

The Important Role of an Equipment Bill of Material

The 2nd in a series on Integrated Inventory Management

As appeared in the January / February 08 issue of Reliable Plant

1. Introduction

The principal purpose of the Materials Management organization is to provide the “right parts in the right quantities at the right time.” But where do those material requirements come from? Whether demand is predictable or unpredictable, whether the materials are for production or maintenance, the requirements are usually generated from a Bill of Material (BOM). Without a complete and accurate BOM, decisions regarding material planning and replenishment are often made in an information vacuum, resulting in excess inventory levels, stockouts, significant expediting charges and expensive downtime.

For manufactured items, the BOM lists all the raw materials, pieceparts, and other components required to complete a single unit of an end-item. An Equipment Bill of Material (EBOM) lists all of the components of an asset, including its assemblies and sub-assemblies. With a reliable EBOM, a Planner is able to determine exactly what parts are needed; and in an emergency situation, the EBOM provides valuable information to craftsmen and others to ensure that the right parts are identified and procured.

Below are some guidelines for ensuring availability and accuracy of the EBOM data required to support work order planning and execution. This information provides Materials Management with one of the critical tools required to assure an adequate supply of materials while maintaining optimum inventory levels.

2. EBOM Structures

Figure 1 below shows a product structure for a generic item called “Product 1.” As shown in the graphic, “Product 1” has several assemblies, subassemblies, and components, with different quantities of each required. This structure could easily represent a typical manufactured item, or in this particular case, even an equipment asset.

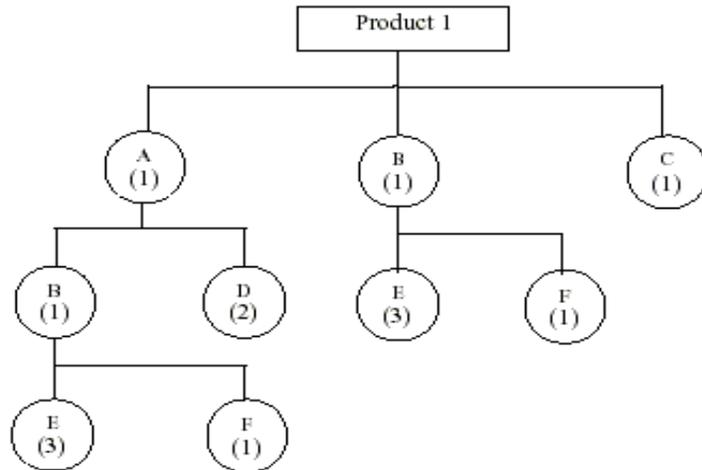


Figure 1: Product “Product 1”

Structure for

There are several different forms that the associated EBOM could take, but the two most common are:

- Single-level (a.k.a. “Spare Parts List”)
- Multi-level (a.k.a. “Indented Product Structure”)

Examples of each are shown below.

Single-level EBOM

Figure 2 below represents a simple single-level EBOM for “Product 1.” In this type of BOM, each individual part that makes up the asset is shown only once, with the total quantity required to complete the entire asset. This type of BOM is convenient for exploding material requirements for manufactured items, where production requirements can be calculated from a Master Production Schedule. For equipment, however, this product structure does not show the actual parent/child relationships of assemblies, subassemblies, and components. This might lead a Maintenance Planner to erroneously conclude that anytime this asset needed to be repaired or replaced, all the items on the BOM might be required. This is clearly not the case if only a particular part of the asset needs to be repaired or replaced.

Part	Qty
A	1
B	2
C	1
D	2
E	6
F	2

Figure 2: Single-level BOM for “Product 1”

Multi-level EBOM

Figure 3 shows a multi-level BOM that provides a better level of detail for equipment assets. In this type of BOM, the same total material requirements are shown, but the product structure is indented to show parent/child relationships between the components, subassemblies, and assemblies. Because of these

parent/child relationships, an indented product structure takes a little more effort to create and enter into the Computerized Maintenance Management System (CMMS). However, it provides a greater level of specificity when determining exactly which materials are required to repair or replace a particular part of the asset.

Product 1	Qty
A	1
B	1
E	3
F	1
D	2
B	1
E	3
F	1
C	1

Figure 3: Multi-level BOM for “Product 1”

Assuming the CMMS supports a multi-level BOM, the indented product structure is preferable.

3. EBOM Creation

EBOM creation is itself a process that should be followed in a disciplined fashion, and consists of several steps:

Determine which assets require an EBOM

Over time, all assets should have an EBOM. However, the order of priority for creating EBOMs should be based on the criticality ranking of the assets. Every critical asset **MUST** have an EBOM. All other assets **SHOULD** have one, and should be developed in order of priority based on the criticality ranking as time, resources, and availability of data allow.

Determine what items should be on the EBOM

In general, any spare parts or components for which there is a reasonable expectation of being repaired or replaced by Maintenance as a result of a Preventive Maintenance (PM) or Corrective Maintenance (CM) Work Order should be included on the EBOM. At a minimum, the EBOM should reflect any item identified as a Critical Spare. In addition, the EBOM should include any other materials used directly to repair the asset, or any item for which it is necessary or beneficial to have usage history tied to the asset in the CMMS.

Items that typically do not need to appear in the EBOM are:

- Specialty tools
- Free Issue material (primarily small hardware)
- Expense materials (rags, towels, etc.)
- Personal Protection Equipment (PPE)

Determine what data should be on the EBOM

Some of the EBOM data will be dictated by the CMMS based on the fields available. Most systems support the following elements that should be considered the minimum required:

- CMMS part number
- Description (properly formatted and in sufficient detail to specify exactly what is required)
- Quantity per
- UOM
- Manufacturer
- Manufacturer's part number

In addition, the following data provides valuable information that should be included in the EBOM if available and supported by the CMMS:

- Preferred supplier
- Supplier's part number
- Authorized substitutes
- Revision number/date and/or effective dates
- Estimated price

Gather the required data

This step often leads to two interesting questions:

1. Who provides the data?
2. Where does the data come from?

The answer to the first question is fairly straightforward, if not simple. The data may come from a variety of sources, but it is usually coordinated by a Reliability Engineer (RE). It doesn't matter who provides the data, as long as it is accurate. Before creating the actual EBOM, however, it should be reviewed by the RE.

Where the data comes from is much more involved. The best source of EBOM data is the Original Equipment Manufacturer (OEM). The most effective means of capturing EBOM information, especially for new equipment, is to request the equipment manual from the manufacturer at the time of purchase. Part numbers can be assigned to components, and the data can be reviewed and entered into the CMMS even before the equipment enters the facility.

In lieu of data from the manufacturer, the equipment supplier may also be able to provide assistance in obtaining OEM documentation. Other sources of EBOM data may include name plate information; Engineering Change Notices (ECN's) or other redesign documentation; Work Order history; or even "tribal knowledge" from craftsmen, engineers, operators, or other "Subject Matter Experts" familiar with the equipment. If all else fails, it may even be worthwhile to track down other users of the same or similar equipment to see what information they may have. Again, the most important thing is not where the data comes from, but whether it is accurate.

Enter the data into the CMMS

It is usually at this point that the inevitable question arises: "Who is responsible for entering the data into the CMMS?" The correct answer is "Anyone with adequate knowledge of the system and the skills required to enter the data accurately into the required fields."

More often than not, however, the simple default answer seems to be "Materials Management," which is not necessarily the worst thing. The Materials group is most familiar with the basic structure of the Part Master from entering inventory items. They are also usually familiar with the structure of the EBOM, or at least the fields that need to be populated and the data that should be entered into each field.

It should also be noted that depending on the CMMS being used, there may be an option to automatically add parts to an EBOM when they are issued against a Work Order for a specific asset. This can be a very useful way to build and/or maintain EBOM's based on actual material usage, but it can also lead to significant degradation of EBOM data integrity if not managed properly.

4. EBOM Maintenance

There are several types of events that can necessitate modifications to the EBOM. Once an EBOM is created, it must be updated as necessary and reviewed periodically to ensure its continued accuracy. Consideration should be given to the following:

Decommissioning

Whenever an asset is decommissioned, the associated EBOM should be deleted as well. As part of that process, each item linked to the asset should be reviewed to see if the item can be deleted and/or if any remaining inventory can be used elsewhere, sold, or scrapped.

Design changes

Whether initiated by the manufacturer or user, anytime equipment is redesigned or modified, there is the possibility that spare parts and components have been upgraded or changed. These changes must also be reflected in the EBOM to assure that the correct materials are used. Any item changed on the EBOM should go through similar scrutiny as if the asset were decommissioned to determine if existing inventory can be used up, or if the item should be deleted. This process helps avoid inventory of unusable parts which is often a major contributing factor to excessive inventories.

Part substitution/standardization

As a result of material availability issues, or as part of engineering and Purchasing Best Practices, there may be a need to authorize parts that are suitable substitutes for an EBOM item. There may also be opportunities to standardize similar parts across multiple assets or plants within an enterprise. In these cases the EBOM must also be updated to reflect the currently acceptable parts that can be used on the asset, including effective start and stop dates if the system supports them.

EBOM review

The EBOM is one of the principal tools used by the Maintenance Planner to properly plan Work Orders. As a result, the Planner is the primary user of the EBOM, and therefore is in the best position to monitor the accuracy of the data. This can most effectively be accomplished in one of two ways.

The easiest way is to make a cursory review any time an EBOM is accessed during the planning process. This is a relatively quick and painless way to identify obvious errors in the EBOM based on the types of materials listed, or specific knowledge that the Planner has about the items on the EBOM. Generally in these cases the Planner will be given blanket authority to document and make the necessary corrections in the CMMS.

A more disciplined approach is to perform periodic reviews of each EBOM, in much the same way as a storekeeper will cycle count his inventory. Specific EBOMs are chosen, and typically the review is done in a more formal fashion by a “Review Board,” which is a group of people who are knowledgeable about the particular asset, and may in fact be the same individuals who provided the initial input to the EBOM.

The collective wisdom of the Review Board often provides insights that the individuals may not have themselves about any of the previously mentioned issues that can impact the EBOM.

5. EBOM Metrics

There are two primary metrics for measuring the effectiveness of EBOMs, and with a robust process in place for creating and maintaining them, the data is relatively easy to capture.

EBOM completion

EBOM completion is no more than a measure of whether an EBOM exists in the CMMS for each asset. The goal should be 100% for all critical assets; and 95% for others.

EBOM accuracy

Calculating EBOM accuracy is a bit more complicated. It usually reflects data captured during periodic reviews, and the data often must be maintained manually outside the CMMS.

The accuracy can be calculated on a line-item basis, or on the entire EBOM. In either case, the target for critical assets is 100% (i.e. zero errors in the EBOM); while the target for other assets is 98% (i.e. no more than 1 error in a sample of 50).

6. Benefits of an Accurate EBOM

The direct and indirect benefits of accurate EBOMs can be difficult to quantify, but are not difficult to delineate.

Fewer incorrect material purchases

By utilizing the information contained in the EBOM to generate purchase requisitions, there is less of an opportunity for guesswork, variation, or errors in the transmission of material requirement data to suppliers.

Faster execution of planned work

Accurate EBOMs reduce the amount of time spent researching required materials. This helps to streamline the Planning and (if necessary) Procurement processes, which in turn reduces the length of time required to obtain the necessary parts to complete the job. This allows for faster execution of equipment PMs or CMs and gets equipment back on line sooner.

Faster execution of unplanned work

An effective EBOM provides craftsmen with quick access to accurate part requirements and descriptions in an emergency situation. Combined with a reliable inventory control system, craftsmen can quickly determine the on-hand quantity and location of available parts in stock. Should insufficient inventory be available, the EBOM can also provide valuable manufacturer and supplier details to facilitate expedited procurement.

Disposition of inactive inventory

EBOMs can be used to determine whether a non-moving inventory item is still required for an active asset.

More effective Reliability Engineering

EBOMs can be used to identify similar items or similar equipment where individual materials can be standardized or substituted.

7. Extensions of the BOM

Where-used

In many cases, the CMMS will provide the capability to do an inverse look up of EBOM data. Rather than querying an asset to see what parts are listed on the EBOM, the system allows a query on a part and displays all the EBOMs where it is listed. This “Where Used” capability provides a valuable tool for determining the impact of decommissioning and design changes on the continued need for specific material items.

Critical Spares

Also a feature of a robust CMMS, the EBOM (or in some cases another field in the Part Master) will provide a flag to identify critical spares. These are items that need to be readily available to avoid significant production losses due to downtime. Additional information on Critical Spares will be included in a future article

8. Summary

As a rule of thumb, remember that the RE is primarily responsible for providing initial EBOM information and all engineering-driven changes. The Planner is primarily responsible for ensuring EBOM accuracy. But the key to overall EBOM effectiveness is to recognize that the creation and maintenance of the data is a collaborative process that requires teamwork and communication among many individuals.