TITLE OF PROJECT

PROJECT REPORT

submitted by:

STUDENT NAME INITIALS
TVE15MEXXYY

to

the APJ Abdul Kalam Technological University

in partial fulfilment of the requirements for the award of the Degree

of

Master of Technology

in

Your Specialization of Study

Department of Mechanical Engineering

College of Engineering Trivandrum

MAY 2018

Declaration

I undersigned, hereby declare that the project titled “Title of Project” submitted in partial fulfilment of the requirements for the award of degree of Master of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under the supervision of Name of Supervisor. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma, or similar title of any other university.

Place: Signature

Date: Student Name Initials

DEPARTMENT OF MECHANICAL ENGINEERING

COLLEGE OF ENGINEERING TRIVANDRUM

CERTIFICATE

This is to certify that the project report titled **Title of Project** submitted by **Student Name Initials**, Reg. No. TVE15MEXXYY, to the APJ Abdul Kalam Technological University in partial fulfilment of the requirements for the award of the Degree of Master of Technology in Department Stream - Your Specialization of Study, is a bonafide record of the project work carried out by him/her under my guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Name of Supervisor
Project Supervisor

Name of PG Coordinator
PG Coordinator

HoD Name
Head of the Department

ACKNOWLEDGEMENT

Write your acknowledgements here.

Student Name Initials

ABSTRACT

The objective is to minimize the overall system costs which include the fixed costs of opening depots and using vehicles at each depot site, and the variable costs associated with delivery activities. A novel heuristic is proposed which is based on variable neighbourhood descent (VND) algorithm to solve the resulted problem.

Keywords: *keyword1, keyword2, keyword3, keyword4*

Contents

List of Tables

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Chapter 1

INTRODUCTION

In every chapter we usually provide an introduction to the chapter in this space. Since it is the chapter named 'Introduction', a brief introduction about the project work is to be provided here in this chapter. It can extend to two or three pages, if required. This unnamed section can even hold citations to references also.

After reading this section of the report the reader will get an idea about the problem being discussed in this report and the tools used to solve/analyse the problem and address the research question.

1.1 Problem Definition

Provide a brief description of the problem and its domain, the practical importances of the problem, etc.

1.2 Objectives of the Project Work

The objectives of this project work are:

1. To measure the cost effectiveness of E-Procurement of indirect materials in BPCL-KR.
2. To compare the lead time of traditional procurement and E- procurement of indirect materials.
3. To compare the cost pattern of traditional procurement and E-procurement.
4. To assess the role of E- procurement in market penetration.
5. To measure the role of E-procurement in inventory management.

1.3 Scope of the Project Work

The scope of this project work to be included in this section. By the term 'scope' we usually intend to provide the boundary of the problem and the validity and applicability of: (a) the results based on the volume and source of data, (b) the methodology used to solve the problem, (c) the sensityvity of the results based on the parameter settings, etc.

1.4 Research Methodology

This section is to provide an overview of the selection of research methods used in this project work, tools, variables, hypothesis, especially with the data collection, data analysis, making inferences, testing of the hypotheses, comparing the results, etc. This section should provide only an introductory description. Description of each has to be provided in detail after the literature review in the next Chapter, Sec 2.9.

1.5 Limitations of the Project Work

As the title says, this section is dedicated to explain what limitations exist for the project work in terms of the validity of the results because of the method used, data source, data collection method, difficulties faced in different stages of the project, etc. It can go up to two paragraphs.

Now here you can provide a last paragraph for chapterisation. A sample will look like the following.

Refer the chapters by their labels as follows. Chapter 2 (page 3) discusses the ..... The data collection method and the details of data sources are provided Chapter 3 (page 15), etc... The conclusions of the findings are provided in Chapter 6 (page 22). It should be sequentially and logically framed such that the reader can decide which chapter will be of importance to him and can turn into that chapter.

Chapter 2

LITERATURE REVIEW

Here comes the intro to the literature review done. Tell how the review is classified into sections and subsections, what sources provided the required information about the existing research and the results,.... etc. An important thing to be kept in mind is that preparing the literature review according to proper subject (topic) classification is a best practice. A reference can be cited in many sub sections or paragraphs where ever it is required to be cited. No citations should be kept without its position in the reference list. This happens when the citations are provided manually by including the appropriate text within the matter. Use the standard practice of keeping a database of references as a `.bib` file and using the `\cite{key}`, `\citet{key}` or `\citep{key}` code. Those who want to use only **Microsoft Word**, use either **EndNote** or **Mendeley** to keep bibliography database file and to cite the references appropriately.

2.1 Maintanance Management Techniques

When operating costs of all manufacturing and production plants are considered, maintenance costs cover a major part. It can vary from 15 to 60 percent depending on the type of industry. In food related industries, maintenance costs can be as low as 15 percent, while in a steel or iron plant, maintenance cost can be close to 60 percent. Ineffective maintenance management can resut in lesser quality products and can result in less competitive products, so timely maintenance is an important aspect of any industry. The main reason for ineffective maintenance is the lack of proper predictive maintenance techniques to predict a need for repair or maintenance pf machinery, equipment and systems.

In general, maintanance management techniques are categorized into (a) Run-to-Failure Management and(c) Predicive Maintenance Management

2.1.1 Run to failure Management

The simplest maintenance strategy is to execute run to failure maintenance. Here, machinery are allowed to operate until they break down, at which point maintenance is performed. No maintenance, is performed on the asset until the occurrence of failure event. However, a plan is in place for ahead of the failure, so that the asset can be fixed without causing any production issues. This strategy is useful for assets that, on breakdown, pose no safety risks and have minimal effect on production.

In run-to-failure approach we, wait for the machine or equipment failure beforetaking any maintenance action .So, it can be also called a nomaintenance approach of management. It is actually the most expensive method of maintenance management as the cost assocated with failure are much higher than maintanance costs. Only very few plants use a run-to-failure management approach. In almost all instances, plants perform basic preventive tasks such as lubrication, machine adjustments etc, even in a run-to-failure environment. However,in the scenario machines and other plant equipment are not rebuilt, nor are any major repairs are made until the equipment fails. This approach can cause several costs like, inventory cost, high overtime labor costs, high machine downtime, and low production availability. Since no maintenance is done, a plant that uses true run-to-failure management must be able to react to all possible failures within the plant. This reactive method of management forces the maintenance department to have all extensive spare parts in the inventory. The alternative is to rely on equipment vendorswho are able to provide immediate delivery of all needed spare parts. Even if the second option is possible, extra rate of fast delivery increases the costs and downtime required to correct machine failures. To cope with the impact of unexpected machine failures, maintenance crew must also be able to react quickly to all machine failures.

2.1.2 Preventive Maintanance

Here, maintenance tasks are carried out on the basis of elapsed time of operation. Figure illustrates how the statistical life of a machine varies in time. This curve, called the bathtub curve indicates that a new machine has a high chance of failure during the first few weeks of operation due to occurance of severa problems associated with setup and installation. After this period, the probability of occurance of failure is relatively low for an extended period. After this normal machine life period, the probability of failure increases sharply with elapsed time. In preventive maintenance management, machine repairs or rebuilds are scheduled based on the statistical measures. The actual implementation of preventive maintenance varies greatly. Sometimes the equipments

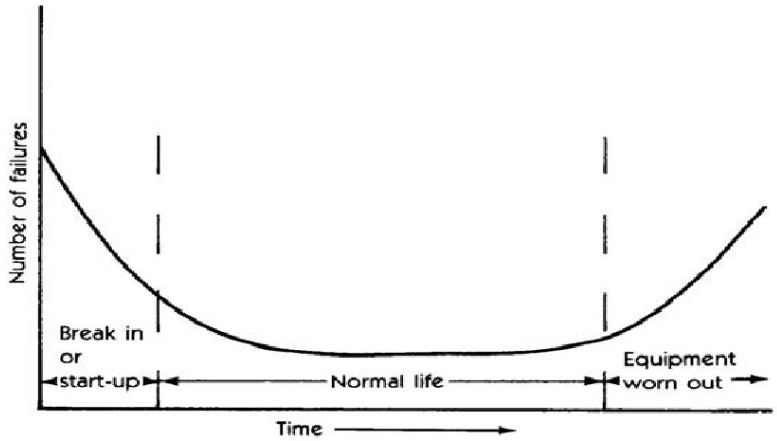

Figure 2.1

need only lubrication and minor adjustments. In preventive maintenance management, It is assumed that machines will degrade over time depending on their running conditions.

2.1.3 Predictive Maintananve

predictive maintenance is monitoring the conditions of machinary, in an attempt to detect possible problems and to prevent the occurance of a catastrophic failure. The practice of predictive maintenance involves regular monitoring different conditions of the machanery like, vibration, input parameters etc, to predict equipment failure so that there is maximum interval between repairs and minimum amount of costs associated with machine-train failures. Predictive maintenance thus, improves productivity, product quality, and overall effectiveness of manufacturing and production plants. A good predictive maintenance management program uses the most costeffective tools (e.g., vibration monitoring, thermography, acoustic emission, humidity etc) to obtain the actual operating condition of critical plant systems and based on this data, all maintenance activities are scheduled when needed. predictive maintenance i greatly reduces the maintenance costs and failure costs. It also improves the product quality, productivity, and profitability of manufacturing and production plants. Predictive maintenance can be called as a condition-driven preventive maintenance program. Most mechanical problems can be minimized if they are detected and repaired at the right time.That is , If the problem is detectedat the right time, major repairs can usually be prevented.

Predictive maintenance using vibration measurement depends on two basic criteras: (1) common failure modes have distinct vibration frequency components which stay away from the custer of data points, that can be isolated and identified, and (2) the amplitude of each vibration component will remain constant unless the operating

conditions of the machinetrain, like operating speed and load changes.

2.2 Mechanical Condition Monitoring Techniques

The different techniques used for assessing the condition of machinery are given below

2.2.1 Vibration Analysis

This approach is very popular and well accepted in plants to detect faults at an early stage. As a general rule, machine does not break down or fail without some form of warning, which is indicated by an increasing vibration level. The frequency range typically from approximately 1 Hz to near 20 kHz.This technique is used mainly to track mass unbalance, bent shaft, Misalignment and preloads, Crack, Fluid induced instability, Mechanical looseness and Bearing assembly looseness.The main advantage associated with vibration analysis is that, it is capable to diagnose an extensive range of faults or failure in rotating machinery and is very effective at detecting resonance. The main limitation associated wit this techinique is that, it is unable to monitor low speed machinery.

2.2.2 Ultrasonic inspection

In this approach, recorded high frequency emissions are electronically translated down and analyzed for enhanced diagnostics. Since ultrasound wave lengths are magnitudes smaller, this approach is much more conducive to locating and isolating the source of problems in loud plant environments. Related frequency ranges from 20 kHz to approximately 80 kHz. This technique is used mainly to track leak detection, bearing condition, lack of lubrication, over lubrication, ionization, cavitations, fault analysis of compressor's valve and Testing for arcing and corona in electrical apparatus etc. The main advantage associated with ultrasonic measurement is that it tends to be highly localized, capable for operating in loud and noisy environments, capable to be used in slow-speed machines and has a lower cost in contrast with vibration analysis. Its main disadvantage is limited diagnostic ability in comparison with vibration analysis, more reliable result is achievable when it is used as a complementary approach in an integrated package of conditioning monitoring techniques.

2.2.3 Thermography

Thermography is the process of using a thermal imager to detect emitted heat of objects. This technology allows operators to validate normal operations and, locate thermal anomalies which indicate possible faults. It is used mainly to track any fault that lead to temperature increase in components including: Friction unbalance, Shaft bent or bow, Misalignment and preloads, Bearing assembly looseness, Unsuitable lubrication and Electricals faults. It is a Simple, quick and efficient screening tool since it uses non-contact remote sensing. The main disadvantage assoiated with thermography is late warning of impending failure in comparison to vibration based methods. Likewise as extensive working experience about the faulty equipment and sufficient heat transfer knowledge is required to utilise this method for predictive maintanance.

2.2.4 Acoustic emission

Acoustic emissions are the sound waves or stress waves generated when a piece of material undergoes stress due to external forces. These waves can be measured to detect where the stress has caused wear or degradation, including crushing, cracking or any kind of impacts.It is usually used to track friction and wear, Leakage, Lack of lubrication, bearing assembly looseness, cracking, spalling and cyclic fatigue. It has an earlier detection rate in comparison to vibration analysis and has no spectral overlap with mechanical vibration, Likewise it is not affected by the mechanical noise from adjacent machinery or structural resonances and Only one AE sensor is sufficient. The only problem associated with this techique is that th signal attenuation may affect the results and can be difficult to process, interpret and classify the intelligent information from the acquired AE data.

2.3 Data Acquisition System

Data Acquisition is the process of measuring and analysing various electrical and physical entities like voltage, vibration, temperature, pressure etc. A DAQ system consists of sensors, signal conditioning circuitry, analog to digital converter, and application software. DAQ systems has several applications which include Research and Analysis, Control and automation, Design validation and Verification etc. DAQ's applications are not only limited to medical instruments, industrial equipment and other home appliances but are used for a variety of products. A simple data acquisition system usually consists of an arduino board connected with required sensors depending on

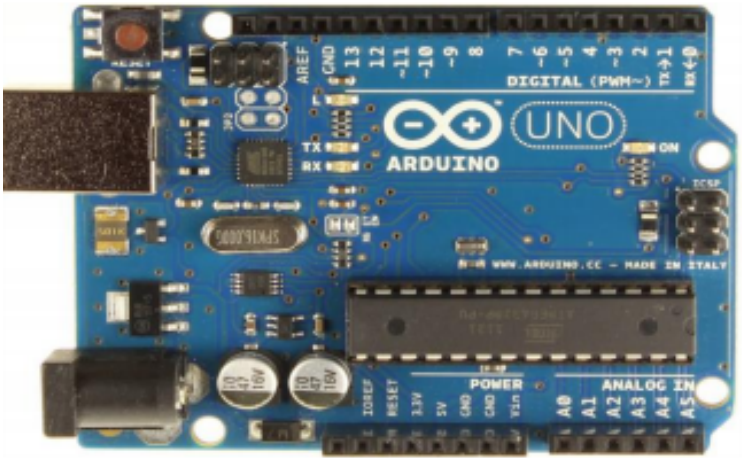

Figure 2.2: Ardunio UNOR3

the type of input required.

2.3.1 Ardunio UNOR3

The Ardunio UNO is a microcontroller board based on ATmega328. It has 14 digital input/output pins(of which 6 can be used as PWM outputs),6 analog inputs.(Uttam et al., 2017). It also has a 16MHz ceramic resonator,a USb connection a power jack, an ICSP header and a reset button.

2.3.2 Wifi Module

The WiFi module used in our system will help us to operate the web page for a customer.We can set a particular threshold vaue to limit the meter reading through these which will be interfaced with the help of MAX232 to ardunio UNO board.

2.4 Indirect purchases

According to Neef (2001) procurement materials can be divided into two separate categories: direct and indirect. Direct materials are those involved in the manufacturing process and related to the production of finished goods, whereas indirect materials relate to the materials that do not result directly in finished goods.

Telgen and de Boer (1995) identified the typical characteristics related to indirect purchases:
(1) They consist of a wide range of goods and services, which are often purchased from

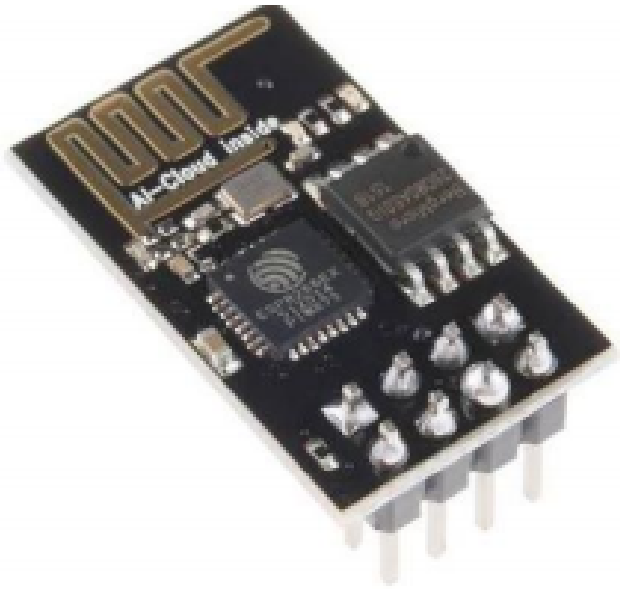

Figure 2.3: Wifi Module

an even larger number of suppliers.
(2) They are often time consuming as they consist of non-standardized items which are usually purchased in small orders.
(3) They show high end user involvement in the tactical purchasing phases which implies that indirect purchasing takes place virtually all over the firm.
(4) In total a lot of money is involved in indirect purchases, and
(5) they attract low attention from managers.

Due to the varying characteristics of purchasing indirect materials, buyers often have to spend a lot of time dealing with individual transactions. This means negotiating with suppliers, converting purchase requests to purchase orders, handling queries and ensuring the correct allocation of invoices received. This huge operational workload is time consuming and derives buyers to neglect more strategic tasks (Puschmann and Alt, 2005).

2.5 Procurement Process

The procurement process is one of the most important processes of a company. The procurement process usually varies between companies due to activity times and relations with suppliers (Trkman and McCormack, 2010). A basic procurement process starts with the specification of need and ends with settlement and payment. Presutti (2002) states that e-procurement systems have the power to transform the purchasing process because it has an effect on all of the steps identified.

E-procurement brings about important simplifications of the operational workload for buyers by decentralizing the operational procurement process, therefore improving the effectiveness and efficiency of the purchasing process and enabling buyers to focus on more strategic tasks (Presutti 2002; Puschmann & Alt 2005). When companies are adopting e-procurement solutions one has to remember that organizational changes (and / or process improvements) can often bring even greater savings than implementation of a simple technology (Trkman and McCormack 2010).

Kalakota and Robinson (2001, s.308) have listed the five key challenges Procurement managers are facing in the increasingly competitive business world:
- Reducing order processing cost and cycle times - Providing enterprise-wide access to corporate procurement capabilities
- Empowering desktop requisitioning through employee self-service
- Achieving procurement software integration with company's back office systems
- elevating the procurement function to a position of strategic importance within the organization

E-procurement can help companies to achieve the targets listed above. It can have an impact on the whole procurement function and its processes, as well as other corporate business functions for example accounting. Next, the benefits and challenges of implementing an e-procurement solution are examined.

2.6 Implementation of E-procurement

Implementing an E-procurement solution is not as simple as many businesses think Croom and Brandon-Jones (2005); Angels and Nath (2007). According to Yu, Yu, Itoga and Lin (2008) companies implementing e-procurement need to clearly understand the purpose of launching such a system. It involves careful analysis about how e-procurement will affect a company and its strategy and in which area it will obtain financial and non-financial benefits. The drivers and problem factors behind adopting E-procurement technologies vary between companies, when businesses are adopting e-procurement solutions there are several factors to consider on many levels of the organization.

To succeed in e-procurement implementation Kalakota and Robinson (2001, s.337-347) have proposed a seven step roadmap for business managers. The roadmap starts with clarification of goals and ends to the education of solutions end-users. According to the authors all of the steps need to be covered thoroughly in order to fully succeed in e-procurement implementation. Clarify your goals: Businesses should make sure that the business problem or goal is well defined and understood. Procurement

managers need to ask themselves what are the functions you are trying to improve and are the goals clearly defined and reachable Construct a process audit: After setting the goal businesses should analyse their current procurement process. It is important to understand where you are now, in order to reach the tomorrow. Businesses should first determine what kind of purchasing is the solution targeted to support: direct or indirect (Kalakota & Robinson 2001).

As Presutti (2002) states, for a business to realize maximum value from an E-procurement initiative, the whole purchasing process must be evaluated to determine if it needs to be re-engineered. Create a business case for e-procurement: Setting up a business case for E-procurement implementation can be useful, as it forces the company to systematically analyse the business (Kalakota & Robinson 2001).

Smart (2010) recognizes that there has been a problem in measuring the value of IT investments and in building a business case for such investments. This derives from the fact that, in many cases the benefits from implementing an E-procurement solution are intangible and non-financial therefore some traditional accounting based-methods such as ROI are not able to capture them (Piotrowicz & Irani, 2010). Develop a supplier integration matrix: Without supplier commitment and involvement, the e-procurement project is useless. Companies should develop a supplier integration matrix. The matrix helps determine what kind of relationship is best for individual vendors (Kalakota and Robinson, 2001). (Kalakota & Robinson 2001). Involving suppliers in organizations e-procurement deployment is important, since it also has a significant impact on suppliers IT-infrastructure and strategy (Croom and Brandon-Jones, 2005). As Smart (2010) identified, neglecting the impact of suppliers in company's e-procurement deployment may lead to the failure of the whole project. Select an e-procurement application: There is a variety of different e-procurement applications for companies to choose from (de. Boer et al., 2002). By categorizing the products and services purchased, companies can more easily decide on the required procurement strategies and e-procurement applications (Smeltzer, 2001).

Kalakota and Robinson (2001) suggest four questions that managers should think about, in order to define the right application for their company: Will it support my procurement process; does it leverage my other application investments; will it work seamlessly with other applications and; is it extendible? Remember: integration is everything: Integrating the e-procurement solution with suppliers and company's existing back-office systems is the most important thing in e-procurement implementation (Kalakota and Robinson, 2001). According to Croom and Brandon-Jones (2005) Integration with company's finance system had a direct impact on the level of process savings and was also an important determinant in selecting the application. Educate,

educate, educate: Redesigning the procurement process and influencing end-user behavior towards the new procedures and business rules is one of the 18 most critical factors in a successful e-procurement implementation (Angels and Nath, 2007). Change tends to generate resistance and managers should deal with it by communicating and encouraging employees to comply with the new guidelines (Kalakota and Robinson, 2001). Angels and Nath (2007) propose that providing information about their spend to employees encourages them to take ownership of savings targets with the use of re-engineered procurement processes.

2.7 Benefits of E-procurement

The benefits of adopting e-procurement technologies have been widely researched in the literature (Kalakota and Robinson 2001; Attaran & Attaran 2002; de Boer et al. 2002; Davila et al. 2003; Croom and Brandon-Jones 2005). The primary motivation for companies adopting e-procurement solutions has been cost reductions and process efficiencies. Croom and Brandon-Jones (2005) found that cost reductions in goods purchased comprise from three key issues: consolidation of purchase specifications; reducing the number of suppliers and; through improved compliance with existing contracts. A research by Quesada et al. (2010)proposes that E-procurement technologies affect positively to company's procurement practices and procurement performance. Positive impact on procurement practices facilitates the development of operational tasks in the procurement function, which leads to continuous improving. As the operational tasks are performed more effectively the procurement performance is enhanced.

According to Davila et al. companies using e-procurement solutions report savings of 42 percent in purchasing transactions costs. Another research by Croom and Johnston (2003) found that E-procurement implementation can have up to 75% cost reduction in procurement process costs and 16 - 18 % reduction in purchasing price for indirect purchases.

According to Croom and Brandon-Jones (2005) complying with existing contracts is an important mechanism for realizing lower prices and discounts. The savings that come out from automating the process derive from eliminating paperwork and human intervention, reducing transaction costs and cycle time and also from streamlining and automating the audit trail and approval process (Neef, 2001 s.48).

While the cost savings can be significant, de Boer et al. (2002) argue that the total volume of purchases needs to be high, as well as the amount of internal customers, in order to reach savings as high as mentioned above. The research by Davila et al. (2003) also identifies that companies using e-procurement gain additional control over

maverick spending and can reduce the headcount supporting purchasing transactions.

To support this Croom and Johnston (2003) found that e-procurement can have a major impact on compliance on many different levels of the procurement process: it supports managerial budgetary control; reduces data entering failures; offers greater transparency and accessibility to corporate wide spending; improves system reliability; and improves the access to managerial information.

2.7.1 E-procurement process risks

This risk relates to the security and control of the E-procurement process itself. Such issues can be related to, for example data security and fraud prevention e.g. fake suppliers, fake bids etc. As identified in the examination of earlier e-procurement literature, adopting E-procurement solutions can provide substantial cost savings and other benefits, but there are also challenges and risks companies need to take into account when considering e-procurement adoption. Making the procurement process more efficient and faster can be achieved with the use of e-procurement solutions. Nonetheless, this requires that the implementation process must be planned and executed thoroughly in order to minimize the challenges and risks companies might face. While indirect purchases can sometimes account for a big part of company's overall spending it is important that also these purchases are conducted following company policies and instructions. Using e-procurement only for indirect purchases in the beginning can act as stepping stone for companies before moving into comprehensive e-procurement which also involves direct purchases.

2.8 Relevance of Literature Reviewed

Use this section to write the relation between the problem being analysed and the relevance of the reviewed literature. Also, relate the concepts, tools and theory understood from the literature review to the research problem being discussed in this report.

2.9 Research Methodology

This section introduces the techniques and tools used for project work, especially, methodology and sample selection, research design, period of the study, sources of data, tools of data collection, tools for data analysis, statistical analysis, broad hypotheses put for testing, limitations, etc. This title resembles the section in Chapter 1,

Section 1.4. However, here the difference is that, the methodology has to be correlated with the literature review done in this chapter. In the previous chapter you will provide only an overview of the methods adopted in the project work.

Here you have to provide the design of the project work, setting hypothesis and hypothesis testing tools used, etc., data collection and collection methods, etc., under different sub-sections.

2.9.1 Data Collection

What are the sources of data for the work, how it was collected, type of source, etc. have to be discussed here.

2.9.2 Hypotheses

What hypothesis are to be set to achieve the objectives have to be discussed here. If there are multiple hypotheses related to different aspects, provide each of them with appropriate assumptions to be used.

2.9.3 Tools for Data Analysis

All the tools for the data analysis have to be provided in this section.

2.9.4 Tools for Hypothesis Testing

2.10 Summary

This is a must especially in this chapter, which will tell the reader what are the points you accepted for the analysis and which forms the basis for the study.

Chapter 3

EXPERIMENTAL DESIGN/DATA COLLECTION

An introduction to this chapter has to be provided here.

3.1 Inserting a Figure

A figure can be inserted as follows. Fig. 3.1 is in this section and so on.....

Figure 3.1: A sample figure inserted in a chapter

See how the figure in this chapter is used in another chapter to refer to it by its number and page number. Check Chapter 4, page no. 17.

3.1.1 Table referred here

We can see a sample table, Table 4.1, in page no. 17 referred in this section. Any floating objects like this can be referred without actually counting the page where it comes in the document. Just say what to be done, the rest is up to LaTeX.

Table 3.1: Expenses of Rakhul

Item	Rate	Qty.	Amount
Rice	34	5	170
Sugar	32	1	32
Salt	15	1	15
Chilli	150	0.25	37.5
		Total	254.5

Table 3.2: Modifications in a table design

Rakhul	Vrinda	Raveendran	Krishna	Anu
		Anna	Bhaskar	Nizam

3.1.2 A section in another chapter referred here

In Section **??**, page no. **??**, the different modes and different practices in e-procurement has been discussed. The research in e-procurement actually discusses the success stories of e-procurement.

3.2 Equation referred here

Any equation in the report can be referred anywhere like this. Eqn. (4.3), page no. 17 is a sample equation that says about the displacement of an object travelling with specific parameters.

3.3 Summary

Provide a paragraph to summarise every chapter.

Chapter 4

DATA ANALYSIS

In Chapter 3, a figure was inserted to show the capabilities of LaTeX. Now we can refer back to that figure like: Fig. 3.1, Page no. 15.

Like a figure, we can insert a table and refer it anywhere in the document. We had a table in page no. 16, numbered as Table 3.1. The following is another sample table. Provide captions for every table to enable readability. Usually the table captions are provided above the table, as in Table 4.1

Table 4.1: First sample table with the table caption above the table

Left align	Center	Right align
one	two	three
four	five	six

4.1 Equations

We can have many types of equations. They are single equation, equation array, and aligned equations. The first one below is a single equation.

$$p(x \leq n) = \sum_{i=0}^{n} \frac{e^{-\lambda x}(\lambda x)^{i}}{i!} \tag{4.1}$$

Now we can see an equation array.

$$f(x) = \lambda e^{-(\lambda x)} \quad \text{pdf of exponenial} \tag{4.2}$$

$$S = ut + \frac{1}{2}at^2 \tag{4.3}$$

The above equations are aligned to the right. We can make them aligned at any character. If we select the equal sign as the alignment position, we have to use align environment like this.

$$f(x) = \lambda e^{-(\lambda x)} \quad \text{pdf of exponenial} \tag{4.4}$$

$$S = ut + \frac{1}{2}at^2 \tag{4.5}$$

4.2 Using the equation, table and figure numbers globally

The above equations can be referred to at any position in the document. It is by its identifiers. Eqn. (4.5) measures the distance an object travels in time t, starting with an initial velocity u and an acceleration a. Eqn. (4.1) gives the cumulative probability of a Poison process that there will be n or less events in a given period of x units of time when the process has an average rate of λ per time.

In the same way we can refer any table or figure in the document at any place. Example, Table 5.2 is a sideways table, placed alone in a page.

4.3 Summary

Chapter 5

RESULTS AND DISCUSSIONS

The results of the analyses are presented in this chapter divided in to different sections. Each section presents results of one analysis each.

5.1 Sub-figures

Here we will discuss how to include figures side by side. Assume there are two figures to be added. We have to create **subfigure** environment inside the figure environment.

(a) First sub-figure caption

(b) Second sub-figure caption

Figure 5.1: Common Caption for the Two Figures

5.2 Tables

Another table can be sideways as shown in the next page, Table 5.2. The table is long and therefore a separate page is used.

Table 5.1: Results of analysis to determine the impact of factor A on system performance

Col 1	Col 2	Col 3	Col 4
Row 1	a	b	c
Row 2	A	B	C
Row 3	α	β	δ

5.3 Summary

Table 5.2: Performance After Post Filtering

Audio	Audibility	Decision	Sum of Extracted Bits						
Police	5	soft	1	−1	1	1	−1	−1	1
		hard	2	−4	4	4	−2	−4	4
Beethoven	5	soft	1	−1	1	1	−1	−1	1
		hard	8	−8	2	8	−8	−8	6
Metallica	5	soft	1	−1	1	1	−1	−1	1
		hard	4	−8	8	4	−8	−8	8

Chapter 6

CONCLUSIONS

Here comes the conclusions derived after completion of the project work. This chapter should provide the future directions for the current work. This chapter can extend to any number of pages. If it goes into many pages, keep them under different and appropriate sections.

REFERENCES

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