

## CUSTOMIZABLE SOLUTION FOR MULTI-LEVEL BILL OF MATERIALS (CostedBOM)

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### 1. Introduction

#### 1.1 Abstract

The need to cost products, as accurately as possible, is increasing as the pressure to provide good margin and profitability analysis becomes more critical to manufacturers. When engineers want a cost for a product, they generally need to gather data of finance, sourcing, and production overhead. This paper presents an application that allows the engineers to obtain cost of multi-level BOM.

The purpose of the **Costed BOM** application is to offer a way to predict the manufactured cost of an item it accomplishes this by **rolling up** material, labor and overhead costs from the lowest levels of the BOM.

Bills Of Material (BOM) form the nucleus of any product-costing program. Most traditional approaches roll-up a BOM based on the material costs in inventory.

The presented application has a highly configurable roll-up algorithm:

- Used decimals
- Include/exclude detailed costs
- Set part total cost and set final part
- Currency conversion rates

Costed BOM reports are highly customizable, and PDF and Excel format are supported. The tool is a J2EE and XML application built on top of a Service Oriented Architecture (SOA) framework.

#### **Key benefits:**

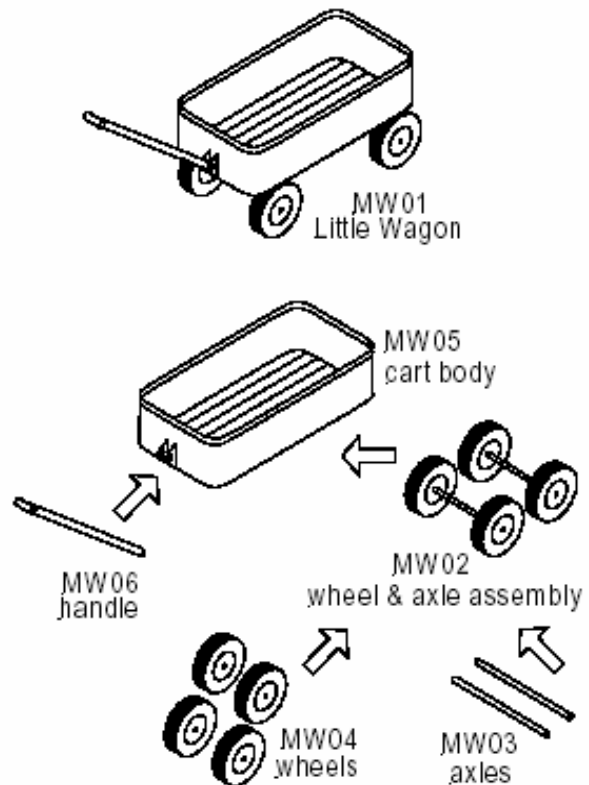
- Java based architecture: platform independent implementation, JSP/Servlets web presentation layer – worldwide accessible application
- Cost information persistency – PLM system or external database
- BoM structure provider – TeamCenter or others PLM systems

## 1.2 Understanding rolled up cost

A rolled up cost is made up of all the lower level costs that went into it. To illustrate we will use the wagon example shown here. For simplicity, only material costs will be used. No labor or overheads will be considered at this time.

**Indented BOM**

Item	Quantity	
<b>MW01 Little Wagon</b>		
. MW02 wheel & axle assembly	(1)	
.. MW03 axles	(2)	\$ 4.00
.. MW04 wheels	(4)	\$12.00
. MW05 cart body	(1)	\$20.00
. MW06 handle	(1)	\$ 3.00



The rolled up cost for the MW02 wheel and axle assembly is \$16.00, which is the total of the two components that go into it, MW03 (\$4.00) and MW04 (\$12.00).

The rolled up cost of the MW01 Little Wagon is \$39.00. This is arrived at by adding up all the components below it; MW02 (\$16.00) + MW05 (\$20.00) + MW06 (\$3.00).

A rolled up cost is used to predict the cost of a manufactured part. It is often used in the setting of standard costs and for projecting the cost of an item that has not been produced before.

## 2. Costed BOM implementation

### 2.1 Part cost information

Part cost information is persisted into externally database or directly in TCAS, as extra-attributes for each item. The detailed costs and currencies can be modified and the changes are saved into PLM system.

**Set Final** functionality: - check out, to set the cost values from the form as final cost. In this case, roll-up calculation algorithm will ignore the costs for all sub-assemblies and sub-parts of the selected item.

**Set Total** functionality: check out, to set total cost and currency for the selected item. This value will be counted in the roll-up calculation algorithm. Detailed costs will be disabled and can be enabled again by un-checking Set Total.

Initially, the displayed costs are from PLM system, but anytime can be retrieved from external database using *Retrieve* button.

The web interface menu:

Part - Cost Items

Part Number: 00000654C  
Revision: 00

Component

Material	1.123456	CAD
Labor	2	BEL
FixOH	3.333	BFL
VarOH	4	CAD
OP	5	CHF

Assembly

VaLabor	424	CAD
VaFixOH	5	CAD
VaVarOH	6	CAD
VaOP	7	CAD

Set Final

Set Total 0.0 CAD

Save Cancel Retrieve

Component costs and used currency

Assembly costs and used currency

if the selected item is a part, it will have no variable costs so the "Assembly" fields will be disabled automatically

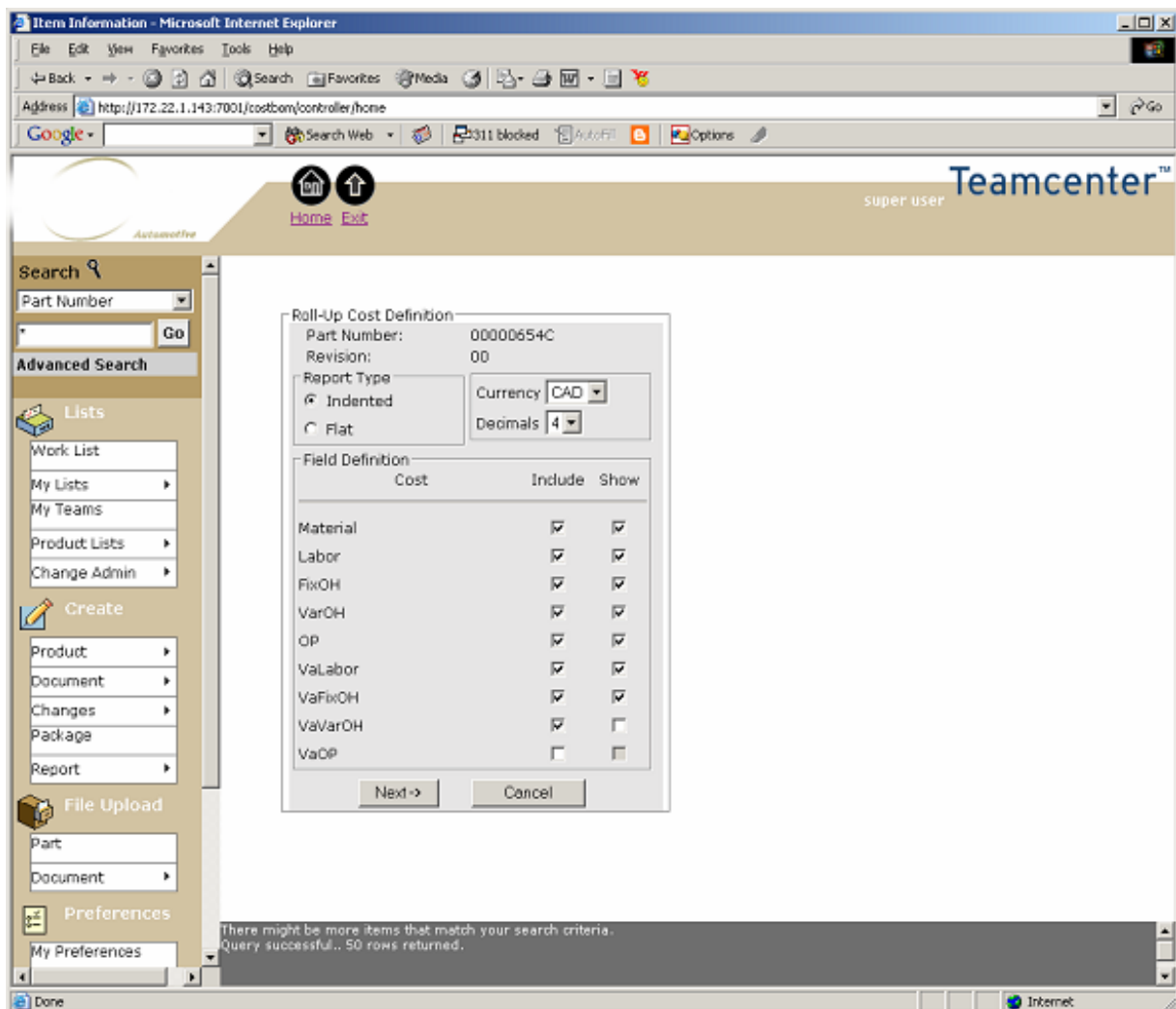
## 2.2 RollUp cost definition.

Data model and roll-up algorithm implementation are independent from BOM provider (usually an PLM system). Currently implementation is based on TeamCenter AS, as BOM provider, but application can be extended to read BOMs from others PLM system.

Roll-up calculation and generated report can be configured from *Roll-up Cost Definition* form:

- Report type (indented or flat)
- Currency target for generated report
- Show/Hide detailed cost in generated report
- Include/Exclude detailed cost in roll-up calculation

The web interface menu:



Currency Conversion manager view is displayed using *Next* button.

### 2.3 Currency conversion manager:

Currencies rates are retrieved from database for all currencies used in this item, based on the input date. By default, the rates are retrieved for current date, and if no rates are found in database, the most recent rate is retrieved. Also, the interface permit manually input for conversion rates, but input rates are not persisted.

The web interface menu:

The screenshot shows a web interface titled "Currency Conversion". It includes a "Target Currency" field set to "CAD". Below this is a section "Use Exchange Rates" with a dropdown menu set to "Magna-Current" and a date field set to "02/03/2004". There are two icons to the right of the date field. Below this section are four rows of conversion rates, each with a text input field and a "CAD" label to its right:

1 EUR =	<input type="text" value="1.6801999807"/>	CAD
1 USD =	<input type="text" value="1.3373999595"/>	CAD
1 ESP =	<input type="text" value="0.0100982049"/>	CAD
1 CAD =	<input type="text" value="1.0"/>	CAD

At the bottom of the interface are two buttons: "<- Back" and "Process".

Three callout boxes with red arrows point to specific elements:

- The top callout box points to the date field and contains the text: "Retrieve conversion rates from database, using selected date (as of date)".
- The middle callout box points to the input field for the EUR to CAD conversion rate and contains the text: "Allow manually input for conversion rates".
- The bottom callout box points to the "Process" button and contains the text: "Apply roll up algorithm and generate rolled up view".

## 2.4 RollUp view

Applying roll-up calculation, customized using *Roll-up Definition* form, the result will be displayed into a tabular form. A summary is generated for the item on which the roll-up was applied.

If a certain item does not have filled the detailed costs (all costs are zero), a problematic situation (missing costs definition) is shown using a read X icon before the part number in tree view.

At any time, clicking on the part name, in the tree view, can modify the detailed costs for an item. After the changes are done, the roll-up algorithm is re-applied and changes are immediately visible, but there is no persistence for this changes.

The web interface view:

The screenshot shows the Teamcenter web interface for a roll-up view. The browser window is titled "MyCosedBom - Microsoft Internet Explorer" and the address bar shows "http://172.22.1.143:7001/costbom/controller/home". The interface includes a search bar, a "Home Exit" button, and a "Teamcenter" logo. The main content area displays a "SUMMARY" table and a detailed cost breakdown table.

**SUMMARY**

Part Number:	00000654C	Total cost:	500.2169
Part Revision:	00	Currency:	CAD
Part Name:	LATCH ASSEMBLY		
Description:			

**Cost Breakdown Table**

Part	Name	Qty	UoM	Material	Labor	FixOH	VarOH	OP	VaLabor	VaFixOH	TotalCost
00000654C.00	LATCH ASSEMBLY	1.0	EA	34.1235	15.3604	3.3330	5.3496	0.0505	424.0000	5.0000	500.2169
F10295A.01	WATERSHIELD	1.0	EA	22.0000	12.0000	0.0000	0.0000	0.0000	0.0000	0.0000	34.0000
Q0F3UR-15221A06-AC.00	(F10266) SEAL CBL- DR LATCH ...	1.0	EA	22.0000	12.0000	0.0000	0.0000	0.0000	0.0000	0.0000	34.0000
F10094A.00	ACTUATOR ASSEMBLY	1.0	EA	11.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	11.0000
899508F.01	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
B11230A.00	SCREW, MACHINE FLATHEAD	4.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
U11094F.00	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F11695E.01	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F11698D.01	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F11696D.00	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
U11190D.01	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F11904C.01	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
999568E.00	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
V10574A.01	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F11697D.00	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F11698B.01	CLIP	1.0	EA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

There might be more items that match your search criteria.  
Query successful... 50 rows returned.

## 2.5 Cost reports

Reporting format supported are PDF and Excel, and are highly customizable and configurable.

Using *Roll-up Definition* form, detailed costs can be shown or hidden in generated report, as well the target currency for the report. The additional information is appended to the report, like part number, revision and name, the currencies rates and date.

### PDF Report example

**Roll-Up Cost - Indented BOM Summary**

PartNumber: 10006      Total Cost: 1452.108  
 Revision: A      Currency: CAD  
 Name: abc1  
 Description:

Date: 3/23/2004

Level	Part Number	Part Rev	Part Name	Qty	UOM	Material	Labor	Mach	Mach1	Mach2	Mach3	Mach4	Mach5	TOTAL
0	10006	K	abc1			26.133	8.872	2.593	4.814	51.100	2.041			218.223
0.1	#12	K	abcd			2.000	0.214	0.440	0.210	0.000				115.700
0.2	#14	K	abcd			2.000	0.210	0.440	0.210	0.000				167.850
0.3	#15	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
0.4	#1	K	abcd			20.000	3.142	4.400	7.884	0.000				1157.000
0.5	#2	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
0.6	#3	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
0.7	#4	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
0.8	#5	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
0.9	#12	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
1.0	#16	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
1.1	#17	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
1.2	#18	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
1.3	#19	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
1.4	#7	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
1.5	#8	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
1.6	#9	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
1.7	#10	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
1.8	#6	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
1.9	#11	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000
2.0	#20	K	abcd			0.000	0.000	0.000	0.000	0.000				0.000

Currency conversion rates  
 To currency: CAD  
 Date: 03/23/2004

Currency	Conversion Rate
EUR	1.8892992836948853
ATS	0.1647578901052475
USD	1.457900047302248
CAD	1.0

# Excel report example

Microsoft Excel - sample[1]

File Edit View Insert Format Tools Data Window Help

A27 Currency conversion rates

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	<b>Roll-Up Cost - Indented BOM</b>												
2	<b>Summary</b>												
3	<b>Part Number:</b>	10007	<b>Total Cost:</b>	222.78									
4	<b>Revision:</b>	A	<b>Currency:</b>	CAD									
5	<b>Name:</b>	test part name clutch housing aaskjdhakdgaskgfasdkasd sdfsdbnsdg											
6	<b>Description:</b>												
7													
8	<b>Date:</b>	2/25/2004											
9													
10	<b>Level</b>	<b>Part Number</b>	<b>Part Rev.</b>	<b>Part Name</b>	<b>Qty</b>	<b>UoM</b>	<b>Material</b>	<b>Labor</b>	<b>FixOH</b>	<b>VaLabor</b>	<b>VaFixOH</b>	<b>TOTAL</b>	
11	0	10007	A	test part name clutch ho	1.0	EA	50.48	14.89	17.45	0.10	0.00	222.78	
12	0.1	10008	A	abc1	1.0	EA	20.08	5.68	8.07	0.00	0.00	111.66	
13	0.1.1	a13	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
14	0.1.2	a13	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
15	0.1.3	a14	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
16	0.1.4	a15	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
17	0.1.5	a1	A	asad	10.0	EA	18.40	3.20	4.79	N/A	N/A	102.46	
18	0.1.6	a2	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
19	0.1.7	a3	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
20	0.1.8	a4	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
21	0.1.9	a5	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
22	0.1.10	a12	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
23	0.1.11	a16	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
24	0.1.12	a17	A	asad	1.0	EA	0.00	0.00	0.00	N/A	N/A	0.00	
25													
26													
27	<b>Currency conversion rates</b>												
28	<b>To currenc USD</b>												
29	<b>Date:</b>	06/07/2004											
30	<b>Currency</b>	<b>Conversion Rate</b>											
31	EUR	1.279999971											
32	ATS	0.068241738											
33	USD	1											
34	CAD	0.800000012											
35													
36													
37													
38													
39													
40													
41													
42													

Excel Report /



### **3. Conclusions**

#### **3.1 The key benefits of Costed BOM application are:**

Predict the manufactured cost of an item

- Roll up detailed Item costs and Item total cost

Configurable roll-up algorithm:

- Used decimals
- Include/exclude detailed costs
- Set part total cost and set final part
- Currency conversion rates

Reports customization:

- Html/PDF/Excel reports
- Indent/ flat reports type
- Currency target selection

#### **3.2 The key benefits of Costed BOM architecture are:**

Java based architecture:

- Platform independent implementation
- JSP/Servlets web presentation layer: worldwide accessible application

Cost information persistency:

- Database persistency
- PDM persistency

BOM structure provider:

- TeamCenter AS
- Others PDM systems