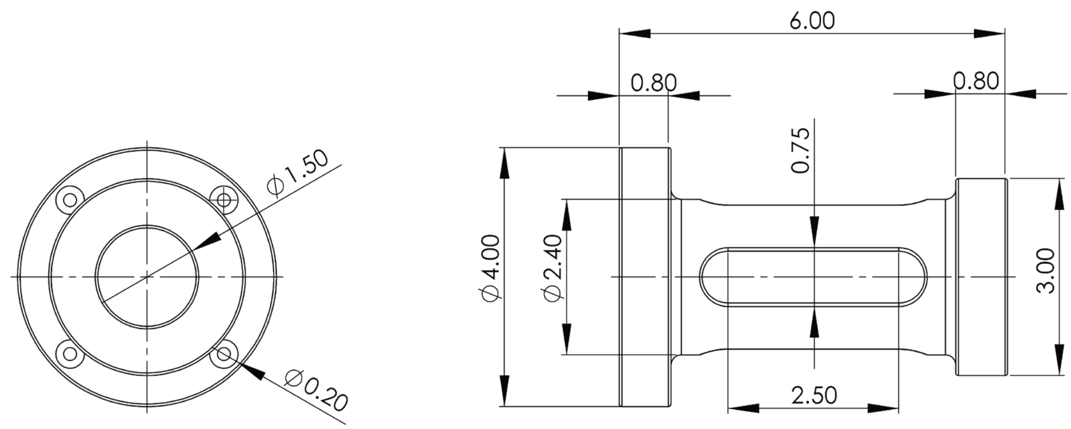
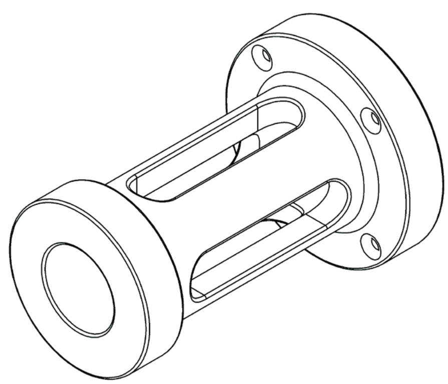
Machining Quick Estimate

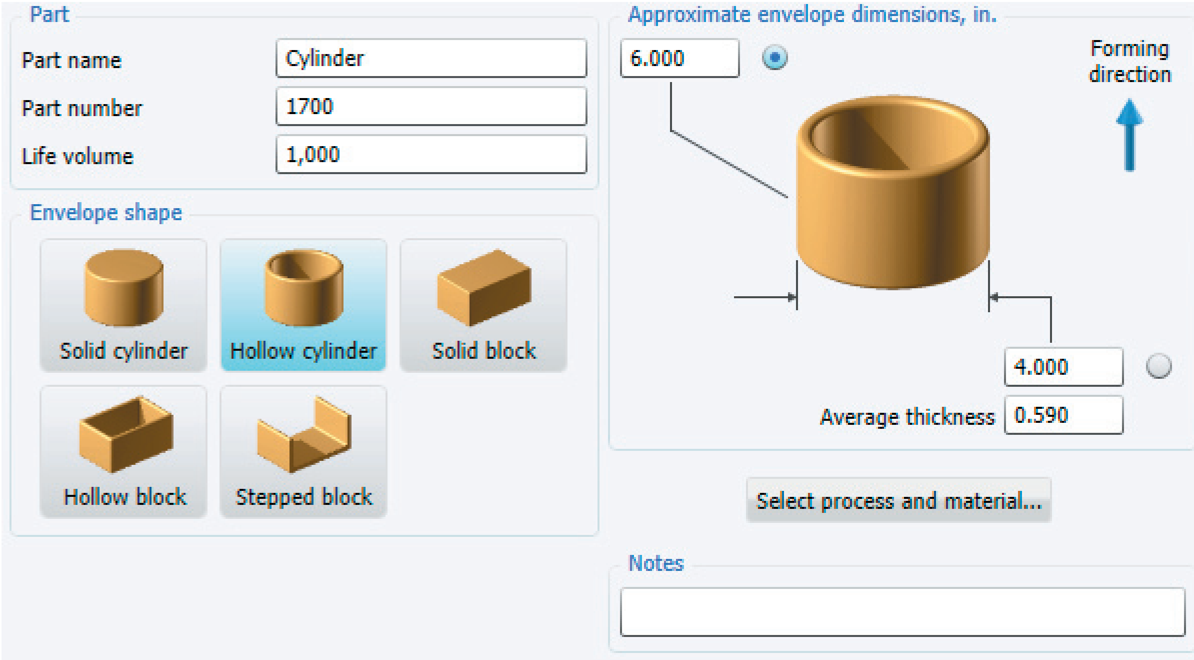
With the DFM Concurrent Costing software, two types of machined/cut from stock analyses are possible; namely a Full analysis and a Quick estimate. If accuracy of results is of the utmost importance or a detailed breakdown of the machining cost is required, a Full analysis is recommended. However, a machining Quick estimate is helpful when detailed knowledge of machining operations and machine tools is not available. A Quick estimate is also useful when a rough estimate of part cost is needed very quickly and with less effort than that required for a Full analysis. In this tutorial, we will generate a machining Quick estimate for the machined part shown below. We will also compare the Quick estimate with a Full analysis to estimate the difference in the cost results.





A machining Quick estimate and a machining Full analysis for this part have also been completed and stored in the cylinder.dfmx sample file installed with the software.

1. Start a new analysis in DFM Concurrent Costing and complete the part description as shown below.



2. Click the Original tab above the Process chart and enter **Quick estimate**. Press *enter* to rename the analysis tab.

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

4. On the *Process and material selection* dialog, open the *Machining or cut from stock* category and click the *Quick estimate* process. Choose the *Generic stainless steel* material in the *Stainless steel* category. Click the **OK** button to accept the selections and return to the main window.

5. The Stock process entry is now highlighted on the Process chart. A default cost estimate for the machined part has been calculated. This default cost estimate will now be refined so that a more accurate Quick estimate is generated.

6. Select *Round bar or rod* from the *Stock material form* dropdown.

7. Click the *Machining* operations entry on the Process chart. In the *Part shape classification* group box, click *Primary rotational and secondary (features)*. Click the **Calculate** button to update the default values and results for the machining operations.

8. This part must be machined from both ends and as a result will be reversed once during machining. For this reason, enter **2** into the *Number of clampings* input.

9. Rough turning is carried out on the outside diameter of the small flange and the outside diameter of the center section. A large non-secondary hole is drilled through the center. For these features, enter **3** into the *Rough turned features* input.

10. Enter **4** into the *Rough milled features* input to account for the four rough milled slots in the part's center section.

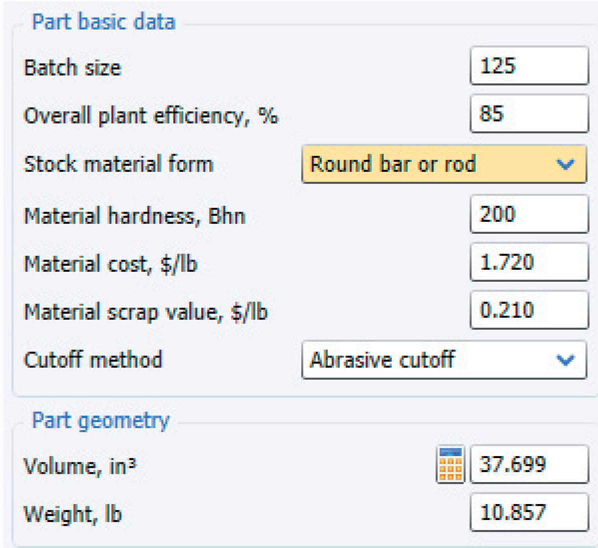
11. Finish turning is carried out on the outside and inside faces of the large flange, the outside face of the small flange, and the central hole. For these features enter **4** into the *Finish machined turned features* input.

12. Enter **4** for both the *Drilled secondary holes* and the *Threaded features* inputs to account for the four secondary holes that are drilled into the large flange and then tapped. Click the *Calculate* button to update the machining operations cost results.

13. The *Part feature details* group box contains inputs for the surface area generated by various machining processes. This information can either be entered directly into these fields or it can be estimated using the geometry calculators. Normally, the machining cost is not very sensitive to changes in this surface area information. For this reason, it is intended that rough estimates for these area inputs would be entered without use of the geometry calculator. However, for completeness, this tutorial will guide you through completion of the entire geometry for this part using the calculators.

Using the Geometry calculators to define the part volume and machined areas.

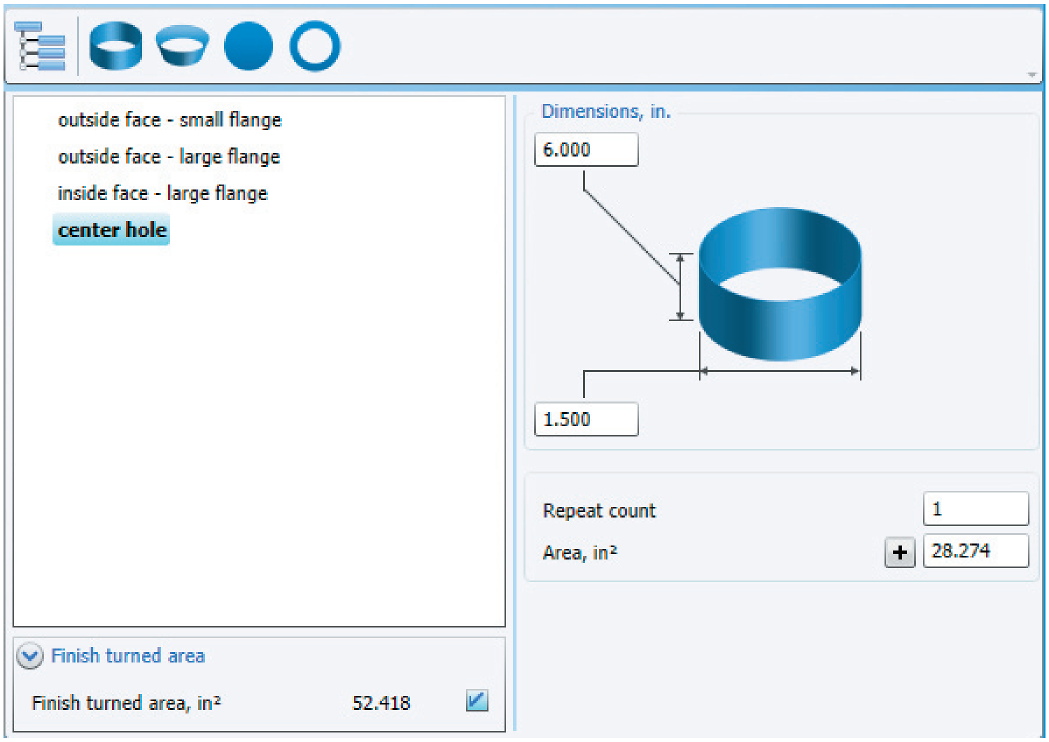
1. Highlight the Stock process entry on the Process Chart.



2. Open the geometry calculator for the part volume by clicking the located next to the Part volume field.
3. We will approximate the volume of the finished part by first adding cylinders for the part's flanges and center section. Click the button on the shapes toolbar to add a cylinder to the geometry chart. Name the cylinder **large flange**.
4. Enter a length of **0.8** inches and a diameter of **4** inches in the dimensions panel on the right side of the screen.
5. Add another cylinder to the geometry chart and name it **center section**. Enter a length of **4.4** inches and a diameter of **2.4** inches.
6. Add a third cylinder to the geometry chart and name it **small flange**. Enter a length of **0.8** inches and a diameter of **3** inches.
7. We will also subtract cylinders to account for the holes that pass through the part's center and large flange. Add a fourth cylinder to the geometry chart and name it **center hole**. Enter a length of **6** inches and a diameter of **1.5** inches. Subtract this hole by clicking the button next to the Volume field on the right panel.
8. Add a *cylinder* to the chart and name it **flange hole**. Enter a length of **0.8** inches and a diameter of **0.2** inches. Change the repeat count to **4** and subtract the volume by clicking the button.
9. Obrounds are subtracted to account for the slots that are milled in the part's center section. Add an *obround* to the chart and name it **slot**. Click the button on the shapes toolbar. Enter a thickness of **0.45** inches, a width of **0.75** inches, and a length of **2.5** inches. Change the repeat count for the obround to **4**.
10. Note that the part volume total shown beneath the chart is 20.74 cubic inches. Click **OK** to transfer this total volume to the analysis.
11. Click on the *Machining operations* entry on the Process chart.
12. Next we will approximate the surface area generated by the finish turning done on the outside faces of the large and small flanges, the inside face of the large flange, and the central hole. Click the button next to the Finish turned area field on the responses panel. Click to add an annulus area to the chart and name it **outside face - small flange**. Enter an inside diameter of **1.5** inches and an outside diameter of **3** inches.
13. Add another annulus area to the chart and name it **outside face - large flange**. Enter an inside diameter of **1.5** inches and an outside diameter of **4** inches.

14. Add a third annulus area to the chart and name it **inside face - large flange**. Enter an inside diameter of **2.4** inches and an outside diameter of **4** inches.

15. Add a cylindrical area to the chart and name it **center hole**. Enter a length of **6** inches and a diameter of **1.5** inches.



16. Click **OK** to transfer the Finish turned area of 52.418 to the analysis.

17. Click the beside the *Area of drilled or reamed holes* field. This calculator will be used to define the cylindrical area of the four small secondary holes drilled into the large flange. Add a cylindrical area to the chart and name it **flange hole**. Enter a length of **0.8** inches and a diameter of **0.2** inches. Change the repeat count to **4**.

18. Click **OK** to transfer the hole area to the analysis.

19. Click the beside the Area of threaded features field.

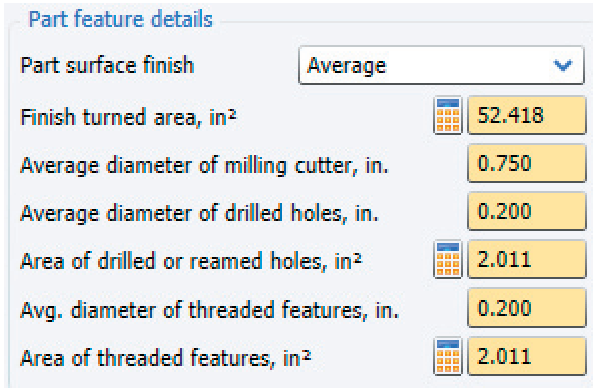
20. This calculator will be used to define the cylindrical area of the four threaded holes on the large flange. Add a cylindrical area to the chart and name it **flange hole threads**. Enter a length of **0.8** inches and a diameter of **0.2** inches. Change the repeat count to **4**.

21. Click **OK** to transfer the area of threaded features to the analysis.

22. On the Machining operations response panel, check the values shown in *Part feature details* group box that have been transferred from the calculators below.

Completing the Quick estimate

1. Leave the *Part surface finish* dropdown set to Average. Enter **0.75** inches for the average diameter of milling cutters and enter **0.2** inches for both the *Average diameter of drilled holes* and the *Average diameter of threaded features*.



2. Press the **Calculate** button to complete the Quick estimate. Click the *Stock process* entry on the Process chart and note that the total cost result is $47.12.

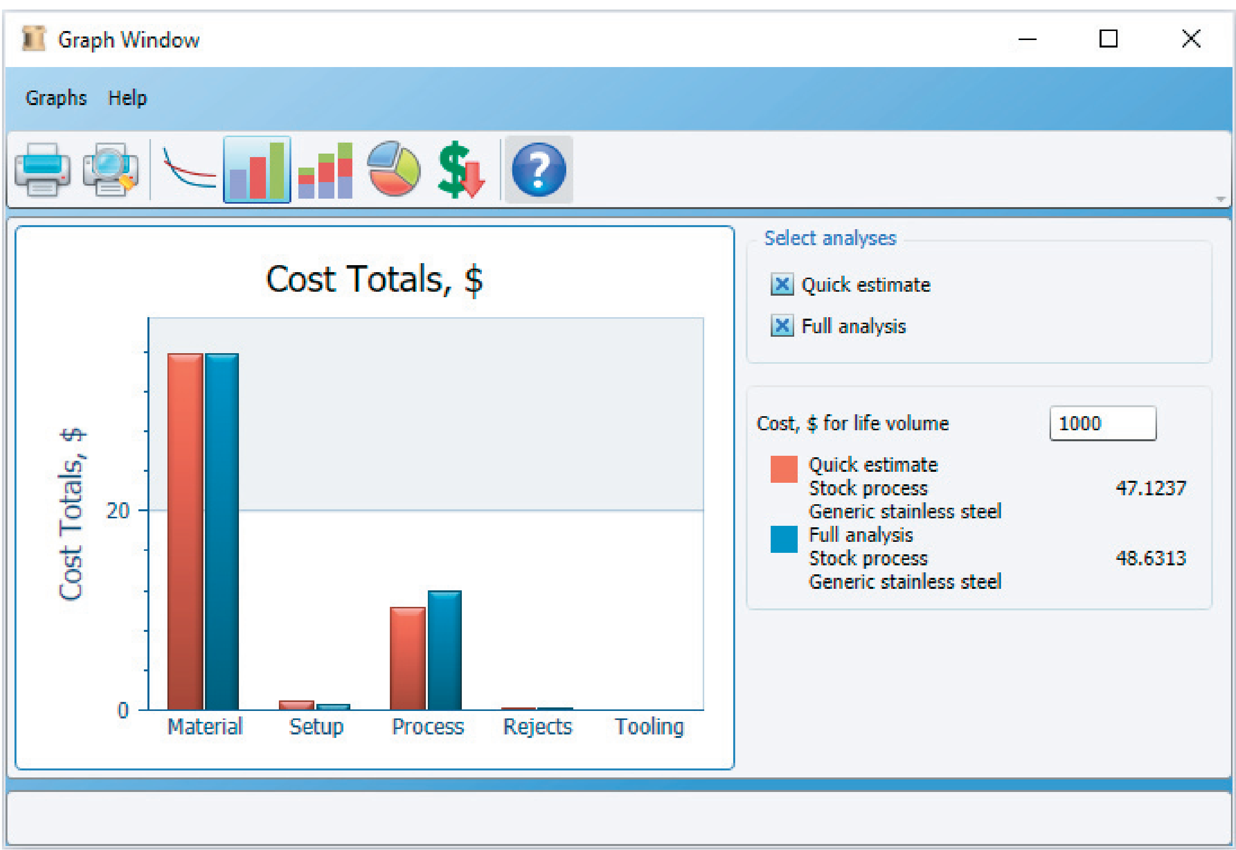
3. Click the *Machining operations* entry on the Process chart. Click the *Display machine properties* checkbox. Note that a Shenyang HTC2050im CNC lathe has been automatically chosen to turn this part and to mill, drill, and tap the secondary features. All default properties of this machine have been taken from the software's machine library.

Open a completed analysis file

1. Open the completed analysis file by selecting *Open* from the *File* menu. In the Open dialog, open the **cylinder.dfmx** file that is installed in \data\samples. There is no need to save the Quick estimate created during this tutorial.

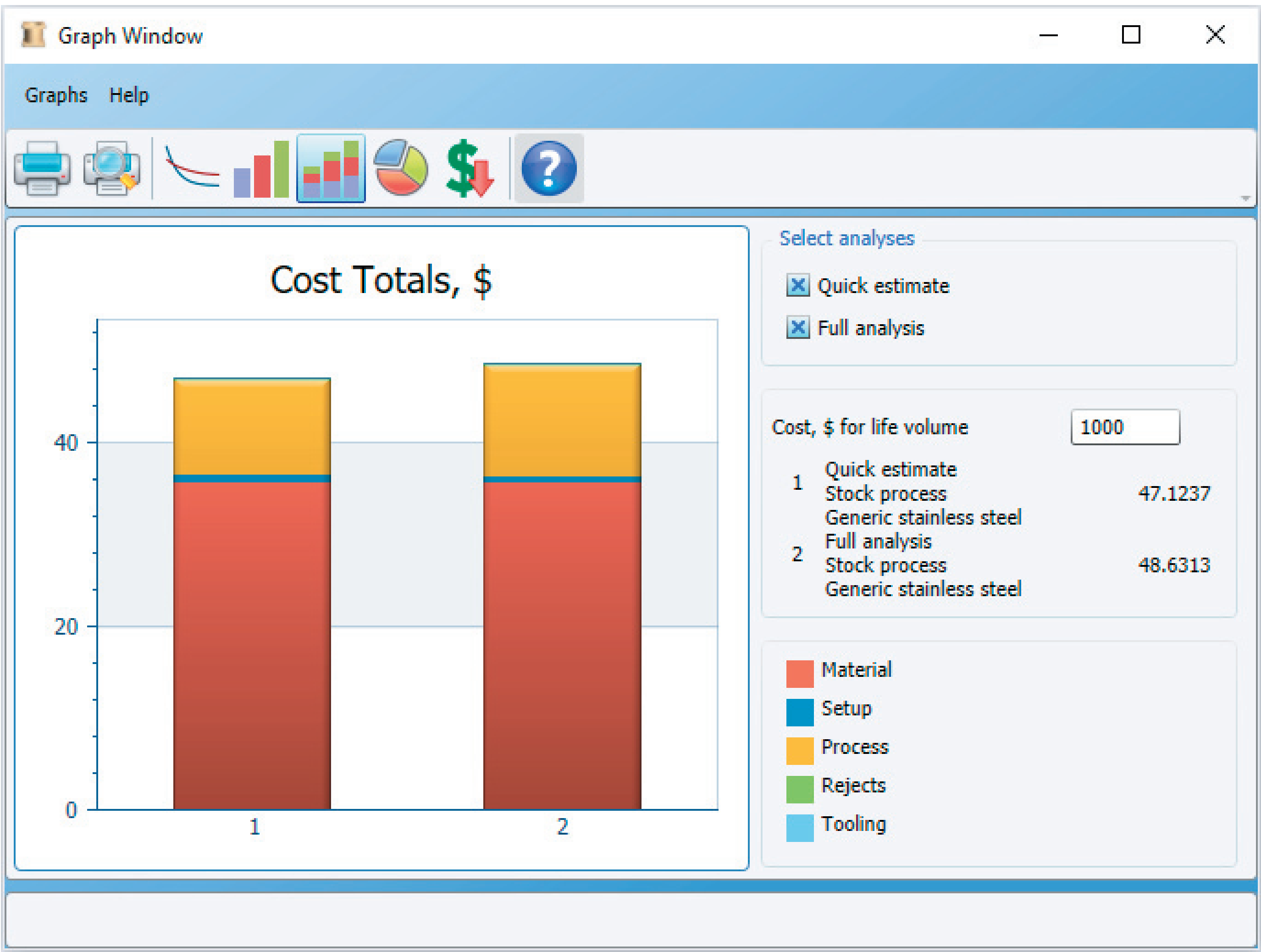
2. In the cylinder.dfmx file, there are two analysis tabs. The first tab, Quick estimate, contains the Quick estimate you will have created during this tutorial. The second tab, Full analysis, contains a machining full analysis of the same part.

3. To compare the Quick estimate and the Full analysis, click the *Results* menu and then click *Cost Totals*. Select both analyses in the *Select Analyses* group box to display the cost breakdown comparison graph shown below.



4. Note that the material cost estimate for the Full analysis and the Quick estimate are identical. This is because the method used for estimating material cost is the same for both types of machining analyses. Also note that the Quick estimator has overestimated the setup cost by 34.9% (\$0.85 versus \$0.63). This is because the number of different cutting tools required to machine the part is not defined by the user in the Quick estimate and is instead estimated internally. Each different cutting tool requires additional setup time so the comparison shows that the Quick estimator's estimate of the number of different cutting tools required is a bit too high for this particular part. Also note that the Quick estimator has underestimated the Process cost by 14.3% (\$10.28 versus \$12.00). This is because the number of cutting tool movements must be estimated internally by the Quick estimator. Each movement of the cutting tool results in additional costs for non-productive time so the comparison shows that the number of cutting tool movements estimated by the quick estimator was a bit too low for this particular part. The cost of rejects is about the same for the two analyses.

5. Click the toolbar button to display the cost breakdown graph as a stacked bar chart.



6. Note that the total part cost estimated by the Full analysis is \$48.63 while the Quick estimate for the same part is \$47.12. This indicates an overall underestimate of 3.1% in the Quick estimate of total part cost.

Normally, the machining cost is not very sensitive to changes in the surface areas generated by machining operations. This means these areas can be roughly defined when completing a Quick estimate. In fact, if all the default values for these areas were used, the Quick estimate of part cost would be \$51.16 which is only 8.6% larger than the completely defined Quick estimate. The partially defined Quick estimate overestimates the part cost by only 5.2% when compared with the full analysis.