The BOM Edge

SRS Document

Disclaimer

This Software Requirements Specification document is a guideline. The document details all the high level requirements. The document should be used as a guideline by the students to design the Solution Architecture for the project. The document also describes the broad scope of the project and high level logical object model. But while developing the solution if the developer has a valid point to add more details being within the scope specified then it can be accommodated after consultation.

The Bill of Material Edge

Introduction

The purpose of this document is to define scope and requirements a Bill of Material Generation & Analysis System, that will be used by the Production house to implement outsourced designs from electronic design house. The new system proposes to overcome the challenges faced by the team in making decisions while planning for production line or ordering of raw material.

This document should be used by the development team to architect the solution the project.

Management Summary

The design house is engaged in producing new electronic designs regularly. While the CAD systems export the complete BOM in a CSV format, the BOM analysis process is manual and error prone. The design hand-off to production house, in time-phased product structure is needed to aid the production house. Creation of a visual time-phased product structure is time consuming manually and accuracy is always a question.

The BOM Edge will assist design teams to access the application and enter complete BOM specifying Off the shelf (OTS) and Made to specification (MTS) items. These items will have design house item codes assigned to them. The procurement and production team will act upon this BOM to perform various kinds of analysis.

The system will provide a mechanism to create a Indented BOM and Summary BOM.

The proposed solution will be designed & developed to run on IBM WebSphere Application Server and IBM DB2 Universal Database in a 2-tier architecture.

About Bill of Materials (BOM)

The bill of materials (BOM) is, in its simplest form, is a list of parts or components required to build a product. Indented Bill of Material is a hierarchical bill of material listing, where each row lists the parent part (assembly or sub assembly) and child part, its UOM and quantity. Such a list reflects the structure of the product by each assembly/sub-assembly level. This indented BOM can be processed to produce a Summarized Bill of Materials that totals the quantities for each part used in every level. It does not represent the structure level by level.

In today's scenario, the design houses transition the BOM to production houses via a standard format and that's how world wide outsourcing of design execution is possible. In the current scope, the design team has been given access to the production house system to enter the BOM for their design.

Time Phase BOM

A time-phased product structure is the combination of lead-time of each part with product structure derived from the indented BOM. It shows the sequence in which each part must be “acquired” in order to deliver the final product. The sequence is derived from the child(s) dependency and their respective lead-times. Therefore, time-phased structure resembles a project network. Recall that the critical path of a project network indicates the total project duration. Similarly, the critical path of a time-phased structure will be the total time to manufacture/produce the product. Refer to example section below the use cases to relate to the data of a time phased BOM.

About Pareto Chart

A Pareto Chart helps in identification of “vital few elements” that have maximum impact in a situation. It is named after Vilfredo Pareto, a famous Italian engineer, sociologist, economist, political scientist and philosopher. In this project, it will help user to identify parts who contributes to the maximum percentage of cost. This way user will know the parts whose cost needs to be managed to control the overall product cost. Learn more about it at http://asq.org/learn-about-quality/cause-analysis-tools/overview/pareto.html URL.

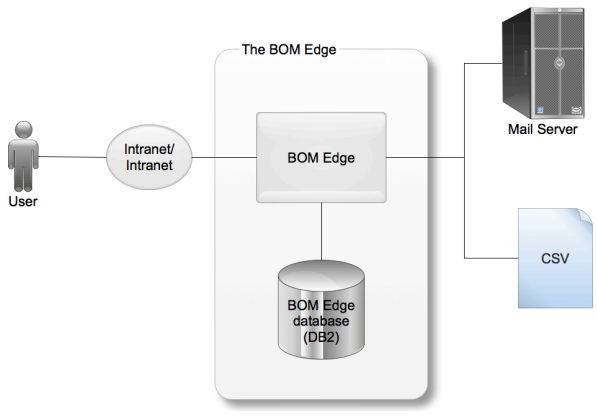
Key Assumptions

1. The project owner requires to be aware of Bill of Material concepts and structures followed to create a BOM.
2. The project owner has read about Pareto Chart and understands the computational and graphical aspect to represent data for analysis.
3. Item codes of design team are uploaded from backend directly. Use identical codes such as the production house inventory item codes.
4. Production house item codes list of CSV will have some errors in codes. These cases will come in handy while testing the Item code gaps fixing use case functionality.

High Level Architecture

The BOM Edge’s high level architecture is illustrated through the context diagram shown below. It will have following categories of users:

1. Design User
2. Procurement Officer
3. Production In-charge
4. Administrator



The BOM Edge Context Diagram

The BOM Edge	The system allows design users to create BOM specific to the designs being rolled out to production. The BOM will be indented one. The production users will estimate the Made to specification items. The production will also benefit from the Time phased BOM for the designs to be produced. Timely information sharing and correctness of specifications, single copy of the BOM will ensure quality is maintained through out the cycle
The BOM Edge Database	Stores parts, BOMs, Design Masters along with various analysis, Suppliers, Supplier Rates and delivery Lead Times
CSV	Employees, Parts Master
Mail Server	Notifications are sent using the mail server

Functional Requirements

The high level functional requirements for the The BOM Edge are outlined in the Use Case diagram described in this section.

The BOM Edge will provide a secure user-id/password based secured login mechanism to access its services. The details of this are not outlined here. The development team is expected to create these keeping in mind the general practices followed by the web applications. Login will be a prerequisite to use The BOM Edge.

Once user logs in, as per their profile, the landing page options are displayed.

Design team

1. Create New Design
2. Add BOM to Design

Production Team

1. Estimate Production time for MTS
2. View Time Phase BOM

Procurement Team

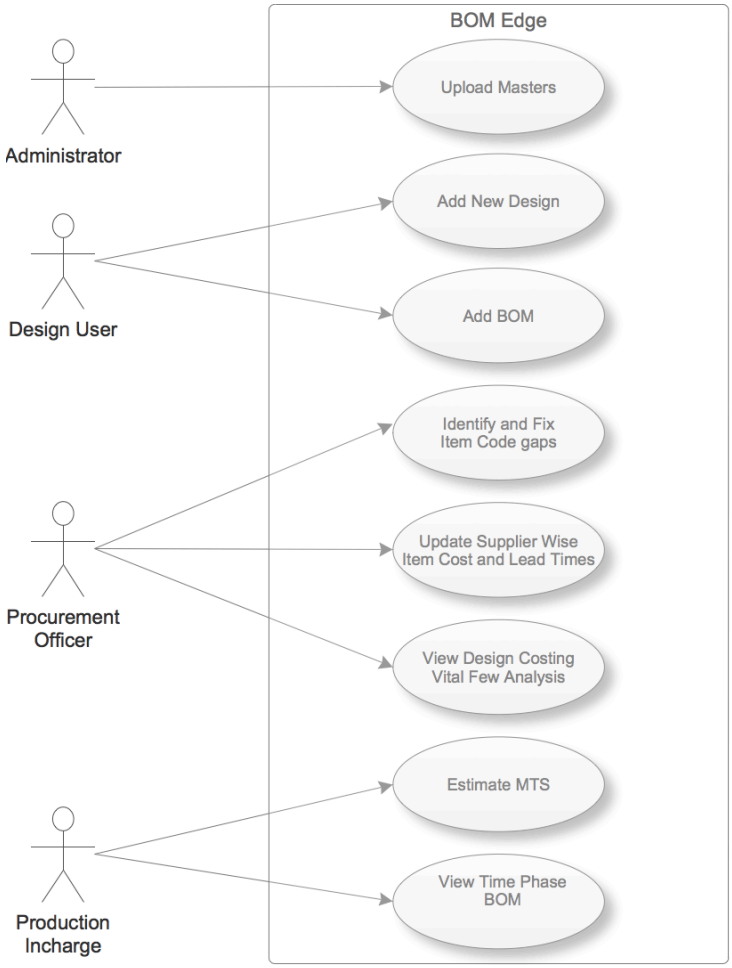
1. Fix gaps in item codes
2. Update Supplier wise Items
3. View BOM Costing

Admin

1. Upload CSVs

Use Case Diagrams

The following figure illustrates the Use Case diagram for the system.



Use Case Diagram

Use Cases

Upload Masters

Use Case Element	Description
Number	UC.01
Application	Master are uploaded using CSV format. Employee master will contain Employee id, Employee Name, Profile(Design/ Procurement/Production/Admin) Production Part master will contain part id, part description, unit of measure, lead time, lot size
Use Case Name	Upload Masters
Primary Actor	Administrator
Secondary Actor	None
Pre-condition	None
Trigger	Administrator clicks on the **Upload Masters** menu item on the admin interface page

Use Case Element	Description
Basic Flow	System prompts for the file name to be uploaded. Standard file upload dialog is presented to select a file from the local system. • The selected file data is uploaded in the related masters; if an existing record is encountered, the old details are replaced with the new details.
Alternate Flow	• In event of incorrect CSV format, system gives an error and NO data is uploaded. • Operation is cancelled
Output	System displays the number of records uploaded. It also highlights the number of records updated (i.e. already existing ones being replaced)

Add Design

Use Case Element	Description
Number	UC.02
Application	The design team enters the record for a design that is ready for rollout into production
Use Case Name	Add Design
Primary Actor	Design User
Secondary Actor	None
Pre-condition	None
Trigger	User clicks on the **Add Design** menu item on the application landing page.
Basic Flow	• The system displays a form with following information to be entered: • Design Code • Design Title • Product Name • Image of Product, Attach file link [File selection dialog box opens and user selects the image file] The above information is saved along with either the image file location or image file as its meta data.
Alternate Flow	• User abandons the operation, no database impact
Output	None

Add BOM

Use Case Element	Description
Number	UC.03
Application	A Bill of material is defined to that will be used for the implementation of the design into a final product.
Use Case Name	Assign BOM
Primary Actor	Design team
Secondary Actor	None

Use Case Element	Description
Pre-condition	None
Trigger	User clicks on the **Assign BOM to Design** menu item on the Home page
Basic Flow	• The system displays Designs that do not have BOM attached to them. • One of the designs is selected by the user. • System displays the list of design team part numbers to be used at the first level • Multiple selection is done for design team part numbers at this level. [User should have selected all the part numbers that are the top level. • The system displays proceed to next step of assigning BOM • The part numbers are assigned a qty and stage (order in which they will get consumed in the production process) • System displays proceed to next step of assigning next level part numbers(this is normally valid for assembly or sub-assembly cases) • Stage by Stage part numbers are displayed, the user can click a part number, the system prompts for the child part number from the master list of design team's part numbers (excluding the ones already selected for level 1), enters qty • The user completes the BOM by selecting the next levels of part number wherever applicable. A tree like structure begins to appear if there are multiple levels. This type of BOM is referred to as Indented BOM. • On save the complete data is saved for the design with columns like (a) Parent Part Number, (b) Child Part Number, (c) Child Part Type, (d) Child Part's Unit of Measure (UOM), and (e) Child Part Quantity required in the Parent Part.
Alternate Flow	• Cancel abandons the operation, no database impact
Output	BOM is displayed in tabular format

Identify & Fix Item Code Gaps

Use Case Element	Description
Number	UC.04
Application	The item codes provided by design team may not match with the production house item codes. The system identifies the gaps and presents it to the user to fix.
Use Case Name	Identify & Fix Item Code Gaps
Primary Actor	Procurement Team
Secondary Actor	None
Pre-condition	None
Trigger	User clicks on the **Fix Gaps in Item Codes** menu item on the home page

Use Case Element	Description
Basic Flow	• The system displays the list of designs that require Item codes review. • The user selects the a design to be reviewed for item codes • The system performs a check in the back ground to identify, whether design item codes exist in the production house item codes master. If yes, the secondary column of item codes is updated with the design house item code. This step is followed for the complete BOM items. A message is displayed for the user to 'Checking for Item Code Discrepancy'. • The system refreshes the screen and displays the count of item codes that require a review and fix. • System prompts the user to Proceed for review or Cancel. • List of Item codes from design house are displayed and along side an input field to enter or select the BOM item matching the description of the Item code mentioned by design team. • The user selects the appropriate Item codes of the production house for all the item codes identified as not found in the item master of production house. • User selects Update Item Codes for the system to update the selected production house item codes in the BOM. • The design BOM review flag is marked as 'Done'
Alternate Flow	• Cancel abandons the operation, no database impact
Output	None

Update Supplier wise Lead Time and Costs

Use Case Element	Description
Number	UC.05
Application	Procurement officer works on negotiating prices, quality of delivery and lead times with vendors to ensure the delivery happens on time. The finalized costs and Lead Times are entered in the system to generate MIS like Design costing
Use Case Name	Update Lead Time and Costs
Primary Actor	Procurement Officer
Secondary Actor	None
Pre-condition	None
Trigger	User clicks on **Update Lead Time and Costs** link on the landing page

Use Case Element	Description
Basic Flow	• System displays the list of suppliers for selecting 1 supplier. • User clicks on one of the supplier listed, the system displays the list item codes from the production item master for multiple selection. • Once item codes are selected, system displays the a rate column and a delivery lead time to be entered for each of the item code selected. • On saving, the system will populate a child table defining vendor and item code relationship along with Lead Time and Cost of the part numbers. • Blank entry is not valid and will not get stored in database.
Alternate Flow	• None
Output	• None

View Costing

Use Case Element	Description
Number	UC.06
Application	Costing comparisons are critical for taking action by the procurement team to ensure best deals are availed from the vendors.
Use Case Name	View Costing
Primary Actor	Procurement team
Secondary Actor	None
Pre-condition	None
Trigger	User clicks on **View Costing** link on the landing page

Basic Flow	• System displays list of designs for which the costing report is required.
	• The user selects one of the design.
	• The system displays the following:
	  ◦ A summarized BOM of item code and description, qty UOM and Cost and Supplier. (The minimum cost for item and its supplier is selected and displayed in this list)
	  ◦ Total cost is displayed at the bottom of the report.
	  ◦ A Pareto chart of pricing is displayed to determine which items impact major part of pricing – a key input for price negotiations and cost management. The user will also be able to perform “what-if” analysis by changing the unit price for the OTS parts used in this design. Note, this change will be a local change for analysis purpose and will not impact the main master data.

Alternate Flow	• None
Output	• None

Estimate MTS items

Use Case Element	Description
Number	UC.07
Application	Made to specification items are estimated for production time by the production. This information is used by Time phased BOM MIS for planning purposes
Use Case Name	Estimate MTS items
Primary Actor	Production team
Secondary Actor	None
Pre-condition	None
Trigger	User clicks on **Estimate MTS** link on the landing page
Basic Flow	• System displays list of designs for which the MTS has not been estimated. • The user selects one of the design. • The system displays the MTS items with their related item details row wise • User will enter the time(hours) to produce the MTS item for each of the item presented in the form. • The system keeps displaying total number of hours for MTS times at the bottom. • On completion of the entry, system allows user to Update Estimates or Cancel the operation. • The time estimates are updated as hours in the system.
Alternate Flow	• None
Output	• None

View TIme Phase BOM

Use Case Element	Description
Number	UC.08
Application	MIS for production to plan their production line
Use Case Name	View Time Phase BOM
Primary Actor	Production In-charge
Secondary Actor	None
Pre-condition	None
Trigger	User clicks on **View Time Phase BOM** link on the landing page

Use Case Element	Description
Basic Flow	• System displays list of designs for selection. • The user selects 1 design to view the Time phase BOM. • The system displays the data for the BOM taking into account the production time for MTS items and the order of use of each item in the BOM. Refer to the example below. • The x-axis displays time. All the parts in the critical path are highlighted in bold. The value of time-phased structure in production planning & sourcing is clearly visible from this example. In real life, BOMs' are much more complex. • You may use charting API from High Charts or google to create such a diagram.
Alternate Flow	• None
Output	• None

Example data

Here is an example to illustrate the concept using an over simplified Personal Computer (PC) assembly. The following 2-tables show the indented BOM and the lead-time master. The resulting time-phased structure is illustrated after tables.

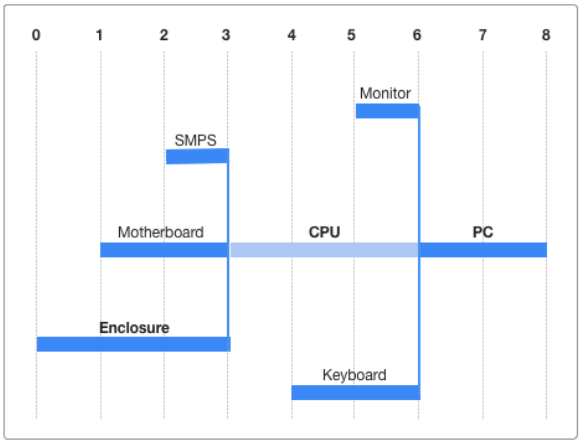
Indented BOM

Parent Part	Child Part	Child UOM	Child Qty
PC	Monitor	Each	1
PC	CPU	Each	1
PC	Keyboard	Each	1
CPU	Enclosure	Each	1
CPU	Mother Board	Each	1
CPU	SMPS	Each	1

Lead Time Data in Parts Master

Part	Lead-time
Monitor	1
Keyboard	2
Enclosure	3
Mother Board	2
SMPS	1
CPU	3
PC	2

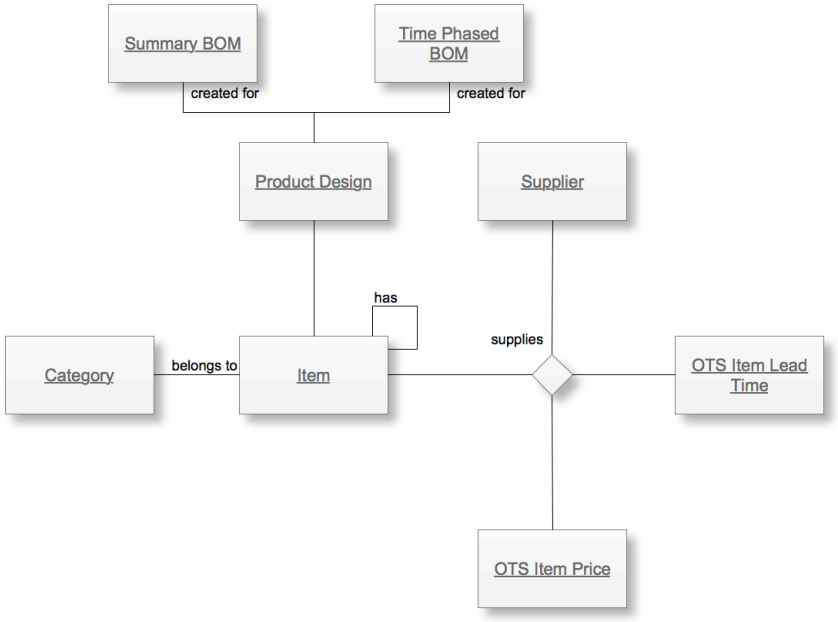
Time Phased Output



The x-axis displays time. All the parts in the critical path are highlighted in bold. The value of time-phased structure in production planning & sourcing is clearly visible from this example. In real life, BOMs' are much more complex

Logical Object Model

A high level logical object model of the system is shown below. During technical design it will be transformed into a physical model covering all system entities. Such a diagram will include their relationship and its cardinality.



Logical Object Model

1. A product company releases a Design for production to a outsourced manufacturing partner.
2. A product design is executed using a Bill of materials of items.
3. Items in the readily available off the shelf of a warehouse are called as Off the Shelf Items (ITS).
4. Items that are created as components using (OTS) items or other raw material are called as Made to Specification (MTS).
5. Items Codes belong to an Item Category.
6. Items Codes are self referencing i.e. a sub item in a Bill of material is also an Item Code in the warehouse
7. OTS items are supplied by more than 1 supplier.

8. The suppliers agree on a delivery time and cost for all the items supplied to the manufacturing unit.
9. For a product design, two types of Bill of Materials are generated, 1) Summary BOM and 2) Time Phased BOM
10. A summary BOM is list of all item codes and qty, uom and their sequence of use in the production process.
11. A Time phased BOM is the Items OTS and MTS on a timeline as per the manufacturing lead times.

Database Design Guidelines

This involves the transformation of the use cases, state diagrams, and logical object model into detailed and optimized physical database table designs.

Typically persistent classes will map to table(s) with their attributes as columns of the table. In some cases a high level object may map in to a master-child table. Invoice is one such example where it maps in to "invoice_header" and "invoice_line_item" table.

Associations between two persistent objects are realized as foreign keys to the associated objects. A foreign key is a column in one table that contains the primary key value of the associated object.

Similarly, a standard technique in relational modeling is to use an intersection entity to represent many-to-many associations. Following is a broad checklist for physical database database design:

1. Database must be properly normalized except those instances where de-normalization help improves performance. This option must be used with special care.
2. All persistent classes that use the database for persistency must map to database structures.
3. Many-to-many relationships must have an intersecting table.
4. Primary keys should be defined for each table, unless there is a performance reason not to define a primary key.
5. Indexes should be defined to optimize access.
6. Data and referential integrity constraints should be defined.

Testing Approach

Quality of the software can be achieved with basic hygiene and consistency followed during design and development of User Interface(UI), Navigation, Validations as per the business process requirement.

To ensure the project delivers acceptable quality to the customer, its important to create a checklist of the conventions to be followed across. Common checks as below are for your reference during design and development:

Common Checks	Validation Type
Page Title is valid for the feature being provided on the page	UI
Order of the Data Entry Fields is logical as per the functionality being provided by the feature	UI
Order of the Display only Fields makes viewing and understanding easy for the user	UI
Spellings and Correctness of Label for the Data Entry and Display fields	UI
The labels are not wrapping onto another row thereby adding a blank row on the page	UI
The fields with drop down are displayed in single row instead of drop down coming on the next row	UI
Data Entry field basic validations are working i.e Text field /Numbers / Dates allow data for their type only	Functional

Common Checks	Validation Type
The dates are following a standard format dd/mmm/yyyy on all forms	UI
The color scheme of all forms i.e headers labels , alerts, entry fields are uniform throughout the application	UI
The action buttons for a New Data Entry Form are uniform for all forms that is allowing data entry	UI
The action buttons are performing the desired action e.g. "submit" is creating a new record if there are no errors and recording all the input fields, whereas 'cancel' is not creating a new record in the database	Functional
The links provided on the forms are opening correctly.	Functional
The data feed mechanism for Read and Write files is generating a log with count of entries.	Navigation

Suggested Technical Reading

The project is aimed at making the student understand concepts of Design and Development using IBM Rational tools, Web Sphere Application Server and DB2 Database. The following reading reference is easy to understand and should be read to get a clear understanding of capabilities of the tools and how you would leverage them to execute a project.

Technical Reference	URL to access
RAD - Tackling challenges of software development with Rational Application Developer for WebSphere Software	http://www.ibm.com/developerworks/rational/library/08/0926_ackerman-mahate/index.html
IBM Education Assistant - Rational Application Developer 7.5	http://publib.boulder.ibm.com/infocenter/ieduasst/rtnv1r0/index.jsp?topic=/com.ibm.iea.rad_v7/rad/rad75.html
RSA-Overview of Rational Software Architect for WebSphere Software Version 7.5	http://www.ibm.com/developerworks/rational/library/08/0926_arnold/index.html
Using the new features of UML Modeler in IBM Rational Software Architect Version 7.5	http://www.ibm.com/developerworks/rational/library/08/0926_diu/index.html
Rational Technical Library	http://www.ibm.com/developerworks/rational/library/