

Fixed Work Breakdown Structures in Microsoft Project

A Case for a Custom Outline Code Field



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Microsoft Project contains Work Breakdown Structure (WBS) and an Outline Code field in the out of the box configuration. The codes have some great features and are very useful in many circumstances. The Microsoft documentation and help on these features is well documented online. One of the drawbacks of these codes is they tend to change when items are moved around within the schedule model, or, they can be easily renumbered. In most cases, however, a static WBS meeting the approved requirements of an external stakeholder is necessary. A Static WBS is easily implemented in Microsoft Project using one of the Custom Outline Code fields; this paper is a how to.

Many contracts require the use of a fixed WBS, the United States Department of Defense routinely requires development contracts to be align with published WBS Standards such as MIL-STD-881: DEPARTMENT OF DEFENSE STANDARD PRACTICE WORK BREAKDOWN STRUCTURES FOR DEFENSE MATERIEL ITEMS. For the purpose of this exercise, I will extract Appendix A from the standard and create a WBS in Microsoft Project. A portion of the MIL-STD-881C Appendix A (Aircraft System) is shown below; there is no need to fret over the details, just examine the levels of indenture:

Outline Level	Contract Work Breakdown Structure (CWBS)	Task Name
1	1.0	▲ Aircraft System
2	1.1	▲ Air Vehicle
3	1.1.1	▲ Airframe
4	1.1.1.1	Airframe Integration, Assembly, Test and Checkout
4	1.1.1.2	Fuselage
4	1.1.1.3	Wing
4	1.1.1.4	Empennage
4	1.1.1.5	Nacelle
4	1.1.1.6	Other Airframe Components 1..n (Specify)
3	1.1.2	Propulsion
3	1.1.3	▲ Vehicle Subsystems
4	1.1.3.1	Vehicle Subsystem Integration, Assembly, Test, and Checkout
4	1.1.3.2	Flight Control Subsystem
4	1.1.3.3	Auxiliary Power Subsystem
4	1.1.3.4	Hydraulic Subsystem
4	1.1.3.5	Electrical Subsystem
4	1.1.3.6	Crew Station Subsystem
4	1.1.3.7	Environmental Control Subsystem

It would be an academic exercise to make a template by simply typing each of these documents into Microsoft Project, anyone can do that with a free copy of the standard in PDF Format, and copy/paste. If you need a Microsoft Project Schedule model in WBS format, I encourage you to do exactly what I just described.

However, many contracts are now getting away from a deliverables based format and are trending more toward a process driven Integrated Master Plan (Schedule) model. Other programs are wanting to see schedule models developed more in alignment with a Primary Work Statement (or Statement of Work).

Instead of emphasis on the specific end items to be manufactured and delivered, Program Management is now taking a more keen interest in “How” over “What” in managing the program. As such, stakeholders are more interested in “getting there” and want to know the steps necessary to get to a Preliminary Design, and what is the path we need to follow to authorize Manufacturing to start? The same can be said for software development. In these cases, it is more advantageous to develop a schedule model based on Process over physical deliverables. But how do I assign a WBS to schedule model activities when it will not “roll-up” by WBS or other requirement?

If a WBS describes the physical deliverables of a contract (Landing Gear, Wings, Fuselage, Propulsion System), then how am I to make a schedule model that will properly roll up all elements of “Landing Gear” when I must also show my schedule model as a process proceeding from requirements gathering, system requirements review, conceptual design, preliminary design, detail design, release to manufacturing, assembly, test, integration, flight test, and final delivery?

Yes, it is possible to put each of the topics from the previous paragraph multiple times into the schedule model (that is, once for each deliverable item of the WBS). When we do things that way, we find pieces of “preliminary design” scattered throughout the schedule. We are not able to easily answer questions like “when will the (entire) preliminary design be completed?” without looking through the entire schedule model. So, we have a push to present the schedule model in a “process” based format.

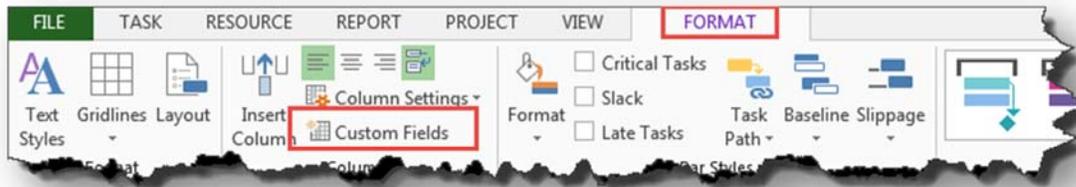
Conversely, if we maintain the schedule model purely in physical deliverable WBS format, we have the reciprocal challenge to place each process element below each WBS element.

Custom Fields to the Rescue

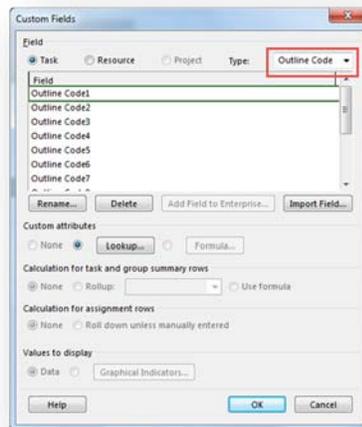
What I am proposing here can be extended to nearly any externally required numbering schema such as Statement of Work, Work Breakdown Structure, Integrated Master Plan, or other known requirement. You develop the schedule model to some convenient structure, then enter cross reference coding to the schedule model allowing grouping and sorting to present the detail task data in various views. In this example, I assume the program is constrained to an Aircraft System WBS and that costs must be reported to a specified level of WBS within another cost control system.

Create a Custom Outline Code

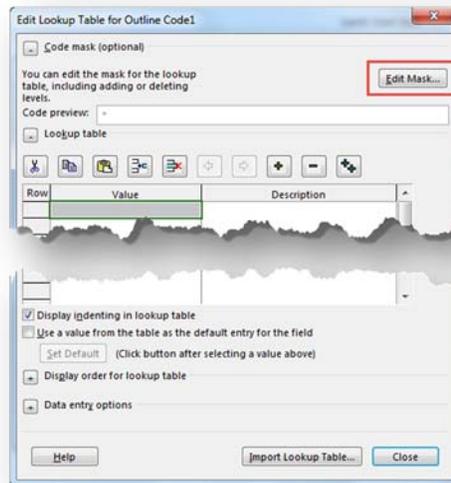
On the Format ribbon, select Custom Fields:



In the Custom Field Dialog Box, select one of the Custom Outline Code Fields, I selected Outline Code 1:

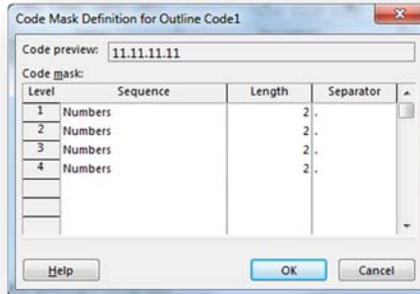


Once the desired Outline Code is selected, click on "Lookup..." to reveal the input menu:



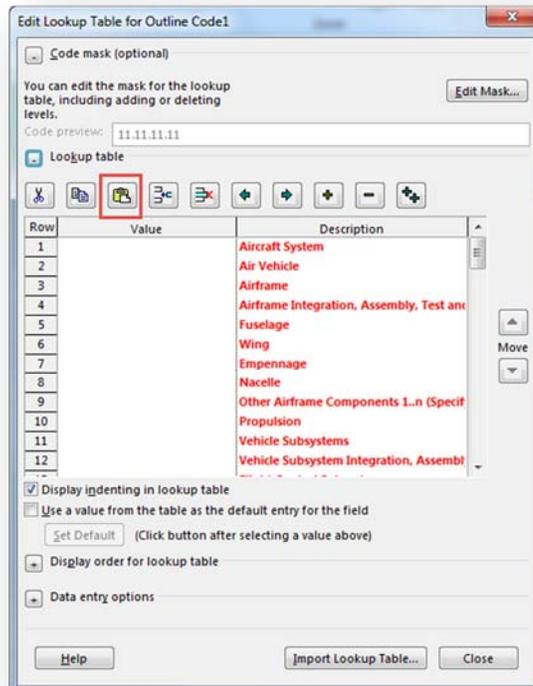
An input table will appear in the middle of the screen; I have cropped the empty table out here, because it is not quite time for that yet. You will need to decide what type of input mask should be applied to the new WBS. Should it be numeric only? Should I allow leading zeros in the number schema? Are

alphabetic characters allowed in fixed or mixed case? Most importantly, how many levels should be allowed in the WBS hierarchy? Let's decide on four levels that must be of two digits each. So our WBS will go from 00.00.00.00 to 99.99.99.99 and will always have two digit for each level. Select the Edit Mask button and fill in like below:

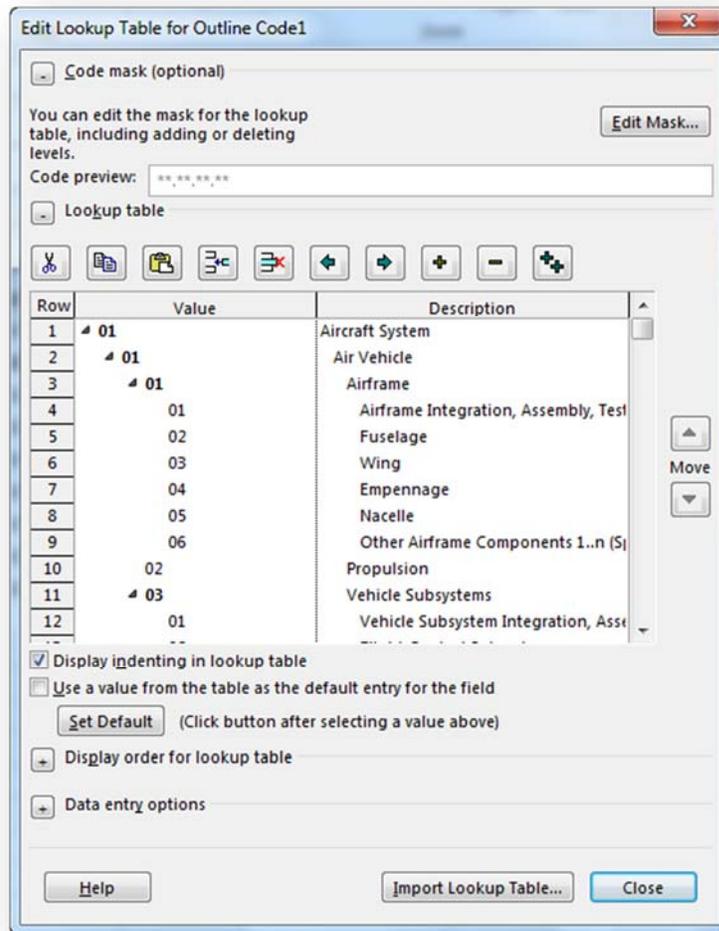


Since we require exactly two digits in each level of the WBS, we will automatically get leading zeros (if needed) when creating the details. Select OK.

What I did was take a copy of the specific WBS and copied it directly to my clipboard from the PDF copy of the WBS I wanted to use. Make certain there are no blank lines and the entire WBS is expanded (for example, if you are copying from Excel).



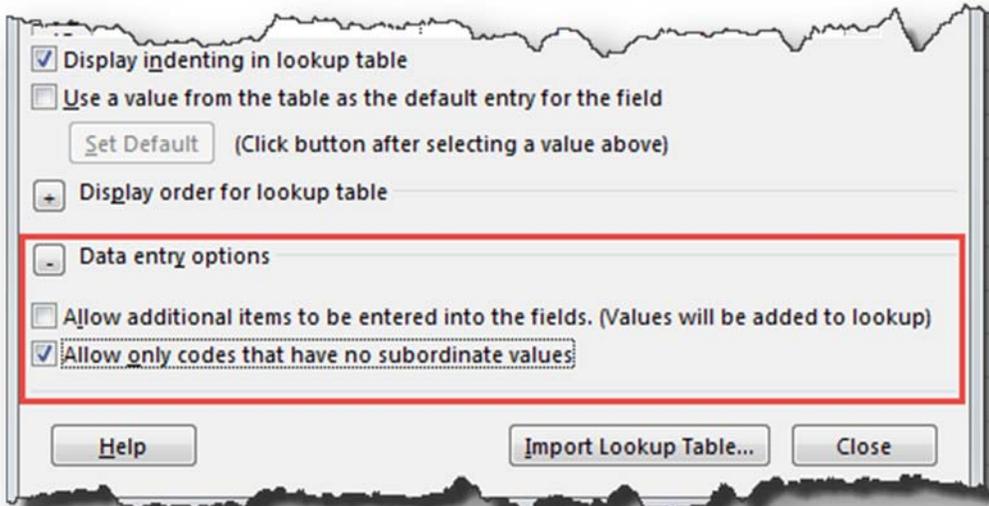
When all the items are pasted into the lookup table, you will need to establish appropriate entries in the Values side of the table. In this case, we require numerals of two digits width. Following the screen shot from above, here is what we have (notice the red errors are gone):



You adjust the level of indenture for the entries using the green arrow keys on the form.

You now have a WBS Structure embedded into a Microsoft Project file.

The WBS can be to any reasonable level of indenture as long as it is at least as deep as the reporting requirements. When assigning WBS elements to individual task elements in the schedule model, it is important to only select WBS elements that are at or below the required level of reporting. If the WBS in Microsoft Project is only down to the reporting level, Microsoft Project makes enforcing this concept easy by expanding the Data entry options on the Edit Lookup Table dialog and force the assignments only to be at the lowest level of the WBS. Additionally, it is usually convenient to preclude the user from allowing new entries in the WBS by leaving the appropriate check box unselected. Keep in mind this is a false sense of security since there is no way to preclude users from changing these settings.



Using the Embedded WBS Structure

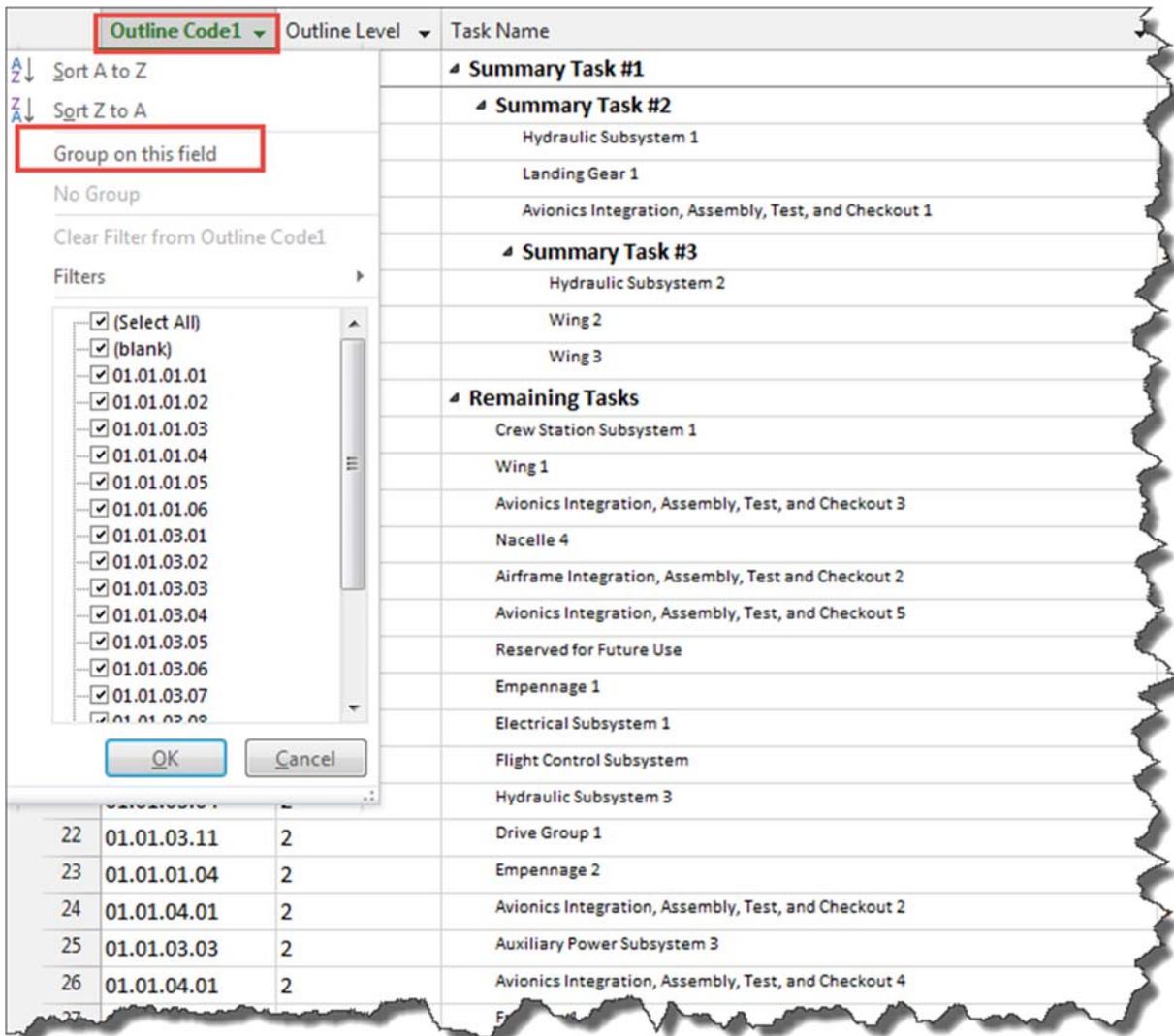
The new WBS Field (Outline Code 1) works just like any other custom Outline Code. Assign a value to each detail level task within the Schedule Model. It is best to only assign the lowest level WBS Elements in the WBS to detail task elements (those without children) and milestones. Since Summary Tasks in the Schedule Model are only for human readability and understanding, it is best not to assign things like a WBS to those elements. Instead, use the grouping features with Microsoft Project to display a custom view of the WBS.

Custom Outline Code and Grouping

Creating a WBS ordered Schedule Model takes only a few mouse clicks. Below, I created a very random order of tasks and summary tasks relationships. Although this order does not seem to make much sense, I am making the point that your schedule model may be grouped and presented in nearly any manner desired. The only important item in the figure below is that each detailed task (those lacking children) contains a WBS code from the custom WBS we just created. Notice the WBS code order appears to make no sense at all in this view.

	Outline Code1 ▾	Outline Level ▾	Task Name
1		1	▸ Summary Task #1
2		2	▸ Summary Task #2
3	01.01.03.04	3	Hydraulic Subsystem 1
4	01.01.03.09	3	Landing Gear 1
5	01.01.04.01	3	Avionics Integration, Assembly, Test, and Checkout 1
6		3	▸ Summary Task #3
7	01.01.03.04	4	Hydraulic Subsystem 2
8	01.01.01.03	4	Wing 2
9	01.01.01.03	4	Wing 3
10		1	▸ Remaining Tasks
11	01.01.03.06	2	Crew Station Subsystem 1
12	01.01.01.03	2	Wing 1
13	01.01.04.01	2	Avionics Integration, Assembly, Test, and Checkout 3
14	01.01.01.05	2	Nacelle 4
15	01.01.01.01	2	Airframe Integration, Assembly, Test and Checkout 2
16	01.01.04.01	2	Avionics Integration, Assembly, Test, and Checkout 5
17	01.01.04.13	2	Reserved for Future Use
18	01.01.01.04	2	Empennage 1
19	01.01.03.05	2	Electrical Subsystem 1
20	01.01.03.02	2	Flight Control Subsystem
21	01.01.03.04	2	Hydraulic Subsystem 3
22	01.01.03.11	2	Drive Group 1
23	01.01.01.04	2	Empennage 2
24	01.01.04.01	2	Avionics Integration, Assembly, Test, and Checkout 2
25	01.01.03.03	2	Auxiliary Power Subsystem 3

We can organize this to the WBS view in two mouse clicks:



1. Click on the down arrow next to Outline Code1
2. Click on "Group on this field"

The result is a nice ordered WBS layout, see the next two figures:

Outline Code1	Outline Level	Task Name
01	1	▲ Aircraft System
01.01	2	▲ Air Vehicle
01.01.01	3	▲ Airframe
01.01.01.01	4	▷ Airframe Integration, Assembly, Test and Check
01.01.01.02	4	▷ Fuselage
01.01.01.03	4	▷ Wing
01.01.01.04	4	▷ Empennage
01.01.01.05	4	▷ Nacelle
01.01.01.06	4	▷ Other Airframe Components 1..n (Specify)
01.01.02	3	▷ Propulsion
01.01.03	3	▲ Vehicle Subsystems
01.01.03.01	4	▷ Vehicle Subsystem Integration, Assembly, Test
01.01.03.02	4	▷ Flight Control Subsystem
01.01.03.03	4	- ▷ Auxiliary Power Subsystem
01.01.03.04	4	▷ Hydraulic Subsystem
01.01.03.05	4	▷ Electrical Subsystem
01.01.03.06	4	▷ Crew Station Subsystem
01.01.03.07	4	▷ Environmental Control Subsystem
01.01.03.08	4	▷ Fuel Subsystem
01.01.03.09	4	▷ Landing Gear
01.01.03.10	4	▷ Rotor Group
01.01.03.11	4	▷ Drive Group
01.01.04	3	▲ Avionics
01.01.04.01	4	▷ Avionics Integration, Assembly, Test, and Cl
01.01.04.02	4	▷ Avionics Integration, Assembly, Test, and Cl (Specify)

WBS Order

And here it is with all the detailed tasks displayed:

	Outline Code1 ▾	Outline Level ▾	Task Name
	01	1	▾ Aircraft System
	01.01	2	▾ Air Vehicle
	01.01.01	3	▾ Airframe
	01.01.01.01	4	▾ Airframe Integration, Assembly, Test and Checkout
15	01.01.01.01	5	Airframe Integration, Assembly, Test and Checkout 1
32	01.01.01.01	5	Airframe Integration, Assembly, Test and Checkout 2
35	01.01.01.01	5	Airframe Integration, Assembly, Test and Checkout 3
	01.01.01.02	4	▾ Fuselage
27	01.01.01.02	5	Fuselage 1
36	01.01.01.02	5	Fuselage 2
	01.01.01.03	4	▾ Wing
8	01.01.01.03	5	Wing 1
9	01.01.01.03	5	Wing 2
12	01.01.01.03	5	Wing 3
	01.01.01.04	4	▾ Empennage
18	01.01.01.04	5	Empennage 1
23	01.01.01.04	5	Empennage 2
	01.01.01.05	4	▾ Nacelle
14	01.01.01.05	5	Nacelle 1
30	01.01.01.05	5	Nacelle 2
34	01.01.01.05	5	Nacelle 3
42	01.01.01.05	5	Nacelle 4
	01.01.01.06	4	▸ Other Airframe Components 1..n (Specify)
	01.01.02	3	▾ Propulsion
46	01.01.02	4	Propulsion Task 1
	01.01.03	3	▾ Vehicle Subsystems

There are advantages to this type of grouping such as the newly identified “summary” tasks will automatically roll up calculations for formula driven fields, dates, work, cost, etc.