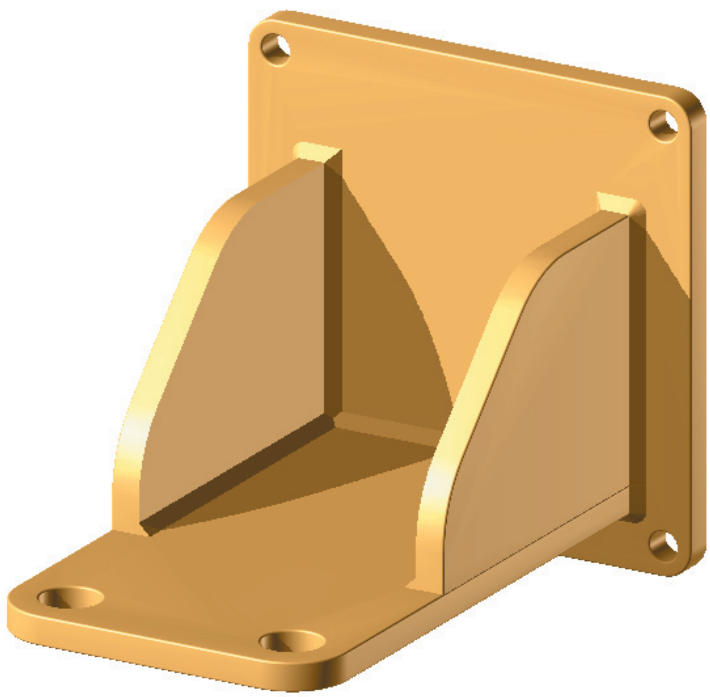
Fabricated Assembly Analysis

The DFM Concurrent Costing software can be used to evaluate various strategies for the design of a manufactured item. Frequently, one design strategy might involve breaking the item up into several parts and utilizing joining processes such as welding or riveting to create a fabricated assembly.

DFM Concurrent Costing can be used to make cost comparisons to determine if a fabricated assembly is more cost effective than manufacturing the item as a single part. Fabricated assemblies typically become most cost effective when producing the item as a single part results in significant material waste or a part geometry that is very difficult to manufacture. Fabricated assemblies can also be more cost effective when produced in lower volumes because in some cases, the cost of tooling is less.

The analysis uses the same database of assembly times as the Design for Assembly (DFA) software. However the procedure for analysis has been simplified so that the responses required only include those that are significant in estimating the assembly cost. Also, the program estimates the distance to the locations of the parts in the assembly area depending on the size of the assembly. This eliminates the need to guess the distances to acquire parts during the analysis. However the results of an analysis will be close to those obtained from the DFA program.

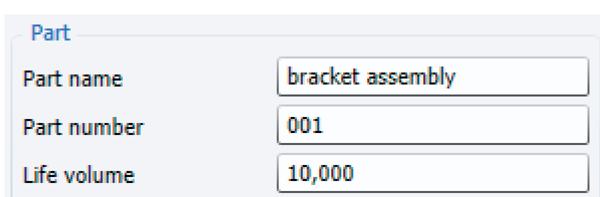
This tutorial illustrates the estimation of the total cost of manufacture of a welded fabrication, consisting of 4 parts welded together, shown below. The complete analysis is contained in the sample file **welded assembly.dfmx** included with your installation of DFM Concurrent Costing.



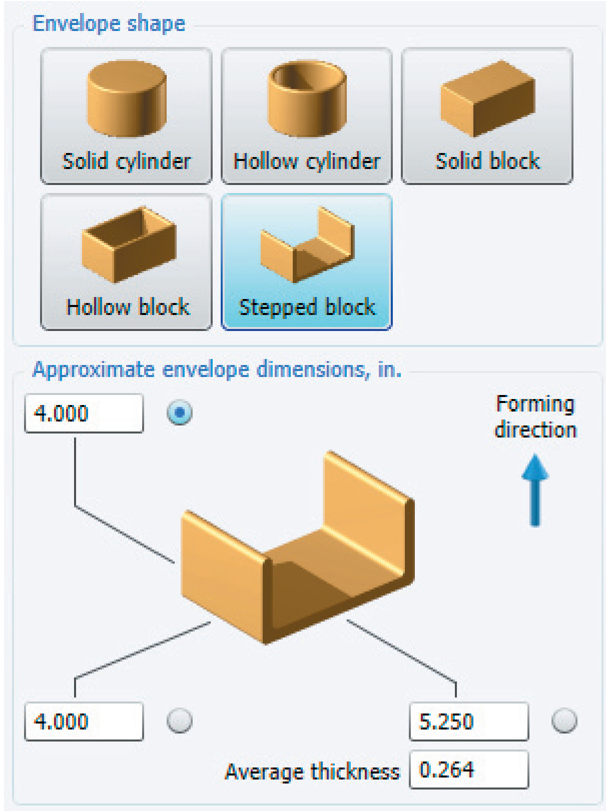
Begin the analysis

The Process Chart for an assembly fabrication starts with a definition of some general parameters and the primary material.

1. In a new analysis, complete the part description as shown here:



2. Complete the envelope shape selection and dimensions as below:



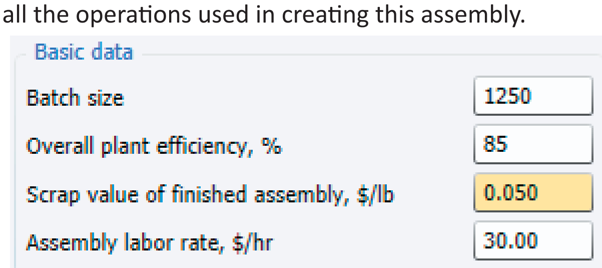
3. Accept the default forming direction. Rename the Process Chart tab from *Original* to **weldment**, by clicking the tab to put it into edit mode and then type the new name.

4. Click the button **Select process and material**.

5. In the *Process and material selection* window, choose *Assembly fabrication* for the process. For the material, open the *Carbon steel* category and choose *Generic low carbon steel.*

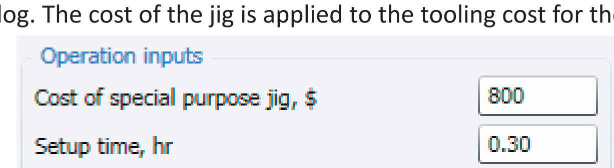
6. Click the **OK** button to return to the main window with the responses for the fabrication process shown on the right panel.

7. In the *Basic data* box enter $**0.05** in the response *Scrap value of finished assembly.* The *Assembly labor rate* of $30.00 will be applied to all the operations used in creating this assembly.

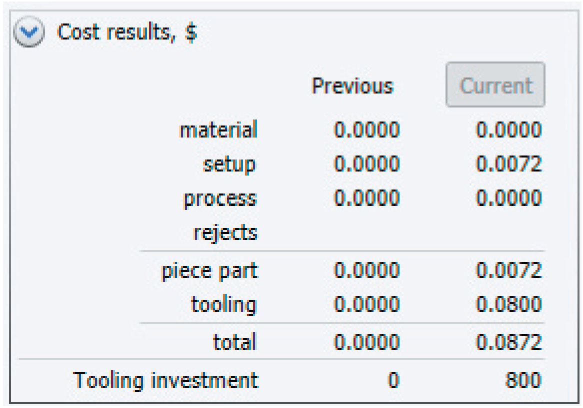


8. There are 4 sheet metal parts to be welded together. The first process step is to set up the assembly jig to hold the first part. We can start with the operation of setting up this jig. Click the *Insert Operation* toolbar button.

9. In the Insert Operation dialog that opens, expand the category, if necessary, to see the operations in the *Welded fabrication* category. Double-click the *Setup welding jig* operation to add it to the Process Chart. Close the Insert Operation dialog. The cost of the jig is applied to the tooling cost for the part.



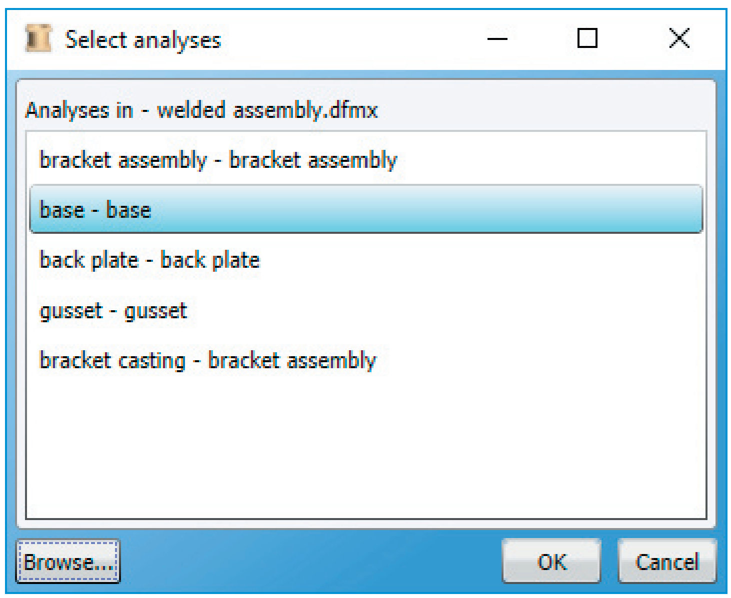
The assembly labor rate, set at the process level as we saw earlier, will be applied to the setup time. Click the **Calculate** button to update the *Cost resuts* box.



10. We now add the first part. This part has been analyzed using DFM Concurrent Costing, and the cost information from that analysis is used here. To add a DFM part, click the Import Analyzed Part toolbar button, then click **Browse** in the Select analyses dialog.

11. You are presented with an Open dialog. Navigate to the directory where the DFM sample file **welded assembly.dfmx** is located, the *samples* subfolder of the DFMA *Data* directory, by default. Select the welded assembly file and click the **Open** button.

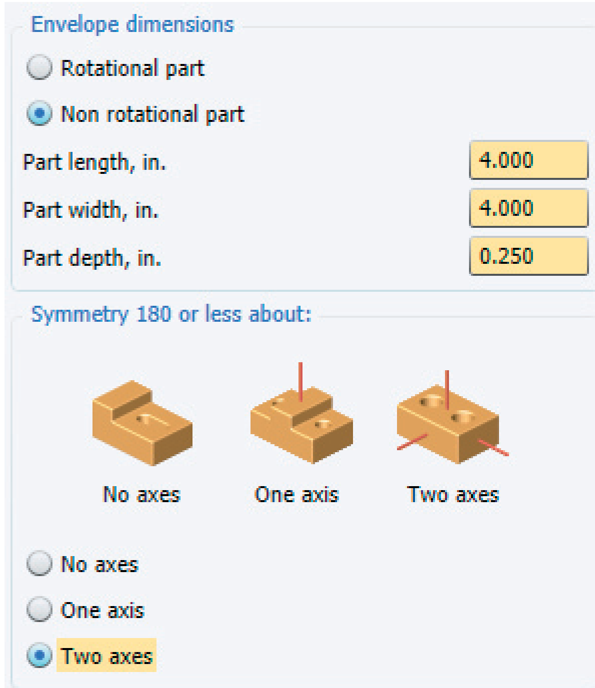
12. Because the file **welded assembly.dfm** contains more than one analysis, you are presented with the tab names of each analysis. Click the second name, *base,* and click **OK** to add the base to the Process Chart.



13. The Response Panel for the base has two group boxes, one *Basic data,* the other *Part data*. Most of this data has been imported from the existing DFM analysis, and is not editable. Click **Calculate** to see the cost breakdown for the added part as shown in the *Cost results*.

14. The next step in the analysis is to acquire the base and position it in the jig. If necessary, re-open the Insert Operation dialog (*Insert* menu→ *Operation*). Double-click the operation *Get parts and position in jig* (*Welded fabrication* category.) Close the Insert Operation dialog.

15. In the Envelope dimension group box, enter the dimensions of the base: length **4**, width **4**, and depth **0.25**. For Symmetry, select Two axes. There will be no problems acquiring the base or inserting it into the jig, so we will accept the defaults for the other operation fields. Click **Calculate**.

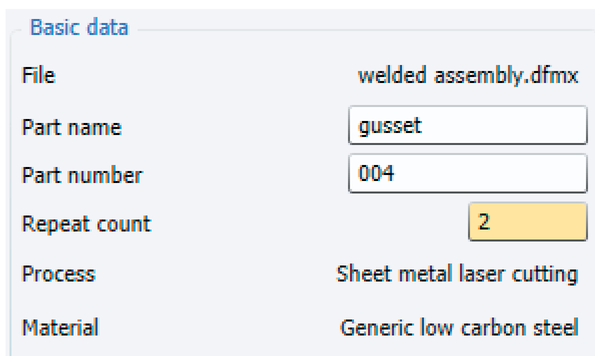


16. Now add the DFM part *back plate* from the welded assembly.dfmx file as you did the *base* and click **Calculate**.

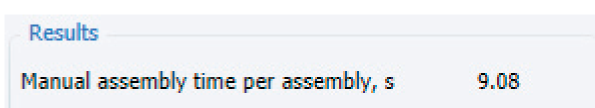
17. Select the *Get parts and position in jig* operation and click the Copy toolbar button. Now select the *back plate entry* and click the Paste toolbar button.

    Edit the dimensions: length **5**, width **3**, and depth **0.25**. Select Symmetry of One axis. Again, there will be no problems acquiring the back plate or inserting it into the jig. Click **Calculate**.

18. Now we will add the two identical *gussets* to the Process Chart. From the welded assembly.dfm file, add one *gusset* and change its repeat count to **2.** Click **Calculate**.



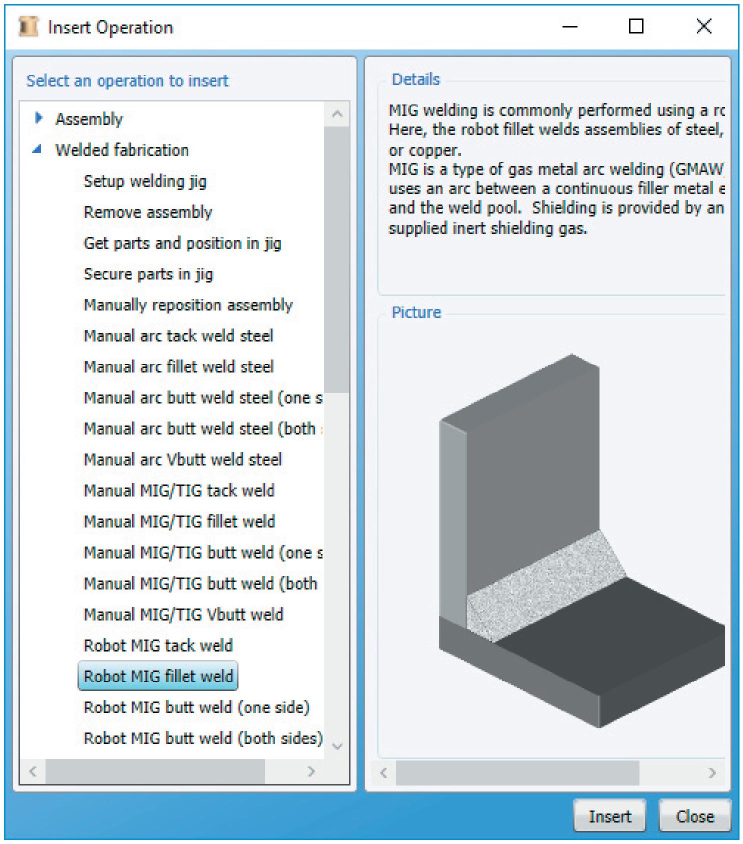
19. Copy and paste the operation *Get part and position in jig* as before. Edit the dimensions: length **3**, width **2.25**, and depth **0.25** and again, change the *Repeat count* response to **2** (the two gussets will be acquired simultaneously). Also check the box for *Not self-locating.* Select Symmetry of No axes. Note that the time for the assembly step is updated after each response as shown below.



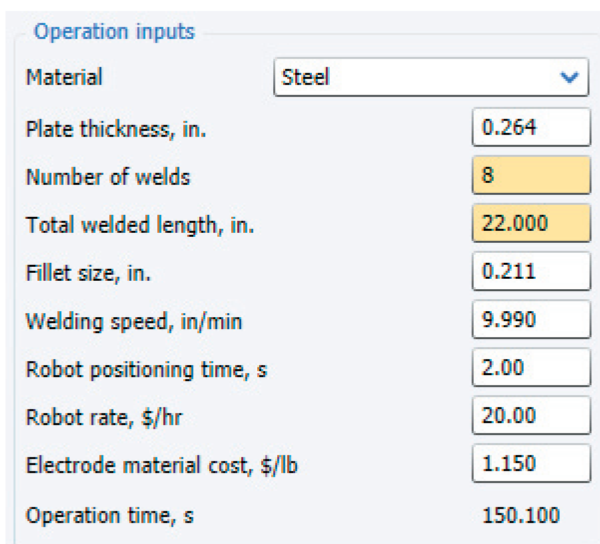
    Click **Calculate** to update the cost results.

20. Now we need to secure the parts in the jig prior to welding them. Add the operation *Secure parts in jig* and change the *Number of toggle clamps* to **4**.

21. Now the parts are to be welded together. With the *Secure parts in jig* entry highlighted on the Process Chart, double-click the *Robot MIG fillet weld* operation in the *Welded fabrication* category. It is added to the Process Chart.



22. The edits needed to the responses for the welding operation are *Number of welds* **8** and *Total welded length* **22** inches. Click the **Calculate** button to update the cost results.



23. To complete the manufacture of the welded fabrication, there is an additional operation needed. From the *Welded fabrication* list in the Insert Operation dialog, double-click *Remove assembly.* Click **Calculate** again.

24. Finally, we will inspect the finished product. In the Insert Operation dialog, expand the *Inspection* entry and double click *Inspect visually* to add it to the Process Chart. Accept the rejects percentage of 0.5. Change the *Inspected area* to **88.15** square inches and click **Calculate**.

25. Close the Insert Operation dialog. To review the *Cost results* for this assembly fabrication analysis, click the top level of the Process Chart. The total cost per part is $5.84.

Cost results, $

	Previous	Current
material	2.0448	2.0448
setup	0.0656	0.0656
process	3.3734	3.3797
rejects	0.0555	0.0556
piece part	5.5394	5.5457
tooling	0.0800	0.0800
total	5.6194	5.6257
Tooling investment	800	800

Viewing the completed fabrication analysis

We now turn to the completed sample analysis of the bracket fabricated assembly. In your Dfma installation, open the **welded assembly.dfmx** file in the *Data\samples* subdirectory.

The completed sample file, which contains the weldment analysis as well as an analysis for each of its parts, also has a casting analysis of the same part.