**Cornell Cup**

**Bill of Materials Guideline**

Creating a bill of materials is an important record keeping tool for your team’s expenditures but also for keeping a list of materials and sources for those materials should you need to purchase more. Perhaps the “driest” of all of the guides, however, this one is still very useful to help with important bookkeeping tips. This guide begins by providing a brief walkthrough on the parts of a common bill of materials format. This format emphasizes how much of your budget is spent on various subsystems and therefore can also be useful in determining how much is spent on achieving different features and/or functionalities.

The sample bill of materials template SampleBillMaterials.xlsx may contain more columns than you may need, but as it is easier to delete than to add, they are all offered to save you time as a good starting point for your own important bookkeeping. You also do not need to present this entire template as part of your final report but information similar to that shown in Columns A-X is recommended to be included.

**Columns G-J: Component and Subsystem Names & Associations:** These columns give the names of all of the components that need to be purchased for your project. The components are listed according to the subsystem that they belong to (or sub-subsystem or even sub-sub-sub system, etc. if need be).

Also notice that the subsystems and components are arranged in a hierarchical order with the parent subsystem at the top of the list and the components (or sub-sub systems and their components) listed on the rows immediately underneath. Furthermore for every layer lower in the hierarchy, the columns are indented by one. This is done solely to make the hierarchy of subsystems easier to read at a glance; it does take a little more effort however to do this.

Services, such as performing external testing or perhaps performing a manufacturing task that you do not have the tools or training to perform yourself safely, should also be listed as components, especially if you cannot create your project without them.

**Columns A and B-F: ID’ing your components:** These columns represent two different ways to ID components and subsystems. Column A represents the simplest way, where every row is assigned a unique number. The downside however is that if you add a row to the middle of the bill of materials, all of the IDs of the subsystems and components of the rows below have now been changed. This can be problematic if the IDs are also used in another document, say an inventory or order tracking system.

Columns B-F follow the indented hierarchy system of Columns G-J very closely. The IDs are a little harder to read at first glance but by scanning left to right across these columns the full ID number can be obtained. For example, the ID for the component in row 15 is 1.2.2.1. This ID number is more informative as it is easy to tell from the number that this component is the first component (1.2.2.***1***) of the second sub-subsystem (1.2.***2***.2), of the second subsystem (1.***2***.2.2) of the first project (***1***.2.2.2). The overall project is given an ID as well as there may be more than one project within a much larger project even and each may have their own bill of materials. It’s a little more of a pain to write or say these IDs, but it is unlikely that the IDs will be used instead of the component names in regular conversation. These IDs are again more useful to interface with other bookkeeping systems like inventory.

To make them a little more readable, sometimes the IDs are written more as a combination of abbreviations. For example, if this was the second component listed in the IR encoder sub system of the overall Sensor system within the PMB engine project, the ID might be PMB.Sen.IR.2.

Another advantage of this method is that it is easy to add a component to the end of the component list in the middle of the bill of materials without having to change the IDs of any row items below it.

Any of variation of these methods is fine but it is recommended that even if the Column B-F method is used, the Column A method still be employed, not as an ID number but rather just as a way to keep track of the order of the rows. Should the bill of materials need to be sorted by something other than the IDs, the Column A row numbers can be first converted to numerical values (instead of formulas) and then after any sort, these row numbers can be an easy way to re-sort the bill of materials to their original order.

**Columns K-L and Rows 8-9: Material Costs and Quantity Savings:** These columns are used to record the cost of a specific component or the cost for buying a set of that component. Column K is the number of units in the set, which in many cases may just be 1, and Column L is the associated cost for purchasing that set.

Sometimes you have the option to buy different quantity sets at different prices. You do not need to list all of the available quantities and their prices, only those that are relevant to your projects. A typical rule of thumb is to list the prices for the maximum quantity you intend to order and then you may list the prices for any quantities less than that.

One way to list different quantities for the same component is to give each available quantity set its own row. An example is shown in rows 8 and 9 (aka Column A values 4 and 5) , where the component name is the same in both rows, just the set quantity and the cost information of columns K and L are different. In this example, the ID of each row listing is also slightly different; an additional suffix term has been added to differentiate the two. Notice though that this ending term is an A-Z character instead of a numeric value. This is done to help the reader recognize that 1.1.2.A and 1.1.2.B are indeed the same component and that it is just the set quantity & cost that is different.

Sometimes this method is also used to represent different prices from different vendors, however this can also be done using Columns AO-AW as described later.

**Columns N-Q and Rows 10 & 15: Specifying the Components of your End Product:** These columns are used to record what is the minimium number of components that go into creating 1 of your end product, i.e. if you were going to mass produce this product what would be the number of each component needed for each product made. In many cases, any recommended back-up or replacement parts that should be kept on hand for each end product are included in the minimum quantity as well.

In some cases decimal quantities are shown to demonstrate the value of economies of scale. For this project though, it is good to provide the cost information for building one and only one. The other case when decimal quantities can be shown is if the same component is used in multiple subsystems, for example two subsystems need the same kind of screw but you can only buy the screws in packages of 100. When this happens, the component is listed under both subsystems and the amount of the component set(s) used in each subsystem is listed in Column N. Additionally, the ID of the component listing(s) that are sharing the set(s) are also listed in Column O, the “Shared With” column. An example of this is shown in rows 10 and 15 where both have the same Column J-L values bit the Column N and O values show that they sets purchased are being shared across the 2 subsystems.

Sometimes though for smaller items like screws, the entire cost is assigned to just one subsystem and the other subsystem(s) are given it for “free”. This is done entirely for the purpose of simplifying the bookkeeping. It is not as accurate but it is not uncommon in practice.

For each component, the value in Column P is the product of the price times the minimum quantity needed. For each subsystem, the value in Column P is the sum of the Column P values for that subsystem’s components (or sub-subsystems). Given the organization of the template, the top row will therefore always have the cost for the entire end product.

**Columns Q-R: Specifying the Total Cost for the Components of your End Product:** Shipping costs can be unexpectedly expensive in some cases taking 20% or more of your entire available budget. They are included in the bill of materials in Column Q and accounted for in the totals by adding the components’ values of Column Q to those in Column P and storing the result in Column R. The subsystem Column Q and R values are calculated as the sum of the their components’ (or sub-subsystems) in those columns.

**Columns T-X: Specifying the Total Cost of Your Project:** These columns work very similar to those of Columns N-R except that the Columns T-X cover all of the components that were purchased regardless of whether those components were a part of the final end product or not. Upon following the same steps that were used for Columns N-Q, the total cost of your project will also be listed in the top row of the bill of materials.

Unlike the Columns N-Q, however, the Columns T-X values relate to actual purchases that were made. Hence, if the same component is ordered on different occasions, it is not uncommon using a template like the one we have provided, to include a new row for each order placed. This can also help to differentiate between the quantities ordered each time, any shipping cost changes and, as will be shown in Columns AH-AK, help keep track of when orders were placed and received.

The difference between the minimum parts total and the ordered parts total cost is usually a combination of the fixed, prototype, and logistic costs for the project. Prototype costs are the costs of components, test materials, and other lab supplies that were not directly used in the end product because they were either used to help create the end product but are not a part of it or they were purchased and later determined not to be used in the end product. Fixed costs are associated with things that you only purchase typically only once for the entirely of the project, such as a new piece of equipment for the lab. Fixed costs may also included other elements that are always a part of the project regardless of what you decide to actually do, such as rent and possibly utilities, but it is unlikely you will be responsible for these costs and they commonly cataloged separately and not included as the bill of materials. Logistic costs may mean office supplies, final poster printing, and potentially travel expenses, although these too are commonly cataloged separately and not included as the bill of materials.

**Columns Z-AB: Specifying the Component Sources:** List the source that the component can be purchased from, providing either a direct webpage address (i.e. where you can “click here to add to cart”) or the street address of the company or shop you are purchasing it from.

Some universities/companies have special business relationships with certain vendors, which are often referred to as “approved” or “preferred” vendors. Your university/company typically would prefer that you purchase your components from these preferred vendors as sometimes incentives such as special discounts or reduced shipping costs may be available to you. It is good to be aware of these relationships not only for these potential benefits but making a purchase from a vendor who is not on the “preferred” list may require additional paperwork which could also affect the amount of time it takes for you to get your purchase. That is not say that you shouldn’t “shop around” for the best deal as there is rarely a guarantee that the preferred vendor will always have the best price. Contact your local purchasing department representative to make sure you are well aware of your group’s purchasing policies.

**Columns AC-AG: Keeping a Vendor Log:** In some cases you may need to contact the vendor directly. In those cases it is a good idea to keep a log of who you have been speaking to. Keeping track of their name and contact information in Columns can be very helpful for remembering that person who helped to get you that special deal or was able to help answer the technical questions you had.

It can also be helpful to keep a log particularly in large teams. It can be rather embarrassing if you try to contact a vendor for the first time only to find out that one of your teammates also contacted that vendor just last week. This can make your team appear to be disorganized and discourage the vendor from building a close relationship with you. Hence Columns AF-AG are important to maintain and it is worthwhile to search for a company name in the contact log before you contact that company just to see if perhaps a teammate has made a good contacted already.

If you have multiple contacts at a company, it is okay to add additional rows to the bill of materials template where in the additional rows only Columns AC-AG may be filled in. Sometimes if you are dealing with multiple people from the same vendor, a separate document is kept. Keeping vendor logs is such an important bookkeeping aspect of being a part of a project that professional software tools are available for this as well.

**Column AH: Providing Good Follow-Up:** When you do have a significant conversation with a vendor, it is important to follow up with a thank you note. It is such a valuable activity to you and your team that we wanted to make sure that you do, so we have provided a template of a simple thank you note below and it should only take you around 1 minute to fill it out and send it.

Dear \_\_\_\_\_\_\_\_\_\_,

Thank you for taking the time to speak with me today about (insert conversation’s main topics). The information you provided was very helpful to our team. (insert any details you may wish to remind them about, for example the great price they offered you, or perhaps the date that they said they would get back to you with more information on something, or perhaps provide them with information that they requested)

Thank you once again and we will look forward to working with (“you” or “insert company name”) more in the future.

Best Regards,

(insert your name)

That 1 minute can be time very well spent. In today’s busy world people will remember that you were the one who actually showed some gratitude for the time that someone spent to help you. Then the next time you need to contact them they will most likely be all the more willing to help you because they know that you appreciate their efforts. People may not always exactly remember what you say or do, but they will remember how you made them feel.

Typically a date is entered into this column which helps to show correspondence between the last time you spoke with them and when the follow-up note was sent.

**Columns AJ-AM: Tracking Your Purchases:** These columns allow you to indicate, what should be ordered (Column AJ), when the order was placed (Column AK), when the order was received (Column AL), and when the receipts, or packaging slip, or other purchasing department tracking paperwork was turned in (Column AM).

This is an important habit to get into considering this bookkeeping as part of the process. Recording the order and received dates can also help you plan the time it may take for future orders from the same vendor. It can also act as a reminder as to which orders haven’t come it yet but that you should follow up on. Additionally, these columns can act as documentation for yourself in order to verify that you have turned in all of the necessary purchasing department paperwork.

**Column AO: Comments:** Like many documents, it is helpful to have some place that you can keep any notes, such as “they often send the wrong parts” or “the parts were not to the specifications listed on the website“ or “this contact was particularly helpful and is a big NY Giants fan”. Comments like these can be worthwhile to review whenever dealing with a vendor again.

**Columns AQ-BA: Alternative Sources:** Sometimes it can be worthwhile to jot down information of alternative sources for your components. One of the most commonly useful purposes of alternative sources is if the source you want to buy from is ***not*** a preferred vendor. In this case the cost from both the non-preferred vendor and the preferred vendor (listed as the alternative source) can both be shown on the same line and which can help to provide evidence to the purchasing department why you are not choosing the preferred vendor.

There may be other reasons for wanting to keep track of this information and you may add several sets of alternative source columns at the end of you bill of materials if you want to.