**1.3 Motivation**

The delay in tracking of materials/items and constant risk of miscalculations in the Finance/Accounts as is manually done now, delay in updating process as the materials are issued to users, cost implications of paper work for each transaction done, accumulation of processing papers and non-availability of stock or inventory information instantly or readily for the management to take decision poses serious concerns and therefore intensified the need to design and implement an online Bill of Materials/Quantity System for Power Transmission Company of Nigeria (TCN), Enugu Sub Region.

**1.4 Aims and Objectives**

The aim of this study is the design and implementation of an Online Bill of Materials/Quantity System. To realise the above aim, the specific objectives of the study are as follows:

1. To design an on-line Bill of Materials/Quantity system.
2. To implement an on-line Bill of Materials/Quantity system
3. To evaluate the on-line Bill of Materials/Quantity system

**1.5 Significance of the Study**

The project work will help in a good number of ways to ease the delay in tracking of materials and instruments, updating of records, complex calculations and easy access to inventory information by the management and finance/accounts personnel, even remotely.

The software developed will help TCN Enugu Sub Region to achieve efficient and effective Billing System. There are many other advantages, and some of them are listed below:

1. It saves time during inventory processing
2. Database for the materials and their usage is maintained.
3. References are very fast and delay can be avoided.
4. It allows easy access to stored information.
5. It provides a medium for Management and Finance/Accounts Department personnel to interact and take decision.
6. It helps in reducing costs such as stationeries and labour.
7. Generation of accurate information on transaction is ensured.
8. Remote access of inventory information.
9. Risk of miscalculations during billing is eliminated.

**1.7 Organization of the Work**

This project is concerned with design and implementation of Bill of Materials/Quantity system, a study of TCN Enugu Sub Region. The report is divided into five chapters.

Chapter one gives the general introduction which includes background of the study, discusses statement of problem, aims and objectives, significance of the study and definition of terms.

Chapter Two reviews related and current literature pertinent to the project.

Chapter three contains research methodology which includes design consideration

and architecture, data collection method, system design, input design, process design and output design.

Chapter four contains implementation and evaluation; system hardware and software requirements, data source, implementation procedure, algorithm / pseudo-codes,

Sample Implementation input snapshots, sample implementation output snapshots,

evaluation and discussion of results.

Finally, the fifth chapter discusses the summary of results, conclusions and recommendations based on findings.

**1.8 Definition of Terms**

**BILL OF QUANTITY (BOQ):** It is a document prepared by a cost consultant that provides project specific measured quantities of the items of work identified by specifications in the tender documentation.

**BILL OF Martials (BOM)**: It is a list of materials, sub-assemblies or intermediate assemblies, sub components, parts and the quantities of each needed to manufacture an end product.

**Ledger Card:** This is a card that contains detailed particulars and cost of an item kept by Finance/Accounts Department personnel.

**Stock Requisition/Issue Note (SRIN):** This is an internal issue note tendered by a concerned staff, which is signed by authorized personnel, to enable one request for an item from Enugu Sub-Region Store Department.

**Store Received/Consignment Note (SRA):** This is an external issue note tendered by a concerned staff, and authorized by the responsible senior officer, to enable one book for an item from any Store Department with the Transmission Company of Nigeria.

**Information System:** It is a collection of procedures, people, instructions and equipment to produce information in a useful way.

**Technology:** It is the study of techniques or process of mobilizing resources (such as information) for accomplishing objectives that benefits man and his environment.

**Information:** It can be defined as the process of gathering, transmitting, receiving, storing and retrieving data or several items put together to convey a desired message.

**Computer Network:** This is a system that connects two or more computers together using a communication link.

**Database:** A systematically arranged collection of computer data structured so that it can be automatically retrieved or manipulated. It is also called Databank.

**Database Table(s):** it is a collection of rows and columns where in the database which are used for logical data storage and retrieval in the database.

**Database Management System (DBMS):** This is the software that performs the task of database management.

**Transaction:** This is a group of operation (database operations) that must be executed as one.

**Encapsulation:** This is the concept of hiding specific behaviour and attributes from a user.

**Class:** This is the prototype from where an object can be created.

**Object:** This is an instance of a class that has both attributes and behaviours.

**Inheritance:** This is the one of the features of Object Oriented Programming (OOP) that gives it the capabilities or properties of a class.

**Entity:** This is an object with a set of properties that makes it easily identifiable.

**Attributes:** These are the properties of an entity. They provide information about an entity and also differentiate one entity from another.

**Relationship:** This refers to the association among entities.

**Entity Relationship Diagram:** This is the pictorial representation of a database. It lists the various components of a database and depicts the relationships between components in the database.

**Programming Language:** This is the language used to give instructions to the computer.

**Structured Query Language (SQL):** This is a very high level programming language that is used to query the database.

**Java Programming Language:** This is an object oriented programming language that is used to develop different types of software application.

**Programmer:** Someone who can read, understand one or two programming(s) and has the ability to develop software applications using some programming languages.

**Application Programming Interface (API):** This is a class library that provides a collection of classes which the programmer may take advantage of when programming.

**Java Database Connectivity (JDBC):** This is a Java API for communicating with different database systems.

**Method:** This is a data member of a class which is used by the objects of such class for performing its actions.

**Constructor:** This is a method like construct tha has the same name as the class. It is also used to create an object.

**Java Platform 2 Standard Edition (J2SE):** This is the technology platform used in developing enterprise applications (web based applications).

**Java Platform 2 Micro Edition (J2ME):** This is the technology platform used in developing mobile applications (software for mobile devices)

**Lead time:** is the time it takes the supplier or the manufacturing process to provide the ordered units.

**Stock Review:** This is a regular review of stock. At every review  
you place an order to return stock to a predetermined level.

**Online:** a system connected to a larger network; a computer which is connected to the Internet or to some other communications service.

**Database Management System (DBMS):** This is the software that performs the task of database management.

**Reorder Level or Reorder point:** The reorder point property is used to indicate when the inventory should be replenished for a particular item if the on hand quantity falls below the specified value. Reorder Level = Lead Time in Days × Daily Average Usage.

**Computerization:** The act of [computerizing](http://www.yourdictionary.com/computerizing) something, or something [computerized](http://www.yourdictionary.com/computerized). Computerization means equipping something with, or the usage of, and associated [automation](https://en.wikipedia.org/wiki/Automation) by computers and software; [business process reengineering](https://en.wikipedia.org/wiki/Business_process_reengineering) that converts a manual process into one done by a computer; equipping with a general purpose [computer](https://en.wikipedia.org/wiki/Computer), embedded computer, or computer system.

**Replenishment:** This could be defined as the ability of making something fully again by replacing what he has used

**Ordering Cost:** It is used in cases of raw material (suppliers) and includes the entire cost of acquiring in activities such as requisition, purchase ordering, transporting, receiving, inspecting, and storing (store placement) ordering cost increase in proportion to the number order placed.

A bill of material (BOM) defines the product structure in terms of materials and provides an optional connection to plant resources such as machinery, tooling, and labour defined by a bill of routing. The Bills of Material application provides a solid base for production activity to be defined, tracked, and reviewed. It also enables more advanced software such as Requirements Planning to be properly utilized.

Originally used internally within a company, the BoM served as a means of tracking product changes and maintaining an accurate list of components needed to build products. As manufacturing has become increasingly distributed, the BoM has taken on even greater importance, serving as the primary reference file for product data number of companies involved in the manufacturing process, the need for accuracy is more critical than ever manufacturing data across multiple companies magnifies problems and increases challenges.

(NEMI Perfect BoM Team March 2002)

While different industries and companies have different formats and information on their bill of materials the following elements should be included in all bills of materials:

• Customer name

• Project description

• Company Job Number

• Person who prepared the BOM

• Drawing number

• Revision number and date

• Component description

• Material Size

• Material Quantity

The information recorded on a Bill of Materials is used to provide traceability and accountability for companies:

**Customer Name:** Often used as the first method of dividing and filing information. Project description: Is used to sub-divide and file individual projects for one specific client.

**Company Job Number:** This is used to track cost elements in a project and is assigned to materials and labour so the all costs can be tracked.

**Prepared by:** This identifies who prepared the bill of materials and ensures accountability for its accuracy. In large organizations it also allows for someone to query information given in the BOM after it has been issued to site.

**Drawing number, revision and date:** This ensures traceability and is used to ensure that the most up to date information is being used.

**Component description:** Basic description of the component required, e.g. Clamp, Armoured Cable, Safety Boots etc.

**Material Size:** Indicates the size of the components required.

**Material Quantity:** Indicated the quantity of the components required.

A bill of materials (BOM) is a comprehensive inventory of the raw materials, assemblies, subassemblies, parts and components, as well as the quantities and prices of each, needed to manufacture a product.

In a nutshell, it is the complete list of all the items that are required to build a product. A BOM is sometimes also referred to as a product structure, assembly component list or production recipe (in process manufacturing industries).

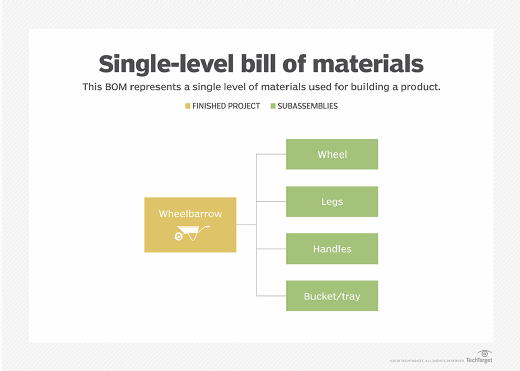
Take, for example, a bicycle manufacturer that wants to build 1,000 bicycles. A bill of materials for a bicycle will include all the parts that make up the bicycle such as seats, frames, brakes, handlebars, wheels, tires, chains, pedals and cranksets, including the quantities required of each component and their cost.

A well-defined BOM helps companies:

* Plan purchases of raw materials
* Estimate material costs
* Gain inventory control
* Track and plan material requirements
* Maintain accurate records
* Ensure supply robustness and reduce waste

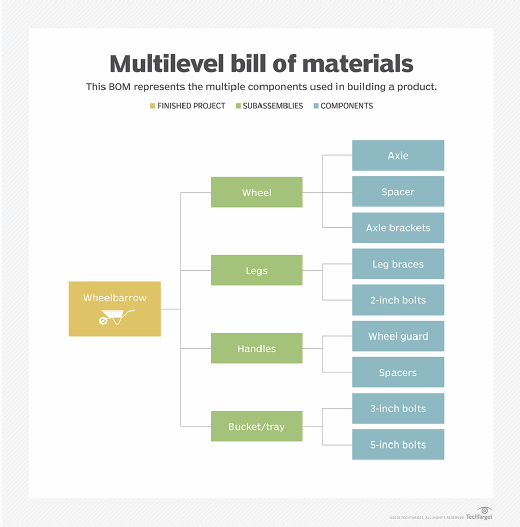
### Bill of Materials (BOM) structure

Typically, a BOM is hierarchical in nature, with the finished product at the top. It includes product codes, part descriptions, quantities, costs and additional specifications.



Among the most common methods of representing a BOM are the following:

* **Single-level bill of materials**, which is a relatively simple list for a product. In this type, each assembly or subassembly is shown only once, with the corresponding quantity required of each to make the product. Though easy to develop, this type of BOM is unsuitable for complex products because it does not specify the relationship between parent and child parts or between assemblies and subassemblies. If the product fails, a single-level BOM makes it difficult to determine which part needs to be replaced or repaired.
* **Multilevel bill of materials**, which takes more work to create but offers greater details and specificity on the parent and child parts in the product. In a multilevel BOM, the total material required is shown. Additionally, the product structure is indented to show the relationship between the parent and child product, as well as assemblies and subassemblies.



A BOM serves as the foundation of production planning systems, and the information in it provides the basic data for other business processes, such as manufacturing resource planning, product costing, material provision for production and plant maintenance.

Since the BOM combines all possible information that goes into building a final product, it finds wide use in departments beyond manufacturing, such as engineering, design, sales, material management and plant management.

### Types of bills of materials

There are three main types of BOMs to be aware of:

**Manufacturing bill of materials**. A manufacturing BOM (MBOM) includes a structured list of all the items or subassemblies required to make a manufactured, shippable finished product. An MBOM, in addition to the information on individual parts, also includes information on the parts that require processing prior to assembly and explains how various components relate to one another in a product. The information in the MBOM is then shared with all the integrated business systems involved in ordering and building the product, including enterprise resource planning ([ERP](https://searcherp.techtarget.com/definition/ERP-enterprise-resource-planning)), material requirements planning (MRP) and, in some cases, a manufacturing execution system ([MES](https://searcherp.techtarget.com/definition/manufacturing-execution-system-MES)).

**Engineering bill of materials**. An engineering BOM ([EBOM](https://searcherp.techtarget.com/definition/engineering-bill-of-materials-EBOM)) defines assemblies or parts as designed by the engineering department. Showing the component structure from a functional perspective, an EBOM, for example, will consist of a mechanical or technical drawing of a product. An EBOM is typically developed by engineers using computer-aided design ([CAD](https://whatis.techtarget.com/definition/CAD-computer-aided-design)) or electronic design automation (EDA) tools, and it is common to have more than one EBOM for a product as the design undergoes a series of revisions.

**Sales bill of materials**. A sales BOM (SBOM) defines a product in the sales stage, meaning details of the product prior to assembly. In an SBOM, the list of finished products and the components required to develop it appear separately in the sales order document. Here, the finished product is managed as a sales item instead of an inventory item.

It's important to note that each type of BOM will involve a different structure and level of detail. For example, an EBOM may list parts related to a specific function of the product, such as chips for a circuit board. An MBOM, by definition, lists every material that goes into manufacturing a product.

**3.2 Design Architecture**

Generates reports

SUPPLIER

ICT ADMINISTRATOR

Updates inventory status

=

Approves requests Receives re-order Creater user profiles alert alert and approves supply

**TCN ENUGU SUB-REGION ONLINE MANAGEMENT SYSTEM**

View reports and inventory status

Issue items Receives re-order alert and Request item supply

MANAGEMENT

STORE KEEPER

View reports and

Inventory status

Receives item from supplier

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **STORES BIN CARD** | | | | | | | |
| **LEVELS** | | |  | | | | |
| **MAXIMUN** |  | | **VOCAB NO:** | | | | |
| **MINIMUM** |  | |
| **RE-ORDER** |  | | **UNIT OF ISSUE** | | | | |
| **DESCRIPTION** | | | | | | | |
| **UNIT** | **LOCATION** | | | **MIN STOCK:** | | | |
| **DATE**  **RECEIPT/ISSUE** | **REFERENCE** | **STATION** | | **IN** | **OUT** | **BALANCE** | **INITIAL** |
|  |  |  | |  |  |  |  |
|  |  |  | |  |  |  |  |
|  |  |  | |  |  |  |  |
|  |  |  | |  |  |  |  |
|  |  |  | |  |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | RAISED | RECEIVED | POSTED ON STOCK CONTROL CARD | PROGRESSED IN PURCHASING | POSTED BY ACCOUNTS |
| SIGNATURE |  |  |  |  |  |
| DESIGNATION |  |  |  |  |  |
| DATE |  |  |  |  |  |
| These items are for use by central store only. | | | | | |

Figure 3.3 Stock Receive Advise form

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| STOCK REQUISITION AND CONSIGNMENT FORM | | | | | | | | | | | | | |
| REQUISITIONING STORES | | | | | | | DATE | | | NO:021832 | | | |
| ISSUING STORES | | | | | | |
| LORRY NUMBER | | LOCATION | | | | | DRIVER’S NAME | | | | | SIGNATURE | |
| STOCK CODE | DESCRIPTION OF THE STOCK | | UNIT OF ISSUE | QUANTITY REQUIRED | | | QUANTITY ISSUED | | | | UNIT PRICE  # | VALUE | |
| FIGURE | WOREDS | | FIGURE | | WOREDS | | # | K |
|  |  | |  |  |  | |  | |  | |  |  |  |
|  |  | |  |  |  | |  | |  | |  |  |  |
|  |  | |  |  |  | |  | |  | |  |  |  |
| TOTAL | | | | | | | | | | | |  | |
|  | REQUISITIONING | | | | ISSUE | | | | | | BIN CARED POSTED | STORES LEDGER POSTED | |
| PREPARED BY | | APPROVED BY | | APPROVED BY | MADE BY | | DESPATCHED BY | RECEIVED BY | |
| SIGNATURE |  | |  | |  |  | |  |  | |  |  | |
| DESIGNATION |  | |  | |  |  | |  |  | |  |  | |
| DATE |  | |  | |  |  | |  |  | |  |  | |
|  | | | | | | | | | | | | | |

Figure 3.4 Stock Requisition and Consignment form

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Location: | | | | | | | | | |  | |
| Project/job description: | | Sanction number Allocation Code: | | | Works Order Number: | | | | |  | |
| Stock Code | Description | | | Unit of issue | Quantity | | | Unit Price | | Value | |
|  |  | | |  | Regd | Issued | |  | |  | |
| Requisitioned by: Date: | | | | | | | | | | | |
|  | Approved | Issued | Received | Bin card posted | Stores Ledger Posted | | | | Stores | |  |
| Signature |  |  |  |  |  | |  | |  | |  |
| Designation |  |  |  |  |  | |  | |  | |  |
| Date |  |  |  |  |  | |  | |  | |  |

Fig 3.5: Stock Requisition/Issue Note

Fig 3.6: Case Tool of the New system

HOME PAGE

STAFF LOGIN

ABOUT US

ADMIN LOGIN

Generate inventory reports

Search Menu

Order item

Update Inventory

Add inventory

Issue

Insert

delete

Items needed

Purchased items

Item levels

Issued items

**CHAPTER FOUR**

**IMPLEMENTATION AND EVALUATION**

* 1. **System Hardware Requirement**

To run the program successful, the following hardware components are required.

1. A Pentium system with 2.5GHz processor and a hard disk capacity of 500GB.
2. A memory size of 3.2GB of Ram.
3. A 15” monitor.
4. An enhanced keyboard and PS/2 mouse.
5. A printer and A UPS
   1. **System Software Requirement**

The software requirements for running this program are:

1. Operating System(Windows 7 and above).
2. Software tools (MySQL, JAVA and PHP)
3. Norton Antivirus or Macfee Antivirus.
   1. **Data Source**

The data source used for this project is gotten from Transmission Company of Nigeria Enugu sub-Region.

* 1. **Implementation Procedure**

Implementation involves the practical method of putting into operation all the theoretical designs and getting the new system to work.

* 1. **Pseudo-codes**

Start

LOG ON TO TCN ENUGU SUB-REGION WEBSITE

If LOG IN is staff choose option from main menu

IF option is to search for an inventory item

CALL SEARCH

ELSE IF option is to print report

CALL PRINT ELSE CALL QUIT

ENDIF

END

ELSE

If LOG IN is ADMIN Choose option from main menu

If option is Add new record

CALL ADD NEW

ELSE IF option is to search for an inventory item

CALL SEARCH

ELSE IF option is to update existing record

CALL UPDATE

ELSE IF option is to issue out inventory item

CALL ISSUE

ELSE IF option is to order for an item

CALL ORDER

ELSE IF option is to process inventory reports

CALL DISPLAY

ELSE

CALL QUIT

* 1. **Sample Implementation input Snapshot**
  2. **Sample Implementation of Output Snapshot**
  3. **Discussion of Results**

The implementation requirement for software development differs, so are the requirements too. System requirements depend on some predefined factors. The simplicity of the programming language used in the development of any system makes the whole development process less tasking, which is a very important feature of software development.

1. **Java Programming Language:** Java is a computer programming language. It enables programmers to write computer instructions using English based commands, instead of having to write in numeric codes. It is known as a high level language because it can be read and written easily by humans. Java has a set of rules that determine how the instructions are written. These rules are known as its syntax. Once a program has been written, the high level instructions are translated into numeric codes that computers can understand and execute. Java servlets were used as a server side scripting language. .

A servlet is an object that receives a request and generates a response based on the request. The Java servlets will also provide added advantages to the database that once put online would enable communication between the database and the web browser. It will also allow a software developer to add a dynamic content to a web browser using the java platform.

1. **MYSQL:** SQL is a special-purpose programming language designed for managing data held in a relational database management system(RDBMS). MySQL is a popular choice of database for use in web application, and is a central component of the widely used LAMP, which is an acronym for “Linux, Apache, MySQL, perl/php/python”. “Free –software” – open source project that requires a full-featured database management system often used MySQL.
2. Personal Home Page Pre-Processor (PHP) is used to communicate with and manipulate the database.
3. **Staff Training:** To achieve maximum utility of the proposed system, staff of the system, staff of store department and Management members of transmission Company of Nigeria Enugu Sub-Region must be practically trained on how to use the system. The training should cover the purpose and the essence of the system, the nature of the system, the workability of the system, maintenance measures that must be taken, the format of input the system requires and every other aspect that concerns the proposed system.

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A bill of materials (BOM) is an extensive list of [raw materials](https://www.investopedia.com/terms/r/rawmaterials.asp), components, and assemblies required to construct, manufacture or repair a product or service. A bill of materials usually appears in a hierarchical format, with the highest level displaying the finished product and the bottom level showing individual components and materials.

There are different types of bills of materials specific to engineering used in the design process; they're also specific to the manufacturing used in the assembling process.

## **Understanding Bills of Materials (BOM)**

The different types of bills of materials depend on the projected use and business needs. A manufacturing BOM is essential in designing [enterprise resource planning](https://www.investopedia.com/terms/e/erp.asp) (ERP) systems and [materials requirement planning](https://www.investopedia.com/terms/m/mrp.asp) (MRP).

A bill of materials explosion displays an assembly at the highest level broken down into its individual components and parts at the lowest level, while a BOM implosion displays the linkage of individual parts at the lower level to an assembly at the higher level.

For example, a computer is exploded into hard drives, computer chips, random access memory panels, and processors. Each processor is exploded into an arithmetic unit, control unit, and a register. The requirements for the arithmetic unit, control unit, and register are imploded into the requirements for the processor, which are imploded into the requirements for the entire computer.

**[Important: The different types of bills of materials depend on the projected use and business needs.]**

A bill of materials is a centralized source of information used to manufacture a product. It is an engineering term that refers to the design of a product. Manufacturers that build products start the assembling process by creating a BOM. Creating an accurate bill of materials is vital because the correct parts must be available when the item is manufactured.

If it is not accurate, it can cause production to halt or cause delays, which increase [operation costs](https://www.investopedia.com/terms/o/operating-cost.asp) because a company has to locate the missing parts, start another production order or deal with customer returns.