2014) has predicted that by the year 2020, there would be an addition of 4.5 billion human beings and 37 billion objects on the internet. As shown in Figure 1.2, IoT is estimated to have a potential economic impact from $3.91 trillion to $11.10 trillion per year in 2025 across nine settings – Vehicles, Homes, Offices, Factories, Retail environments, Worksites, Humans, Outside and Cities (Manyika, et al., The Internet of Things: Mapping the value beyond the hype, 2015). Currently, more than 99% of physical entities are not joined to the internet and the opportunity to make them connected is huge which can bring about operational efficiencies and simplified business processes. Innovations on the IoT are expected to bring about significant business benefits worth millions of dollars across various industries. IoT is poised to become the fabric of a networked economy in future (SAP, 2014). Firms can use IoT for monitoring of inventory including alerts on shortage of inventory apart from highlighting availability of spare parts (Forrrester Consulting, 2014). A business or user can remotely monitor and control a device through IoT in a connected environment. For example, a user can use the smartphone to remotely adjust the temperature of the air-conditioner at home even though miles away (Lopez Research, 2013). IoT is transforming industries by connecting devices, people and services; it is empowering people to take real-time decisions and opening new opportunities (SAP, 2014). In addition to enabling of new business models, IoT is transforming the operations of businesses creating operational efficiencies and richer customer experiences (Forrester, 2015). Firms that are receptive to adoption of IoT would be reaping benefits such as increased competitive advantage, reduced costs and faster time to market (SAP, 2016).

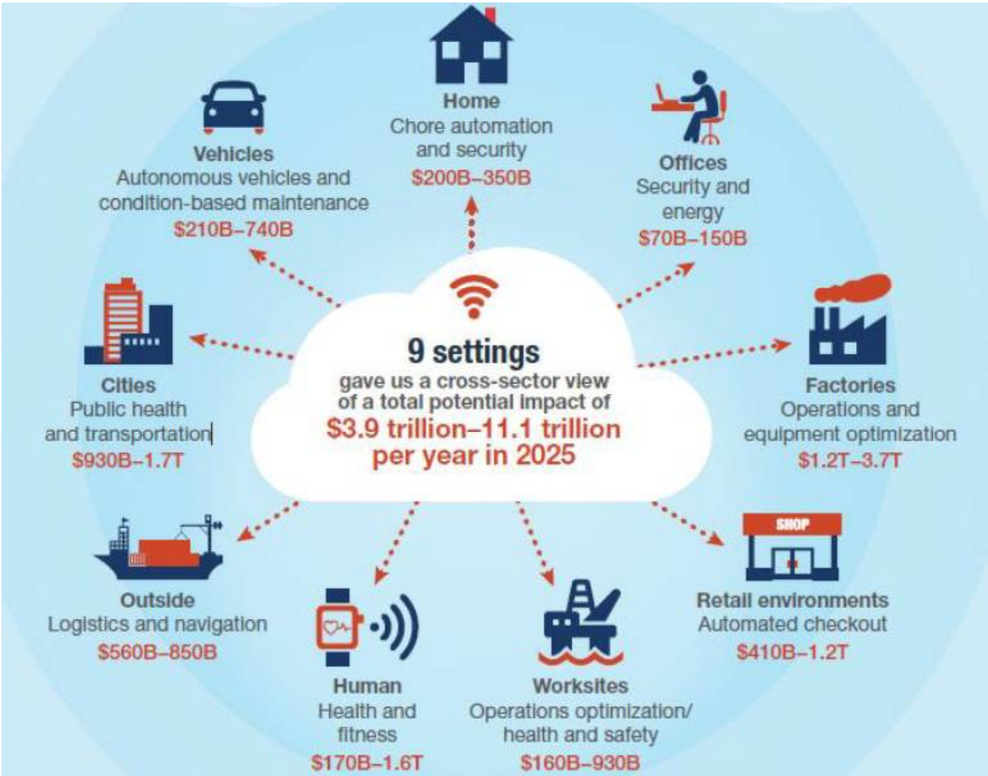

Figure 1.2: Value potential of IoT (Manyika, et al., The Internet of Things: Mapping the value beyond the hype, 2015)

IoT is expected to touch every aspect of oil and gas operations and bring in higher return on innovation (SAP, 2014). Oil and Gas firms seek to improve efficiency of their operations apart from exploring new sources of revenue and competitive advantage (Slaughter, Bean, & Mittal, Connected Barrels - Transforming oil and gas strategies with the Internet of Things, 2015). Use of IoT by the Oil and Gas Sector can increase the global GDP by up to 0.79% or $815.9 billion by the year 2025 (Moriarty, O'Connell, Smit, Noronha, & Barbier, A New Reality for Oil and Gas, 2015). Oil and Gas companies can derive significant value by adopting an integrated IoT strategy. IoT helps the oil and gas companies to manage their existing assets, provides valuable information on them and transform their businesses (Slaughter, Bean, & Mittal, Connected Barrels - Transforming oil and gas strategies with the Internet of Things, 2015).

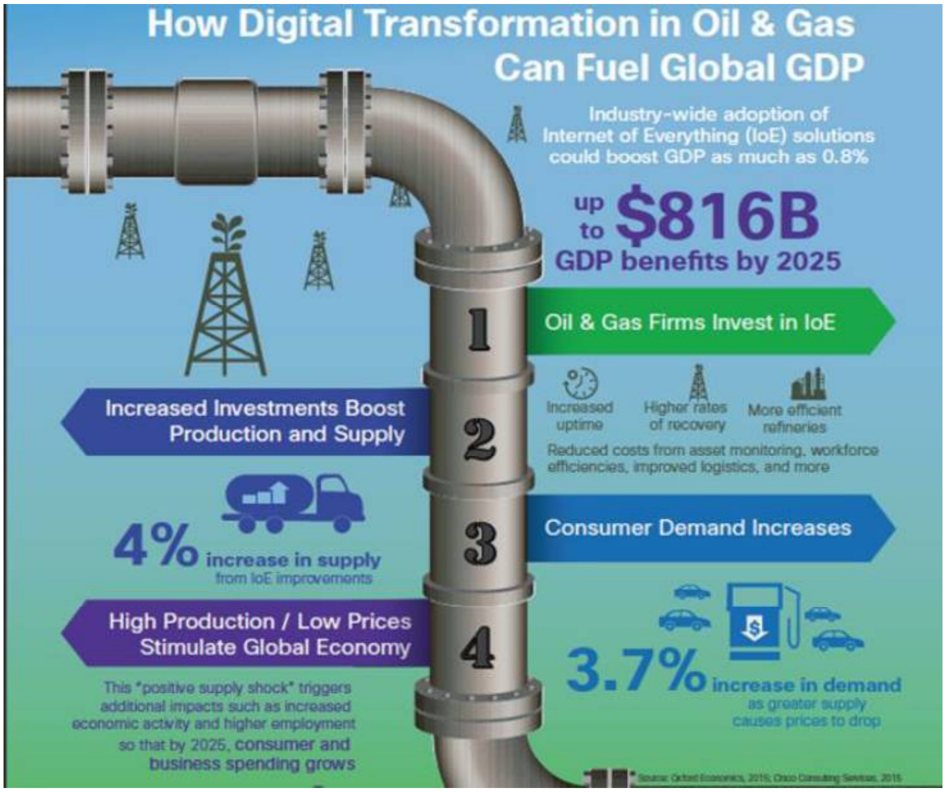

Figure 1.3: IoT adoption by oil & gas industry can increase global GDP revenue by 0.8% or $816 billion (Moriarty, O'Connell, Smit, Noronha, & Barbier, A New Reality for Oil and Gas, 2015)

There is a huge potential of IoT in developing countries, up to 40% of IoT value can be created in these countries (Manyika, et al., The Internet of Things: Mapping the value beyond the hype, 2015). The Indian Government released its first draft IoT policy document in 2014 that plans to have a $15.1 billion market by the year 2020; this has the potential to accelerate the growth of connected objects from the existing 199 million to 2.71 billion by the year 2020. It is predicted that India's market share in the global IoT industry would be around 5-6% of (GOI, 2015).

The population of India is over 1.2 billion people accounting for 16.5% of the entire universe (PwC, 2015); it is the third largest consumer of oil in the world (BP, 2016) with demand of 4.1 million barrels per day (BP, 2016). The U.S. and China stand first and second respectively with demand of 19.39 million bpd and 11.96 million bpd respectively (PwC, 2015). In 2015, India's oil consumption accounted for 4.51 percent of the total world oil consumption (BP, 2016). India's growing population coupled with high economic growth will further fuel the energy consumption in the years to come (PwC, 2015). According to the Energy Information Administration (EIA), India's oil consumption is set to increase to 5.21 million bpd by the year 2025 (PwC, 2015). The International Energy Agency (IEA) predicts India to be the largest importer of oil in the universe by the year 2020. With the opening of the retail fuel sector in India to the private players, there is going to be increased competition for capturing of market share and retention of customers. The Government of India has provided licenses to BP for the setting up of 3,500 petrol pumps in India while Rosneft is planning to enter the Indian market as a result of its deal to acquire Essar Oil and will inherit 2,700 fuel oil outlets (Economic Times, 2016). Increased competition will necessitate the OMCs to adopt new disruptive technologies at their fuel outlets for retaining their market share and thus maintain their dominance in the Indian Market. The Indian Public Sector Retail Oil Outlets considered for this study are IOCL, HPCL and BPCL as they together account for 94% of the total Retail Oil Outlets in India (Ministry of Petroleum and Natural Gas, 2016). Oil PSUs have a significant dependency of their earnings on marketing volumes at their fuel outlets; every 1% decline in the volumes may reduce earnings per share (EPS) by 1-3%. With increased competition from the private sector players, the volume growth of fuels at the OMCs oil outlets has been slower than the industry average. In the first nine months of FY17, volume growth of IOC and BPCL was 4.0% and 6.2%, respectively compared with 8.4% industry growth (Economic Times, 2019).

Organizations are competing in complex and volatile environments today (Kaplan & Norton, 1996). Every firm competing in the fuel retail business has a competitive strategy (Porter, Competitive Strategy - Techniques for analyzing industries and competitors, 1980). The IoT is a means for businesses to build competitive advantage (Berthon, From Productivity to Outcomes using the Internet of Things to drive future business strategies, 2015). IoT can enable the OMCs to retain their dominance and provide increased value to various stakeholders at their fuel outlets. There is an Opportunity Loss of ₹1569 crores for 2014-15 without the adoption of IoT in the Indian Public Sector Retail Oil Outlets as shown in Table 1.1 below.

Table 1.1: Opportunity loss calculation

Product	[9]**Consumption in 2014-15 (Tonnes) (A)**	[10]**3.7(%) Increase in demand due to IoT (Tonnes) (B) = 0.037*A**	**Barrels (C) = B*[11]8.53 (for Petrol) (C) = B*[12]7.46 (for Diesel)**	**Opportunity loss for 2014-15 ($) (D) = C*[13]9.29**	**₹ Rupees (E) = D*[14]68 (Crores)**
Petrol	18,587,000	687,719	5,866,243	54,516,952	
Diesel	68,700,000	2,541,900	18,962,574	176,225,521	
Total	87,287,000	3,229,619	24,828,817	230,742,473	**1569**

[9] *Source: Indian Petroleum & Natural Gas Statistics by Ministry of Petroleum & Natural Gas Petroleum Planning and Analysis Cell*

[10] *As per Cisco's report 'A New Reality for Oil and Gas' (Moriarty, O'Connell, Smit, Noronha, & Barbier, A New Reality for Oil and Gas, 2015), there is a 3.7% increase in consumer demand at Retail Oil Outlets due to adoption of IoT*

[11] *1 metric ton = 8.53 barrels (Petrol)*
http://www.eia.gov/cfapps/ipdbproject/docs/unitswithpetro.cfm

[12] *1 metric ton = 7.46 barrels (Diesel)*
http://www.eia.gov/cfapps/ipdbproject/docs/unitswithpetro.cfm

[13] *The GRM of refineries ($/barrel) for 2014-15 for IOCL was 10.77, BPCL was 8.55 and HPCL was 8.56 respectively. The simple average was taken as 9.29 i.e. mean of 10.77, 8.55 and 8.56.*
[14] *Exchange rate 1 USD = Rs 68 has been considered*
https://www.rbi.org.in/scripts/ReferenceRateArchive.aspx

There is a significant opportunity loss of ₹1569 crores (Table 1.1) without the adoption of IoT in HPCL, BPCL and IOCL therefore there is a need for research whereby this opportunity loss can be minimized through the development of an IoT business model for their retail oil outlets.

1.2 Business Problem

Users who responded to the Oil and Gas Leaders survey, conducted by Cisco, in 2015 (Moriarty, O'Connell, Smit, Noronha, & Barbier, A New Reality for Oil and Gas, 2015) have mentioned the below:

- Oil and Gas companies need to improve the most in the following areas for successful implementation of IoT solutions:
    - Data – 48.01% of the users mentioned 'Data' as the item to improve for more effective decision making.
    - Process – 28% of the respondents mentioned 'Process' as the area to improve for providing the correct information to the right individual at the appropriate time.
    - People – 17.01% of the respondents cited 'People' as the area to improve for connecting persons through various practical means.
    - Things – 7% of the respondents mentioned 'Things' as the area for joining the correct sensors to derive valuable information.
- 59.1% of the users are of the opinion that their organizations' OT and IT strategies are not closely aligned.
- IoT can potentially automate between 25.1% to 50.1% of the manual processes in the oil and gas industry (Moriarty, O'Connell, Smit, Noronha, & Barbier, A New Reality for Oil and Gas, 2015).

The challenges faced by Indian Public Sector Retail Oil Outlets are as follows:

- To increase operational efficiency and employee productivity (IOCL, 2016)
- To increase operating margins and oil sales at the retail oil outlets (BPCL, 2016)
- To provide increased value to various stakeholders (BPCL, 2016)
- To increase revenue streams at the retail oil outlets (BPCL, 2016)
- Adoption of mobility, automation and innovative solutions for competitive advantage (HPCL, 2016)

Table 1.1 shows that there is an opportunity loss of ₹1569 crores for 2014-15 without the adoption of IoT in the Indian Public Sector Retail Oil Outlets.

The business problem can thus be stated as below:

"People, Processes, Data and Things are not connected through Digital Technologies in Indian Public Sector Retail Oil Outlets resulting in Financial Opportunity Loss"

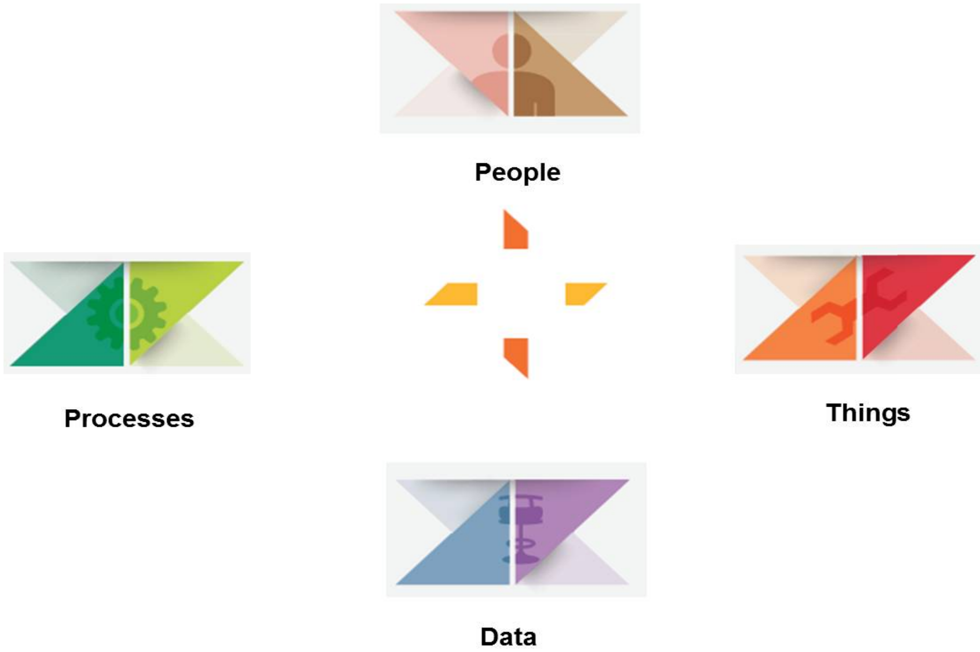

Figure 1.4: People, Processes, Data and Things are not connected through digital technologies in Indian Public Sector Retail Oil Outlets

1.3 Significance of the Study

The main objectives of the thesis are to identify the digital enablers responsible for increased operational efficiency and employee productivity in Indian Public Sector Retail Oil Outlets and to develop an IoT business model which will increase operational efficiency and employee productivity for them. The IoT business model can be leveraged by the Indian Public Sector Downstream Oil Companies for implementation of IoT at their Retail Oil Outlets. The study shows the importance of obtaining useful information from data and enabling to take faster decisions, delivering the correct information to the right machine or person and connecting people in relevant ways. It shows the importance of Processes, People, Things and Data to be linked together through IoT that help in providing valuable insights. IoT stiches them together by combining device-to-device, device-to-individual, individual-to-device and individual-to-individual connections and provides economic opportunities (Cisco, 2013). The study shows the contribution to the 'Thing Theory' by depicting the interrelation of Processes with People, Data and Things through the IoT Business Model in Indian Public Sector Retail Oil Outlets.

1.4 Organization of the Report

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 also could not find any IoT Business model appropriate for Indian Public Sector Retail Oil Outlets. The thesis did an exhaustive literature survey of digital enablers for enhancing employee productivity and operational efficiency in Global Retail Oil Outlets. A semi-structured interview was conducted to filter and narrow down the identified variables applicable for Indian Public Sector Retail Oil Outlets. The internal consistency was checked through Cronbach's alpha and thereafter subjected to factor analysis. Variables having factor loading greater than 0.3 were considered significant. The KMO and Bartlett Test of Sphericity was calculated. Factor Analysis was also done to group the 26 identified variables under nine factors. Using the Osterwalder's Business Model Canvas tool (Osterwalder & Pigneur, 2009) and utilizing the responses received from the respondents through the survey, the 26 identified variables were incorporated under the nine building blocks to come up with an IoT business model for Indian Public Sector Retail Oil Outlets. The relative importance of variables within each building block was computed through the mean score. In each building block, the means of all the variables were measured against the average of all the variables and significant differences were searched for. The relative importance of the variables within each building block has been highlighted in the IoT business model. The interviews for the open ended questions were coded with ATLAS.ti software and the output was incorporated in the IoT Business Model to identify the connection between the identified variables. This thesis will identify the digital enablers that help increase employee productivity and operational efficiency in Indian Public Sector Retail Oil Outlets. It will also depict the IoT business model applicable for these organizations for increasing employee productivity and operational efficiency.

The thesis is structured into five chapters. Chapter 1 discusses about the potential economic impact of 12 disruptive technologies which include IoT as identified by Mckinsey. It mentions about the Opportunity Loss without the adoption of IoT in the Indian Public Sector Retail Oil Outlets. It highlights the outcome of the survey of Oil and Gas leaders whereby the importance of People, Process, Data and Things have been mentioned as important for effective use of IoT solutions. It also refers to the IT-OT strategies of Oil and Gas companies which are not aligned currently. The chapter also mentions about the Business Problem for the study.

The Second chapter highlights the literature review carried out involving various sources. It discusses about the downstream industry in India, key challenges for the downstream industry, the number of Retail Oil Outlets of IOCL, HPCL and BPCL, the meaning of IoT, its importance and benefits in the Energy industry, literature on the various IoT business models, importance of Business Model Canvas tool (Osterwalder & Pigneur, 2009). The Chapter summarizes the literature review through identification of themes and research gaps and thereafter leading to the Research Problem.

The Third chapter mentions about the qualitative and quantitative research, research problems, research objectives, research questions, methodologies of research used for both objectives and for validation of the IoT business model, sampling procedures, research design, design of questionnaire, selection of appropriate scale, reliability test, mode of collection of data, rationale and scope of study. It elaborates the research methodologies of the two objectives along with validation of IoT business model.

The Fourth chapter highlights the findings such as identification of 26 significant variables for Research Objective 1, Cronbach's alpha, KMO test, Bartlett test and reduction of 26 variables into nine factors through factor analysis. It also mentions the key findings for Research Objective 2 which includes open-ended and closed-ended questions, identification of eight research papers that contained an actual IoT business model, depiction of relative significance of variables within each building block, output of ATLAS.Ti software, validation of IoT Business Model through an in-depth interview, depiction of the IoT business model along with the connections of the various significant variables.

The Fifth chapter highlights the conclusions and recommendations. The contributions to literature, limitations of study and the theoretical premise for this study are mentioned in this chapter. This chapter also shows the contribution to the 'Thing Theory' by depicting the interrelation of Processes with People, Data and Things through the IoT Business Model for the Indian Public Sector Retail Oil Outlets.

The Sixth chapter highlights the various references that were used in the thesis; they include various research papers, annual reports of companies, publication reports of companies, databases of companies etc.

1.5 Concluding Remarks

IoT is being termed as the Fourth Industrial revolution. Innovations on the IoT are expected to bring about significant business benefits worth millions of dollars across various industries. Physical Objects which were isolated earlier are being connected to global networks. IoT is expected to bring about significant return on investment to various businesses, open new opportunities to citizens and bring in new streams of revenue. Physical objects having embedded sensors would soon be connected to the internet and shall be able to communicate with each other and exchange data.

India is the third largest importer of energy in the world, it purchases $180.01 billion every year in oil and gas accounting for 40.1 percent of the total 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). IOCL, BPCL and HPCL together account for 94% of the total retail oil outlets in India (Ministry of Petroleum and Natural Gas, 2016). With the opening up of the oil outlet market to private players by the Government of India, the OMCs are going to face increased competition from the private firms. IoT, which is a next generation disruptive technology, can play a significant role to help them stay ahead of competition and to retain their market share.

However, what's missing is an IoT business model for OMCs' retail oil outlets that can increase operational efficiency and employee productivity. Extensive literature survey was conducted to identify the digital enablers responsible for increased operational efficiency and employee productivity in Indian Public Sector Retail Oil Outlets. This thesis tries to plug the void due to scarcity of literature by identifying a set of variables that contribute to increase in employee productivity and operational efficiency through IoT in OMCs' retail oil outlets and to develop an IoT business model suitable for their oil outlets.

OMCs who view the IoT as a means of disruption and innovation can bring out enhanced business value to their customers and various stakeholders through the implementation of the IoT business model at their retail oil outlets and thereby have a competitive advantage. This study is expected to contribute to the existing knowledge repository as the literature on IoT at fuel stations is at a nascent stage. In the next chapter, extensive review is presented to understand the existing available literature on the above, and also to identify the research gaps that exist.