Chapter: 3
Research Methodology
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RESEARCH METHODOLOGY

Further to literature review, the research objectives have been identified. To achieve the stated objectives, the research methodology involved designing of the questionnaire, administering the questionnaire to the target groups, tabulation and analysis of the data. The questionnaire was designed based on the literature review, brain storming with the industry executives and feedback from pilot study. The questionnaire was administered through mail survey and personal visit.

To achieve the last research objective of comparing traditional procurement model with that of E-Procurement model using simulation software ARENA an “AS/IS” model of traditional procurement process is built by studying the various activities associated with traditional procurement process and compared with “TO/BE” model of E-Procurement process.

3.1 Questionnaire Design.

The relevancy & accuracy of data collected depends mainly on the questionnaire. Questionnaire is tool to obtain & record specified & relevant information with acceptable accuracy & completeness. In other words it channelizes the questioning process and promotes clear proper recording. The task of designing a questionnaire may be considered more an art rather than a science. In order to design an effective questionnaire the design process should follow a series of practical steps as shown in figure below.

![Questionnaire Design Flowchart](image-url)

Figure 3.1: Questionnaire Design Flowchart.
3.1.1 Structure of the Questionnaire.

The questionnaire was basically divided into four parts to ease the answering by the respondents. The first part of questionnaire was designed to collect the particulars of the respondents such as name of the person, designation, company and address of the person completing the questionnaire.

The second part of the questionnaire aimed at collecting the general information such as the type of the company, number of years into operation and about their IT usage.

The third part of the questionnaire intended to collect the current material procurement practice like means used for selecting the supplier, tools or methods used for negotiating with the supplier, issue of purchase orders, issue of payments, track the delivery of the material order, way they organize their purchasing correspondence and also check how the respondent rated the different communication methods used for purchasing material or service for the organization.

The fourth part of the questionnaire was designed with goal of studying the factors affecting the adoption of E-Procurement from the view point of perceive value, trust on supplier and trust on Information Technologies and their direction or strategies towards E-Procurement.

3.1.2 Response scale.

A 5-point scale with 2 being “least important”, 10 being “most important” was used. The type of statistical analysis required for this study (i.e. multiple regression analysis) dictated the use of an interval scale, one which guaranteed that the distances between adjacent numbers were the same. As advised by Allen and Rao (2000), calculating means and standard deviations are “highly suspect” if ordinal-level scales are used. Typically, it is easier to give ratings in terms of percentages or points e.g. 80 per cent or 80 points. The simplicity of a 10-point scale is preferred as compared to the scale of any other number (5 or 7) that may need more explanations. Further, for a narrow scale there are low levels of inter-correlation and limited variance. This was particularly important, with variance explanation being the main concern for this study.
3.1.3 Target population.

The target respondents i.e., small and medium scale industries (SME’s) randomly selected from directory of Karnataka small scale industries association (KASSIA), directory has got more than 5000 registered members out of which 4000 members were selected based on the nature of work (manufacturing) and questionnaire was mailed to them and a personal visit to selected companies and response to the questionnaire was taken.

In total the response received response from respondents were 373 and out of which 347 (Response Rate 8.67%) responses were uses full for our study.
3.1.4 Sample Design.

All items in any field of inquiry constitute a universe or population. A complete enumeration of all items in the population is known as a census inquiry. It can be presumed that in such an inquiry, when all items are covered, n elements of chance is left and highest accuracy is obtained.

But in practice this may not be true. When the field of inquiry is large, this method becomes difficult to adopt because of the resources involved. At times, this method is practically beyond the reach of ordinary researchers.

Perhaps, government is the only institution, which can get the complete enumeration carried out. When field studies are undertaken in practical life, considerations of time and cost almost invariably lead to a selection of respondents. Selection of only a few items, the respondents selected should be as representative of the total population as possible in order to produce a miniature cross-section. The selected respondents constitute what is technically called a sample and the selection process is called sampling technique. The survey so conducted is known as sample survey.

**Non-probability sampling**: Non-probability sampling is that sampling procedure which does not afford any bias for estimating the probability that each item in the population has of being included in the sample. Non probability sampling is also known by different names such as deliberate sampling, purposive sampling and judgment sampling. In this type of sampling, items remain for the sample are selected deliberately by the researcher. His choice concerning the items remains supreme. In other words, under non probability sampling the organizers of the inquiry purposively choose the particular units of the universe for constituting a sample on the basis that the small mass that they so select out of a huge one will be typical or representative of the whole. In such a design, personal element has a great chance of entering into the selection of the sample. The investigator may select a sample which shall yield results favorable to his point of view and if that happens, the entire inquiry may get vitiated. Thus, there is always the danger of bias and have the necessary experience so as to take sound judgment; and the results obtained from an analysis of deliberately selected sample may be tolerably reliable.
**Probability sampling:** Probability sampling is also known as random sampling. Under this sampling design, every item of the universe has an equal chance of inclusion in sample. It is, so to say, a lottery method in which individual units are picked up from the whole not deliberately but by some mechanical process. Here it is blind chance alone that determines one item or the other selected.

**Complex random sampling designs:** Probability sampling under restricted sampling techniques, as stated above may result in complex random sampling designs. Such designs may as well be called mixed sampling designs for many of such designs may represent a combination of probability and non probability sampling procedures in selecting a sample. Some of the popular complex random sampling designs are as follows:

- **Systematic sampling:** The most practical way of sampling is to select every item on a list. Sampling of this type is known as systematic sampling.
- **Stratified sampling:** If a population from which a sample is to be drawn does not constitute a homogeneous group, stratified sampling technique is generally applied in order to obtain a representative sample.
- **Cluster sampling:** If the total area of interest happens to be a big one, a convenient way in which a sample can be taken is to divide the area into a number of smaller non overlapping areas and then to randomly select a number of these smaller areas, with the ultimate sample consisting of all units in these small areas or clusters.
- **Area sampling:** If clusters happen to be some geographic subdivisions in that case cluster sampling is better known as area sampling. In other words, cluster designs where the primary sampling unit represents a cluster of units based on geographic area are distinguished as area sampling.

**Multi stage sampling:** Multi stage sampling is a further development of the principle of cluster sampling. Suppose we want to investigate the working efficiency of nationalized banks in India and we want to take a sample of few banks for this purpose. The first stage is to select large primary sampling unit such as states in a country. Then we may select certain districts and interview all banks the chosen
districts. This would represent a two stage sampling design with the ultimate sampling units being clusters of districts.

The type of sampling considered for this survey is Judgmental sampling or convenient sampling. Judgmental sampling or convenient sampling which falls under the preview of non probability sampling design is used in this particular study. Judgmental sampling requires special efforts to locate and gain access to the individuals who possess the required information. Here, the decision of expert is used to identify a representative sample.

Bangalore which is home to many small and medium scale industries and has several industrial areas located in around Bangalore. The target respondents i.e., small and medium scale industries (SME’s) were selected from directory of Karnataka small scale industries association. While selecting the respondents for survey due care was taken to see that the SME’s from industrial areas such as Peenya Industrial area, Bommasandra Industrial area, Jigani Industrial area, Bommanahalli, Rajajinagar, Chokkasandra, Magadi road, Mysore road and Malleshwaram are included in this survey. Thus the sample that was designed represented the entire population of SME’s located in around Bangalore and in turn represent SME’s in India.

3.1.5 Questionnaire Administration.

The administration of questionnaire to the target group assumes primary importance in the data collection phase. There are various methods being followed for survey studies through questionnaire. The choice of survey administration method or mode is influenced by several factors such as costs, coverage of target population and sampling, flexibility of asking questions, respondents’ willingness to participate, response accuracy, etc. The response to the questionnaire can be obtained through mail, telephone, face to face, computer, online, personal mall intercept survey and scanning questionnaires.

The study employed a cross-sectional field study survey method. Using self-administered questionnaires mailed to 4000 Karnataka small scale industries association (KASSIA) members selected were based on the nature of work
The respondents were promised anonymity and informed that only aggregate information on participants would be made public.

### 3.1.6 Data Tabulation and Analysis.

The data collected from questionnaire has been analyzed for various factors. A summary of the findings projecting the current material procurement practice and their perception about the factors affecting the adoption of E-Procurement are documented pictorially. After the collection of filled up questionnaire from the respondents, the values accorded to each question in the questionnaire have been converted to weighted averages and tabulated in the MS-EXCEL spread sheet. The analysis involved question wise pictorial representation of each question to get a better picture of the survey findings.

The quantitative data collected was subjected to various statistical analyses. In this study, a default $\alpha$ of 0.05 was used to determine the level of significance. For the conduction of statistical analysis, a statistical software- SYSTAT has been extensively used. SYSTAT can be regarded as System for Statistics. It is a statistical package that supports more graphs. SYSTAT is an integrated, desktop statistics and graphical package designed to provide a selection of statistics and high quality, interactive graphics. This software also includes basic and advanced statistics, an intuitive user interface and an interactive library of statistical graphics tools and publication quality charts. The analysis involved fitting a regression equation and an empirical model was obtained based on the statistical analysis carried out on the data.

### 3.1.7 Variables in questionnaire.

Past literature reveals that a great amount of research has been carried on the factors affecting the adoption of E-Procurement and different researchers have studied wide Varity of factors affecting the adoption of E-Procurement by SME’s. In this research the factors affecting the adoption E-Procurement is studied under three heads.

- **Perceived value:** The first one being the perceived value associated with adoption of E-Procurement over tradition procurement methods. E-Procurement helps the organization in procure in the product or service at lesser price compared to
average market price thereby providing price benefit to the organization. Transaction cost benefits are due to the reduction in cost associated with search, negotiation and contracting, and coordination. Technology lock-in costs are costs involved in choosing and using a particular procurement system, including switching costs, opportunistic behavior by contracted suppliers. These costs are offset by the extent of protection from uncertainty. The Five items loaded on the factor has an alpha reliability **0.597**.

- Improves the competitiveness of company (PV₁).
- Reduce the time spent on procurement of material (PV₂).
- Enhance the company’s image in the market (PV₃).
- Reduces the procurement cost (PV₄) and
- Increases the supplier base (PV₅).

**Trust on supplier:** The second one tries to explore how trust on supplier affects the adoption of E-Procurement and to explore this the respondents were asked the respondents to rate the following factors that would affect the adoption of E-Procurement by SME’s. The six items loaded on the factor has an alpha reliability **0.741**.

- Contract liability concerns (TS₁).
- Dealing with unknown suppliers / no proven track record (TS₂).
- Fear of losing valuable proprietary and confidential information (TS₃).
- Quality of product supplied (TS₄).
- Quality of services provided (TS₅).
- Up-to-date information provided (TS₆).

**Trust on information technology:** In line with the second factor the third factor tries to excavate how the respondents felt about trust on information technology and the adoption of E-Procurement by SME’s in order to do so the following points were presented to the respondents. The six items loaded on the factor has an alpha reliability **0.779**.

- Legal legitimacy issues (TI₁).
- Internet security concerns (TI₂).
- Fear of losing valuable proprietary and confidential information (TI₃).
• Lack of faith in the transaction and data integrity (TI4).
• No common accepted standard (TI5).
• Rapid change of technologies (TI6).

3.2 Mathematical Modelling for maximizing the adoption of E-Procurement by SME’s.

Mathematical model uses mathematical language to describe a system. These models are used in engineering, natural sciences, engineering disciplines and social sciences. The process of developing a mathematical model is termed as mathematical Modelling. It is the representation of the essential aspects of an existing system which presents knowledge of that system in usable form. A mathematical model usually describes a system by a set of variables and a set of equations that establish relationships between the variables. The values of the variables can be practically anything—real/integer numbers, Boolean values/strings.

Objectives and constraints of the system and its users can be represented as function of output variables or state variables. The objective functions will depend on the perspective of the models user. Depending on the context, an objective function is also known as an index of performance as it is some measure of interest to the user. Although there is no limit to the number of objective functions and constraints a model can have, using or optimizing the model becomes more involved.

Mathematical models are usually composed by variables which are abstractions of quantities of interest in the described systems and operators that act on these variables which can be algebraic operators, functions, differential operators, etc. If all the operators in the mathematical model represent linearity, the resulting mathematical model is defined as linear. A model is considered to be non linear otherwise.

One of the crucial parts of Modelling is evaluating whether or not a given mathematical model describes a system accurately. There are different types of evaluation mechanisms and the most common type is fit to empirical data.

Based on the information collected through survey and statistical analysis, weights were awarded to various parameters influencing the adoption of E-Procurement.
A linear programming problem was formulated with objective function as maximization of the adoption behavior.

### 3.2.1 Linear Programming Problem.

The LPP problem is formulated as follows:

- The Objective Function was determined by selecting the parameters affecting adoption of E-Procurement. These parameters were given weights based on the interaction with the industry experts and literature survey. Each parameter along with its weight was assigned to the Objective Function.
- The decision variables considered for the model are Perceived value, Trust on supplier, and Trust on information technology.
- The constraints were applied to each of the parameters. Each constraint had certain number of sub-parameters in it based on the questionnaire. Each of these constraints was ranked and corresponding weights were assigned. Now the value of all these constraints is ideally 10 on the response scale chosen, but this isn’t practical. Hence each constraint was assigned a certain ranking and weight was assigned based on the interaction with the industry experts and literature survey. Now both the Objective Function and the constraints values are entered in to the STORM package and the results were obtained.
- Sensitivity Analysis was conducted as follows: The constraints values were varied in steps of 0.5 from a minimum to maximum. The corresponding Objective Function Values were noted down. The slope was found out by

\[
\text{Slope} = \frac{(Z_{i+1} - Z_i)}{0.5}
\]

- The slopes for the different iterations were calculated and plotted.

The LPP model formulated for maximizing the adoption of E-Procurement by SME’s has five constraints.

### 3.2.2 Building blocks for Model Formulation.

**Decision Variables:**

- **PV**: Perceived value
  
  \(PV_1\) = Improve the competitiveness of company
PV_2 = Reduce the time spent on procurement of material
PV_3 = Enhance the company’s image in the market
PV_4 = Reduces the procurement cost
PV_5 = Increases the supplier base

**TS: Trust on supplier**
- TS_1 = Contract liability concerns
- TS_2 = Dealing with unknown suppliers / no proven track record
- TS_3 = Fear of losing valuable proprietary and confidential information
- TS_4 = Quality of product supplied
- TS_5 = Quality of services provided
- TS_6 = Up-to-date information provided

**TI: Trust on information technology**
- TI_1 = Legal legitimacy issues
- TI_2 = Internet security concerns
- TI_3 = Fear of losing valuable proprietary and confidential information
- TI_4 = Lack of faith in the transaction and data integrity
- TI_5 = No common accepted standard
- TI_6 = Rapid change of technologies

**Objective Function:**
Maximize \( Z = 0.45 \cdot TS + 0.35 \cdot TI + 0.2 \cdot PV \)
Subject to constraints:
1) \( 0.25 \cdot PV_1 + 0.2 \cdot PV_2 + 0.25 \cdot PV_3 + 0.2 \cdot PV_4 + 0.1 \cdot PV_5 \leq 7.5 \)
2) \( 0.2 \cdot TS_1 + 0.15 \cdot TS_2 + 0.15 \cdot TS_3 + 0.2 \cdot TS_4 + 0.2 \cdot TS_5 + 0.1 \cdot TS_6 \leq 7.5 \)
3) \( 0.2 \cdot TI_1 + 0.2 \cdot TI_2 + 0.15 \cdot TI_3 + 0.15 \cdot TI_4 + 0.2 \cdot TI_5 + 0.1 \cdot TI_6 \leq 7.0 \)
4) \( PV_1, PV_2, PV_3, PV_4, PV_5, TS_1, TS_2, TS_3, \)
\( TS_4, TS_5, TS_6, TI_1, TI_2, TI_3, TI_4, TI_5, TI_6 \leq 10 \)
5) \( PV_1, PV_2, PV_3, PV_4, PV_5, TS_1, TS_2, TS_3, \)
\( TS_4, TS_5, TS_6, TI_1, TI_2, TI_3, TI_4, TI_5, TI_6 \geq 0 \)

With a research objective of understanding time and cost benefits of adoption of E-Procurement by SME’s in India. A medium scale automobile parts manufacturing company was approached which want to transform its procurement process. But prior to transformation the company want to understand the time and cost benefit associated with this transformation. As it was difficult to locate a SME’s that had completely adopted E-procurement, so that a comparative study can done before and after implementation of E-Procurement this comparative study was done using a simulation model.

Procurement process of a medium scale automobile parts manufacturing company was studied in detail and both qualitative data and quantitative data was collected. Qualitative data was related to the nature of the processes taking place at various stages of the procurement process. Using this data AS/IS model of traditional procurement is built using ARENA simulation Modelling software. After studying in detail the activities that can be automated or eliminated by adopting E-Procurement technologies a TO/BE model of E-Procurement process was also modeled using the same software.

The procurement function in AS/IS model involved forty-four distinctive activities and performed by the following departments Purchasing, Warehouse and Finance / Accounting. In TO/BE model this activities get reduced to twenty in number because of automation or elimination by adopting E-Procurement technologies. For each department i.e. Department, Purchase, Warehouse and Finance/Accounting; the activities, resource, time and salary is found out. This data is used to run the simulation model.

3.3.1 Procurement Activities in a Traditional Procurement model.

Demand planning is the initial and the most crucial step in a purchase process as applied to an industry as the components should be available as and when the customer orders for it. The main source for planning the demand would be from the customer end.
• Identification of need follows the demand planning. Demand planning gives a vague idea about the type and number of goods to be produced. In this step, the technical and commercial feasibility is taken into consideration and the decisions based on the exact number of components to be manufactured are considered. This could be done by analyzing the previous customer orders. Demand planning and identification of need happens at individual department level, once the need has been identified it’s communicated to the purchase department for the further action.

• Once the requisition is accepted the current inventory is checked. If the inventory at the stock is sufficient for carrying out the production process, the raw material is reserved for the same and the concerned employee is notified so as to schedule for production. If the inventory at the stock is not sufficient for carrying out the production process and selecting the best supplier is not required. Supplier is asked to send in their quotations for the same order fulfillment.

• If the inventory at the stock is not sufficient for carrying out the production process and selecting the best supplier is required, then the purchase requisitions from various suppliers are collected and shortlisted. Supplier is asked to send in their quotations for the same order fulfillment.

• Waiting for proposal is the delay on the part of the supplier to send in the proposal to the purchase authority. This includes all the negotiated terms and commercial and legal conditions and must be duly signed by the authorities concerning the supplier.

• Once the proposal is received from various suppliers, the various conditions concerning price, transportation, quantity, quality are scrutinized and a rating is assigned for each supplier.

• Based on these ratings, if the commodities are to be imported from a single supplier or multiple suppliers are decided and a formal agreement is made.

• A purchase order containing the specification of every component to be brought is prepared.

• Sending purchase order to supplier is the delay which is incurred when the purchase order needs to be sent to the supplier. If this purchase order is
acknowledged by the supplier then they wait for the delivery note else the
terms and conditions are reconsidered and a new purchase order is prepared.

- This delivery note is accepted by the receiving department of the manufacturer
  along with the raw materials ordered.
- The delivery note is verified with the terms and conditions specified in the
  order. In case of any deviations negotiations take place between the
  manufacturer and the supplier and only after an agreement is reached, the
  delivery note is signed.
- Once the delivery note is signed, information is sent so as to unload the
  material and this follows the thorough inspection of the material received.
- Once the authorities concerned with the inspection procedures confirm that the
  delivery is of acceptable standards, the delivery is formally accepted.
- The acceptance of goods culminates by filling in the acceptance slip which
  contains the record of every item received along with its code.
- The signed acceptance slip is then sent to the purchase department to finalize
  with the pending financial transactions. After this stage no kinds of rejections
  can be made to the supplier.
- Waiting for invoice is the time delay involved in finalizing with the invoice of
  the materials involved.
- Once the invoice is received, acknowledgement is made of the invoice thus
  received confirming it to be as per as the terms and conditions previously
  discussed.
Figure 3.4: procurement activities in Purchase Department.
Receipt of order from purchase department

Accepting delivery note

Comparison of order and delivery note

Agreement?

No

Reject delivery

Inform purchase department

Yes

Sending goods for unloading

Agreement?

No

Yes

Delivery acceptance

Filling in acceptance slip

Sending acceptance slip to purchase department

Figure 3.5: procurement activities in Warehouse.
3.3.2 Simulation Using Arena Software.

Arena software lets people to bring the power of Modelling and simulation to business process improvement. It is designed primarily for simulation. Typically; any process that can be described by means of a flowchart can be simulated with Arena software. Arena is most effective when analyzing business, service, or simple (nonmaterial-handling intensive) manufacturing processes or flows.

Typical scenarios include:

- Documenting, visualizing, and demonstrating the dynamics of a process with animation.
• Predicting system performance based on key metrics such as costs, cycle times, and utilizations.
• Identifying process bottlenecks such as queue build ups and over-utilization of resources.
• Planning staff, equipment or material requirements.

3.3.3 Model conceptualization.

Model conceptualization mainly deals with the assumptions, assumption are made during Modelling. In this case different assumptions are made. For procurement process following are the assumptions.

• Per month number of working days is considered as 22. Also number of working hours per day is 8 hours.
• Data is collected on the basis of expert opinion.
• Any number of work done by the resource gives him the salary on a monthly basis. This cost is considered as value added cost for the procurement and as well as for E-Procurement process. In resource field cost is added hourly.
• Information flow is not considered.
• Cost is calculated on hourly basis.

For E-Procurement process, the assumptions made are as follows:

• Many activities present in the traditional procurement will become unnecessary for the E-Procurement processes model they are removed.
• The bidding or the auction process will become an online process. Hence time for that process will come down.
• Online money transfer is introduced.
• Only the material flow is considered.

Generally in triangular distribution is used in the time delay; we also want to capture the natural variability that exists in most processes. Very often, for work done by people or equipment, a triangular distribution provides a good approximation. The minimum time, in which the work could be done, the most likely value for the time delay, and the maximum duration of the process is considered. The details of the activities are presented in Table below.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Resources</th>
<th>Min Time</th>
<th>Max Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify a need and prepare purchase requisition</td>
<td>Employee</td>
<td>15 min</td>
<td>80 min</td>
</tr>
<tr>
<td>Accepting requisition</td>
<td>Purchasing officer</td>
<td>15 min</td>
<td></td>
</tr>
<tr>
<td>Inventory level checking</td>
<td>Purchasing officer</td>
<td>10 min</td>
<td>40 min</td>
</tr>
<tr>
<td>Is Inventory sufficient?</td>
<td>25% True</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reserve raw material and notifying the employee</td>
<td>Purchasing officer</td>
<td>15 min</td>
<td></td>
</tr>
<tr>
<td>Selecting the best supplier is necessary?</td>
<td>35% True</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collecting and combining purchase requisitions</td>
<td>Purchasing officer</td>
<td>10 min</td>
<td>60 min</td>
</tr>
<tr>
<td>Issuing and Request for Quotation(RFQ)</td>
<td>Purchasing officer</td>
<td>10 min</td>
<td>30 min</td>
</tr>
<tr>
<td>Find a qualified supplier</td>
<td>Purchasing officer</td>
<td>15 min</td>
<td>180 min</td>
</tr>
<tr>
<td>Waiting for proposals</td>
<td></td>
<td>1 week</td>
<td></td>
</tr>
<tr>
<td>Evaluation of terms and conditions and negotiations</td>
<td>Purchasing director</td>
<td>1 hr</td>
<td>3 hr</td>
</tr>
<tr>
<td></td>
<td>Purchasing officer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selection of 1 or 2 suppliers</td>
<td>Purchasing director</td>
<td>20 min</td>
<td></td>
</tr>
<tr>
<td>Prepare purchase order</td>
<td>Purchasing officer</td>
<td>10 min</td>
<td>30 min</td>
</tr>
<tr>
<td>Waiting for approval</td>
<td></td>
<td>0 hr</td>
<td>24 hr</td>
</tr>
<tr>
<td>PO approval</td>
<td>Purchasing director</td>
<td>20 min</td>
<td></td>
</tr>
<tr>
<td>Sending Purchase order to supplier</td>
<td>Purchasing officer</td>
<td>15 min</td>
<td></td>
</tr>
<tr>
<td>Waiting for acknowledgement</td>
<td></td>
<td>1 hr</td>
<td>48 hr</td>
</tr>
<tr>
<td>PO acknowledgement?</td>
<td>85% True</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Updating and sending PO</td>
<td>Purchasing officer</td>
<td>15 min</td>
<td>30 min</td>
</tr>
<tr>
<td>Sending order to receiving clerk</td>
<td>Purchasing officer</td>
<td>10 min</td>
<td></td>
</tr>
<tr>
<td>Waiting for delivery</td>
<td></td>
<td>1 day</td>
<td>10 days</td>
</tr>
<tr>
<td>Accepting delivery note</td>
<td>Stores in charge</td>
<td>10 min</td>
<td></td>
</tr>
<tr>
<td>Comparison of order and delivery note</td>
<td>Stores in charge</td>
<td>10 min</td>
<td>20 min</td>
</tr>
<tr>
<td>Agreement?</td>
<td>95% True</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reject delivery</td>
<td>Stores in charge</td>
<td>20 min</td>
<td></td>
</tr>
<tr>
<td>Inform purchase dept.</td>
<td>Stores in charge</td>
<td>5 min</td>
<td>15 min</td>
</tr>
<tr>
<td>Reconciliation</td>
<td>Purchasing officer</td>
<td>30 min</td>
<td>120 min</td>
</tr>
<tr>
<td>Sending goods for unloading</td>
<td>Stores in charge</td>
<td>5 min</td>
<td></td>
</tr>
<tr>
<td>Agreement?</td>
<td>95% True</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery acceptance</td>
<td>Stores in charge</td>
<td>15 min</td>
<td>120 min</td>
</tr>
<tr>
<td>Filling in acceptance slip</td>
<td>Stores in charge</td>
<td>5 min</td>
<td>15 min</td>
</tr>
<tr>
<td>Sending acceptance slip to purchase dept.</td>
<td>Stores in charge</td>
<td>10 min</td>
<td>30 min</td>
</tr>
<tr>
<td>Activity</td>
<td>Resources</td>
<td>Min Time</td>
<td>Max Time</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Waiting for invoice</td>
<td></td>
<td>0 day</td>
<td>10 days</td>
</tr>
<tr>
<td>Registering invoice</td>
<td>Purchasing officer</td>
<td>10 min</td>
<td></td>
</tr>
<tr>
<td>Comparing bill, acceptance slip and PO</td>
<td>Purchasing officer</td>
<td>15 min</td>
<td>25 min</td>
</tr>
<tr>
<td>Compared</td>
<td></td>
<td></td>
<td>95% True</td>
</tr>
<tr>
<td>Reconciliation</td>
<td>Purchasing officer</td>
<td>10 min</td>
<td>30 min</td>
</tr>
<tr>
<td>Authorizing invoice</td>
<td>Employee</td>
<td>10 min</td>
<td>30 min</td>
</tr>
<tr>
<td>Confirming invoice for payment</td>
<td>Accountant</td>
<td>10 min</td>
<td>60 min</td>
</tr>
<tr>
<td>Creating and transmitting payment orders</td>
<td>Accountant</td>
<td>10 min</td>
<td>15 min</td>
</tr>
<tr>
<td>Booking invoice</td>
<td>Accountant</td>
<td>15 min</td>
<td></td>
</tr>
<tr>
<td>Waiting for bank statement</td>
<td></td>
<td>1 day</td>
<td>2 days</td>
</tr>
<tr>
<td>Booking payments (accounts payable)</td>
<td>Accountant</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Filling invoice</td>
<td>Financier</td>
<td>10 min</td>
<td>15 min</td>
</tr>
</tbody>
</table>
Table 3.2: Timings Description of the various activities in E-Procurement process.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Resource</th>
<th>Min Time</th>
<th>Max Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify a need and prepare purchase requisition</td>
<td>Employee</td>
<td>15 min</td>
<td>80 min</td>
</tr>
<tr>
<td>Inventory level checking</td>
<td>Purchasing officer</td>
<td>10 min</td>
<td>40 min</td>
</tr>
<tr>
<td>Is Inventory sufficient?</td>
<td></td>
<td>25% True</td>
<td></td>
</tr>
<tr>
<td>Reserve raw material and notifying the employee</td>
<td>Purchasing officer</td>
<td>15 min</td>
<td></td>
</tr>
<tr>
<td>Selecting the best supplier is necessary?</td>
<td></td>
<td>35% True</td>
<td></td>
</tr>
<tr>
<td>Requisition approval</td>
<td>Purchasing director</td>
<td>10 min</td>
<td>15 min</td>
</tr>
<tr>
<td>E Bidding</td>
<td>Purchasing director</td>
<td>15 min</td>
<td>30 min</td>
</tr>
<tr>
<td>Selection Of Low Bidding And Approving Supplier</td>
<td>Purchasing director</td>
<td>10 min</td>
<td>20 min</td>
</tr>
<tr>
<td>Purchase order generation and transmission</td>
<td>Purchasing officer</td>
<td>5 min</td>
<td>30 min</td>
</tr>
<tr>
<td>Reconciliation</td>
<td>Purchasing officer</td>
<td>30 min</td>
<td>120 min</td>
</tr>
<tr>
<td>Waiting for delivery</td>
<td></td>
<td>1 day</td>
<td>10 days</td>
</tr>
<tr>
<td>Accepting delivery note</td>
<td>Stores in charge</td>
<td>10 min</td>
<td></td>
</tr>
<tr>
<td>Sending goods for unloading</td>
<td>Stores in charge</td>
<td>5 min</td>
<td></td>
</tr>
<tr>
<td>Agreement?</td>
<td></td>
<td>95% True</td>
<td></td>
</tr>
<tr>
<td>Delivery acceptance</td>
<td>Stores in charge</td>
<td>15 min</td>
<td>120 min</td>
</tr>
<tr>
<td>Filling in acceptance slip (confirming acceptance)</td>
<td>Stores in charge</td>
<td>5 min</td>
<td>15 min</td>
</tr>
<tr>
<td>Reject delivery</td>
<td>Stores in charge</td>
<td>20 min</td>
<td></td>
</tr>
<tr>
<td>Inform purchase department</td>
<td>Stores in charge</td>
<td>5 min</td>
<td>15 min</td>
</tr>
<tr>
<td>Confirming invoice for payment</td>
<td>Accountant</td>
<td>10 min</td>
<td>60 min</td>
</tr>
<tr>
<td>Creating and transmitting payment orders</td>
<td>Accountant</td>
<td>10 min</td>
<td>15 min</td>
</tr>
</tbody>
</table>
Figure 3.7: Procurement Activities in E-Procurement model.
Figure 3.8: Arena Model of Purchase Department.
Figure 3.9: Arena Models of Warehouse and Finance Department.
Figure 3.10: Arena Model of E-Procurement.