The Product Oriented Design and Construction (PODAC) Cost Model

A Proposed Procedure for Product-Based and Process-Driven Ship Cost Estimating

The (new) Standard Procedure

1. Define the Product to be Built (Mandatory)

1.1. Define the item for which an estimate is required.

1.2. Determine the Product Work Breakdown Structure for the item.

2. Define How the Product will be Built (Mandatory.)

2.1. Determine the Work Types.

2.2. Determine the Stages of Construction.

2.3. Determine the Work Centers.

2.4. Determine the Cost Items

2.5. Determine the unit of measure for each Cost Item.

2.6. Determine the direct labor hours per unit of measure, or the total direct labor hours, for each Cost Item.

2.7. Determine the material cost per unit of measure, or the total material cost, for each Cost Item.

3. Define the Cost Information (Mandatory)

3.1. Determine the direct labor rates.

The standard procedure has five steps; three set up the problem.

The Standard Procedure (Continued)

4. Estimate the Cost of the Baseline Product (Mandatory)

4.1. View by Project Summary

4.2. View by PWBS Summary

4.3. View by Work Center Summary

4.4. View by Paragraph Summary

4.5. View by Cost Item Value by Work Center

4.6. View by Cost Item Value by PWBS

The standard procedure has five steps; one provides the cost estimate.

The Standard Procedure (Continued)

5. Perform Studies on the Baseline Cost Estimate (Optional)

- 5.1. Builder Variations
  - 5.1.1. Modify Work Center labor cost rates and cost rate application equations
  - 5.1.2. Modify overhead cost rates and profit margin
  - 5.1.3. Move selected Cost Items from one Work Center to another
  - 5.1.4. Changing selected Cost Items from one rate year to another
- 5.2. Product Variations
  - 5.2.1. Modify the Cost Item cost data
  - 5.2.2. Modifying labor-hour estimates, labor costs, or material costs
  - 5.2.3. Deleting selected Cost Items
  - 5.2.4. Replacing selected sets of Cost Items with other sets
- 5.3. Process Variations
  - 5.3.1. Modify the Cost Item cost data
  - 5.3.2. Modifying labor-hour estimates, labor costs, or material costs
  - 5.3.3. Changing selected Cost Items from one rate year to another
  - 5.3.4. Deleting selected Cost Items
  - 5.3.5. Replacing selected sets of Cost Items with other sets

The standard procedure has five steps; one provides trade-off opportunities.

New Thinking:

1. Define the Product to be Built (Mandatory)

1.1. Define the item for which an estimate is required.

1.2. Determine the Product Work Breakdown Structure for the item.

2. Define How the Product will be Built (Mandatory.)

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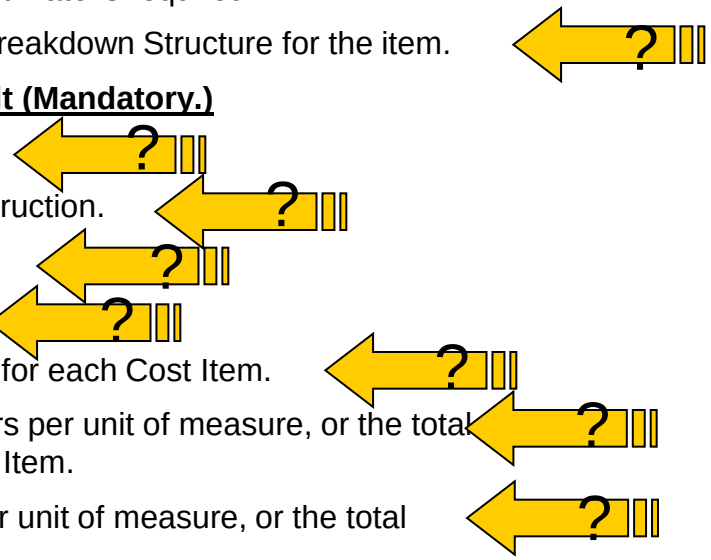
3. Define the Cost Information (Mandatory)

3.1. Determine the direct labor rates.



These items are new to us.

Unit Price Analysis (UPA) Cost Model vs PODAC Cost Model

- UPA is systems-based...PODAC is product-based
- UPA is weight-driven...PODAC is process-driven

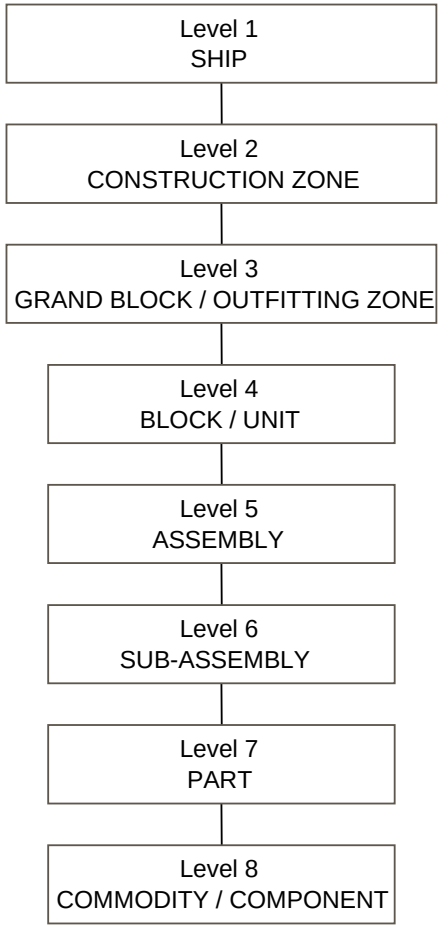
There are two basic differences between the two cost models.

System-Based to Product-Based

Extended Ship Work Breakdown Structure

ESWBS

100	Hull Structure
200	Propulsion
300	Electric Plant
400	Command & Surveillance
500	Auxiliary Systems
600	Outfit & Furnishings
700	Armament
800	Integration/ Engineering
900	Ship Assemble & Support Services



Generic Product Work Breakdown Structure

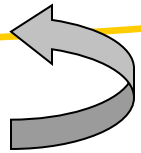
G/PWBS

The PODAC Cost Model uses a different cost accounting system.

Weight-Driven to Process-Driven

UPA CM		*PODAC CM*
Labor CER = Hours / Ton		= f (Process) = g (Interim Product, Stage, Work Type)
Material CER = $ / Ton		= ($ / Unit of Measure)$_{\text{Interim Product}}$

This is different.



This is the “same.”

where Hours, Ton, and $ are known via normal bid proposals or cost reporting and ship weight reports.

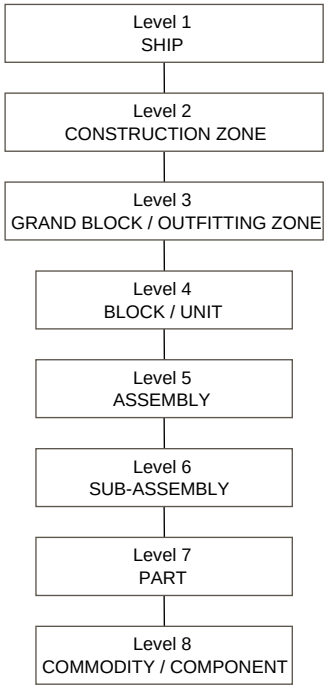
where Interim Product, Stage, and Work Type are known to the shipyard, but (generally) unknown to the Navy cost estimator.

The major difference between the two models is the labor CER since the Unit of Measure could be Tons.

Consider the Labor CER

- Labor CER = f (Process) = g (Interim Product, Stage, Work Type)

Interim Product



Stage

Non-Construction Related	Construction Related
Designing	Fabricating
Planning	Sub-Assembling
Procurement	Assembly
Purchasing	On-Unit Outfitting
Material Management	On-Block Outfitting
Launch	Grand Block Construction
Delivery	Erecting
Post Delivery	On-Board Outfitting
Test & Trials	
	Set-Up
	Clean-Up
	Finishing

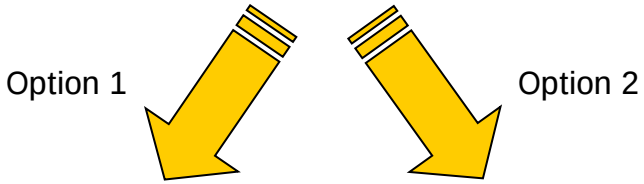
Work Type

- Administration
- Engineering
- Hull Outfitting
- HVAC
- Joiner
- Materials
- Machinery
- Material Handling
- Operations Control
- Paint
- Pipe
- Production Services
- Quality Assurance
- Structure
- Test & Trials
- Unit Construction

Labor CERs are a function of what type of work is being performed on what product, when and where.

Generating the Labor CER

- Labor CER = f (Process) = g (Interim Product, Stage, Work Type)



Shipyard(s) Developed
- Historical records
- Code of Accounts

Navy Developed
- NSRP
- Experts
- Etc.

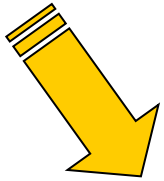
There are two options for generating CERs; they are not mutually exclusive options.

Consider Navy Developed Labor CERs

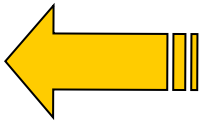
⌘ Labor CER = f (Process) = g (Interim Product, Stage, Work Type)

The CER development procedure is based on work documented in:

- NSRP Paper 0405, “Development of Producibility Evaluation Criteria,” (Dec 1993).
- NSRP Paper 0398, “ Producibility Evaluation Criteria Cost Estimating Computer Programs - Manuals,” (Dec 1993).
- Berentine, LCdr John, “A Process-Based Cost Estimating Tool for Ship Structural Design,” (May 1996).



Option 2



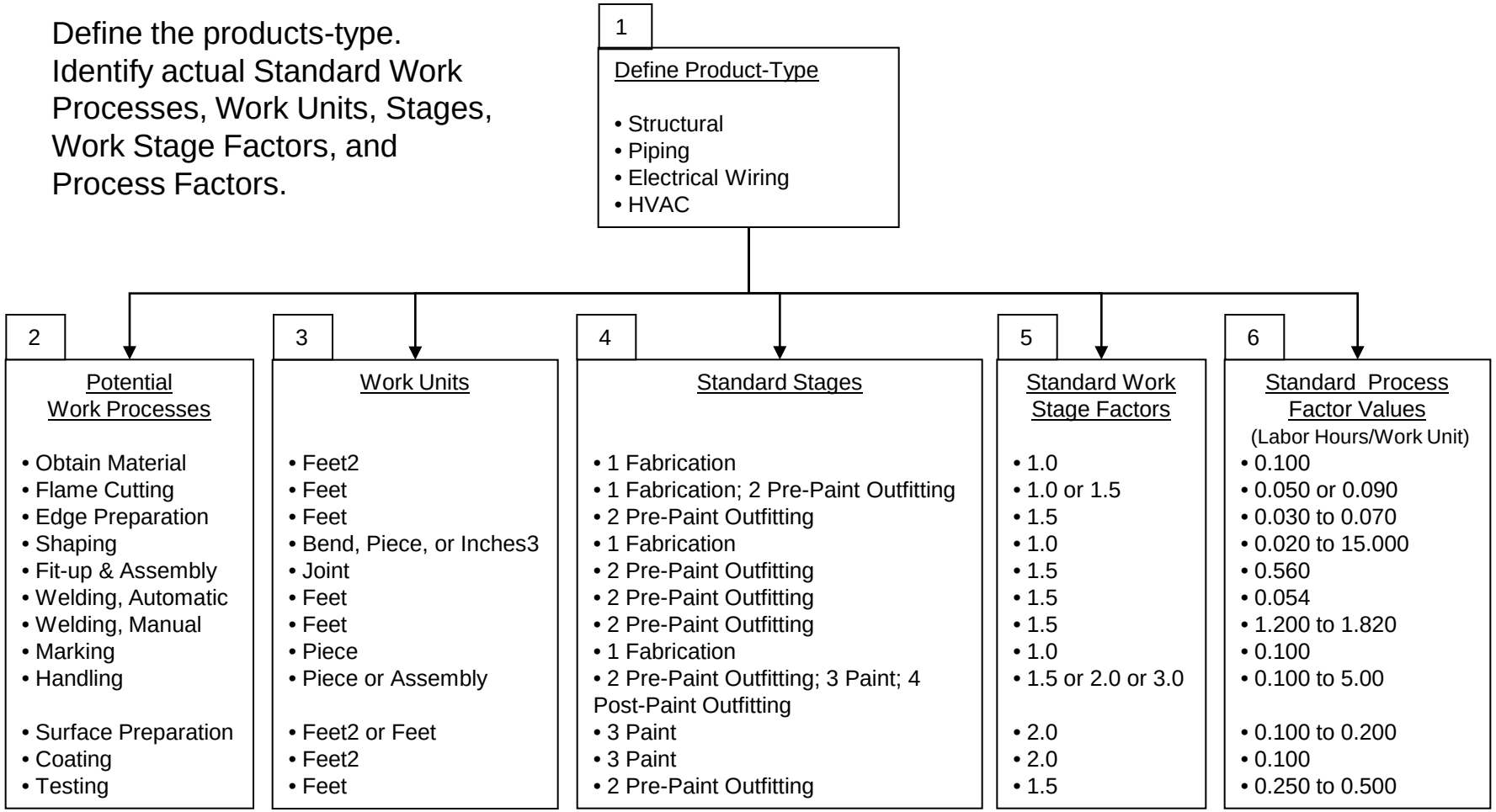
Navy Developed

- NSRP
- Experts
- Etc.

We relied heavily on the work of others.

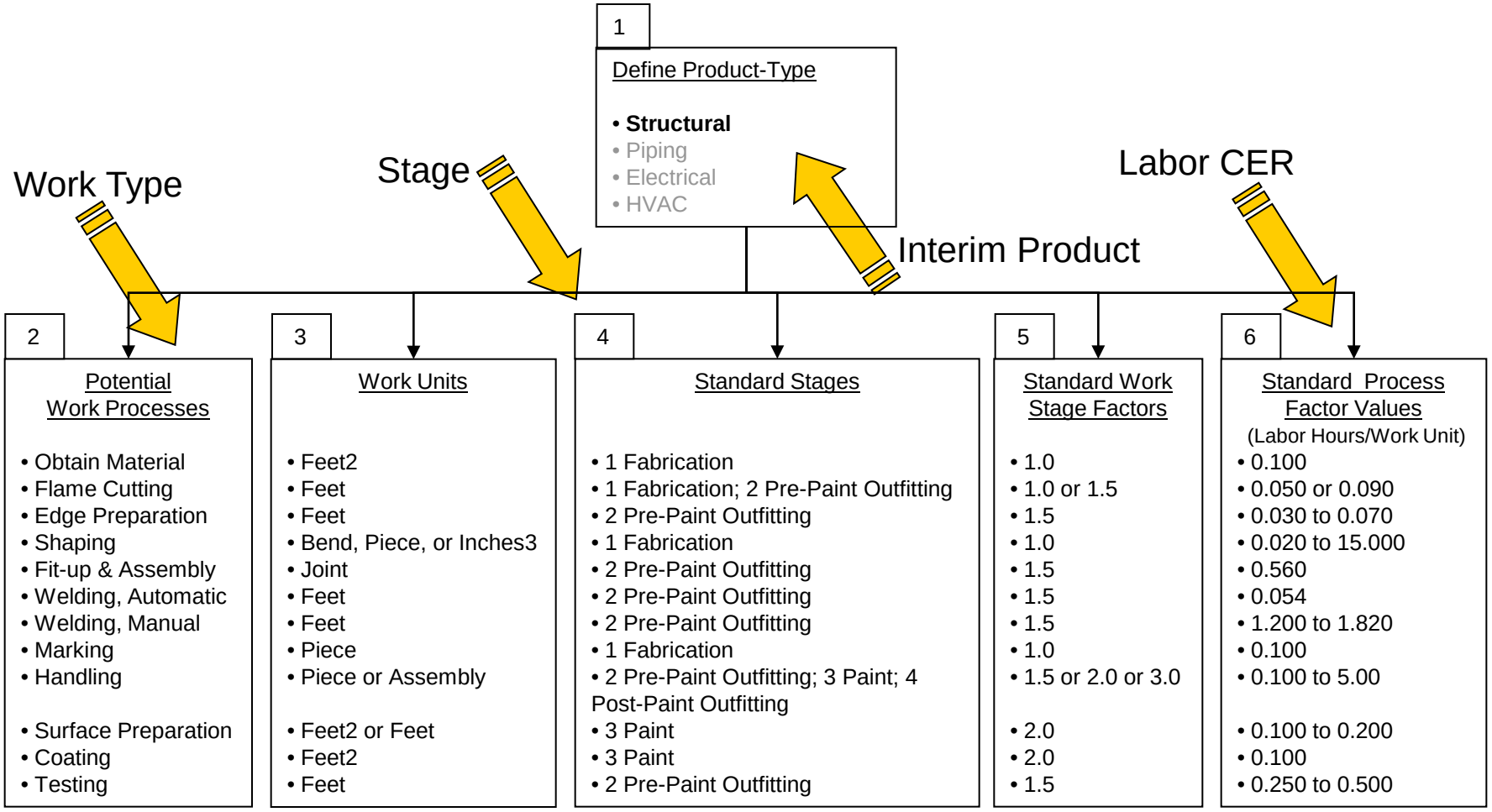
The Procedure for Generating Product CERs

Define the products-type. Identify actual Standard Work Processes, Work Units, Stages, Work Stage Factors, and Process Factors.



The procedure has thirteen steps; the first six are generic.

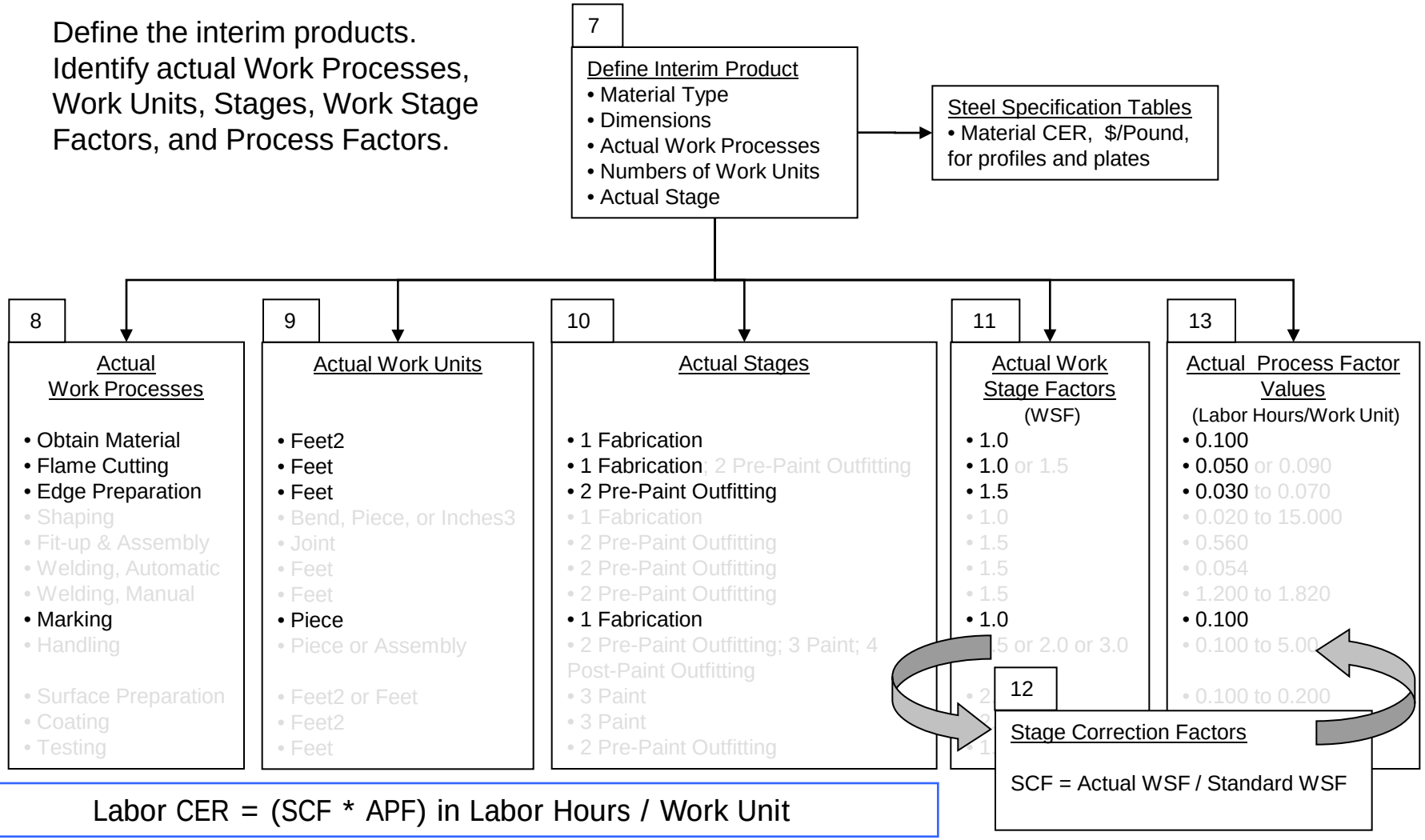
The Procedure for Generating Product CERs



The procedure mimics the PODAC Cost Model approach.

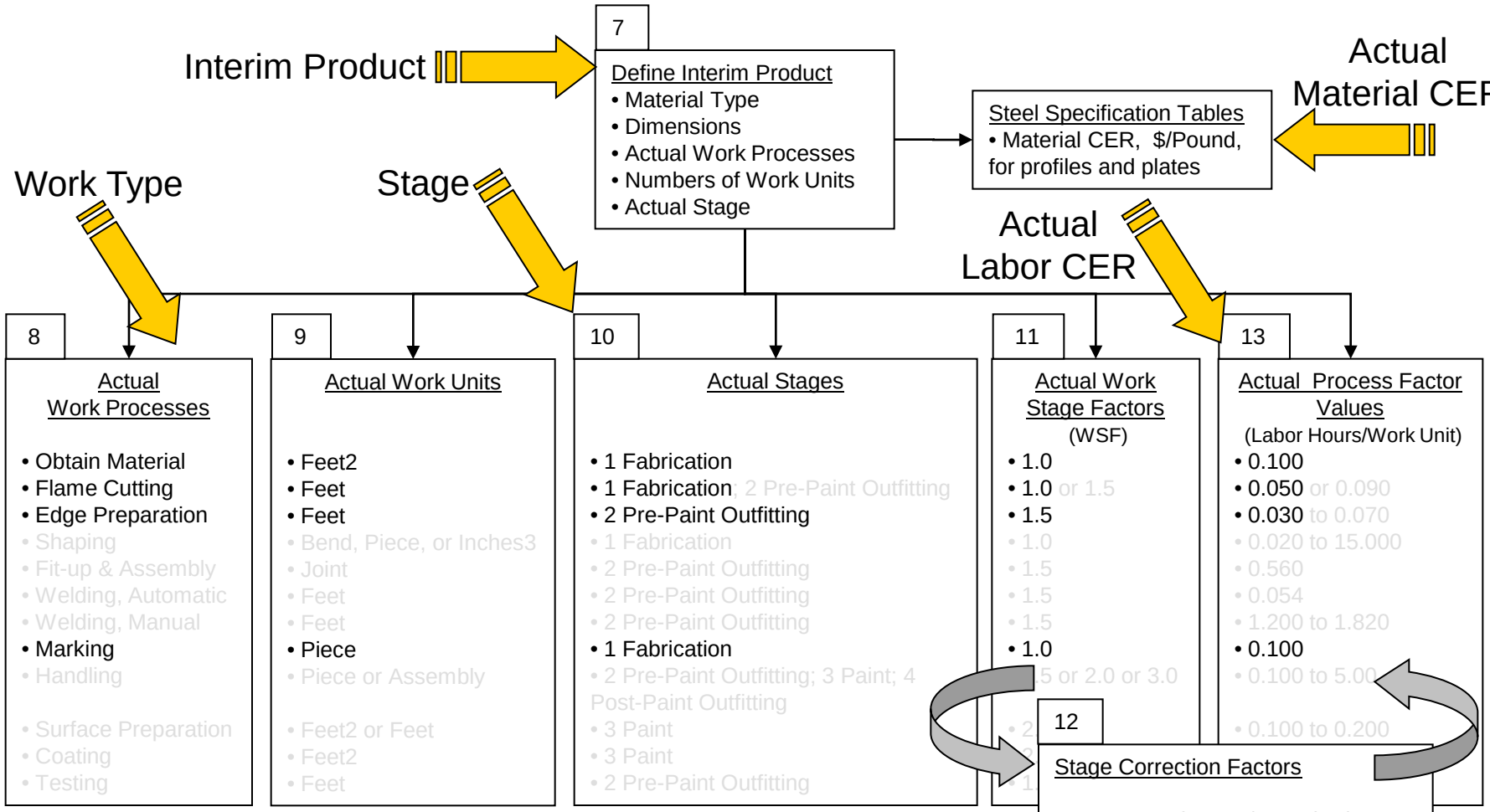
The Procedure for Generating Structural Product CERs

Define the interim products.
Identify actual Work Processes, Work Units, Stages, Work Stage Factors, and Process Factors.



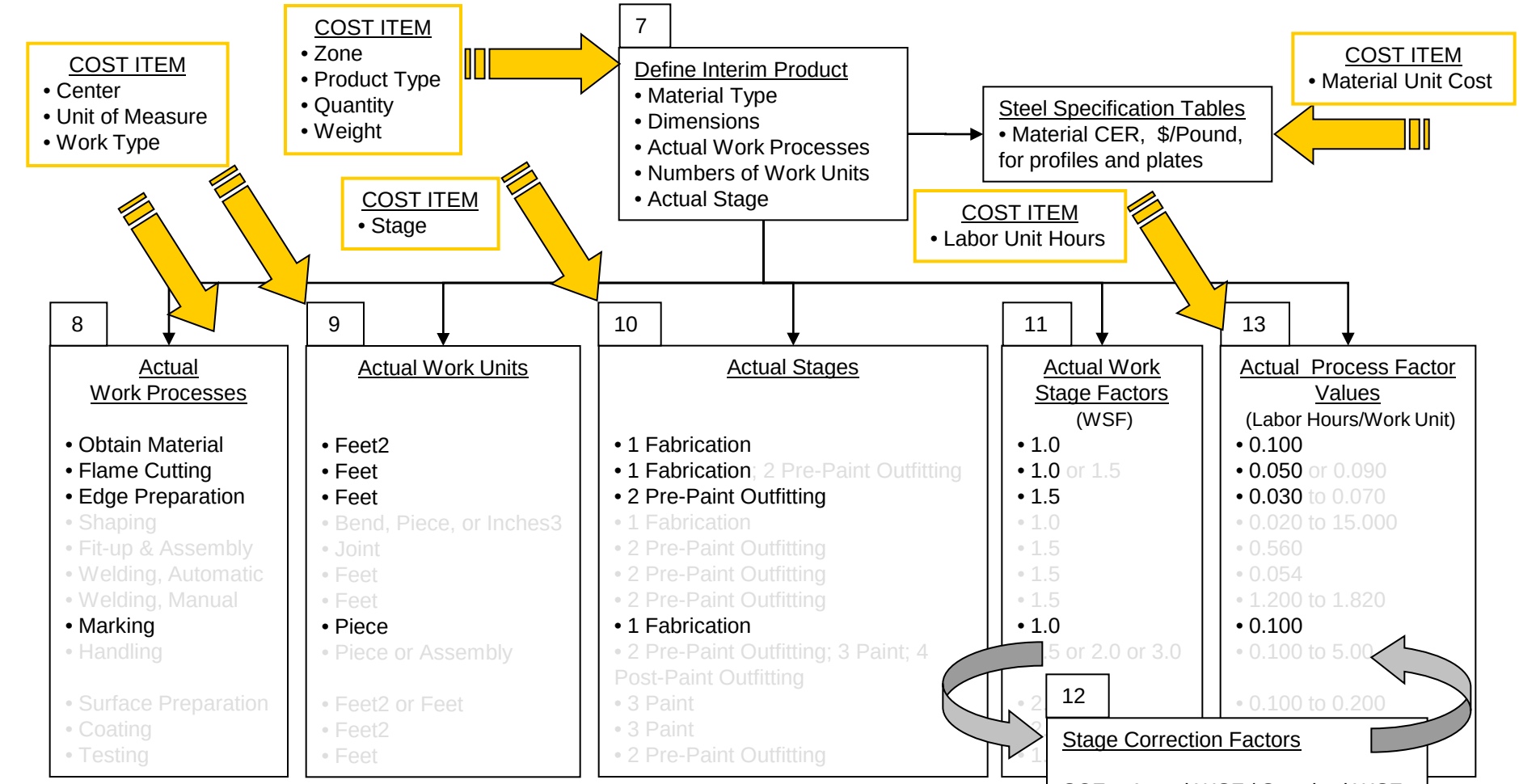
Labor CER = (SCF * APF) in Labor Hours / Work Unit

The Procedure for Generating Structural Product CERs



These steps mimic the PODAC Cost Model approach.

The Procedure and the PODAC Cost Model



These steps generate Cost Item data needed by the PODAC Cost Model.

Returning to the Standard Procedure.....

1. Define the Product to be Built (Mandatory)

1.1. Define the item for which an estimate is required.

1.2. Determine the Product Work Breakdown Structure for the item.

2. Define How the Product will be Built (Mandatory.)

2.1. Determine the Work Types.

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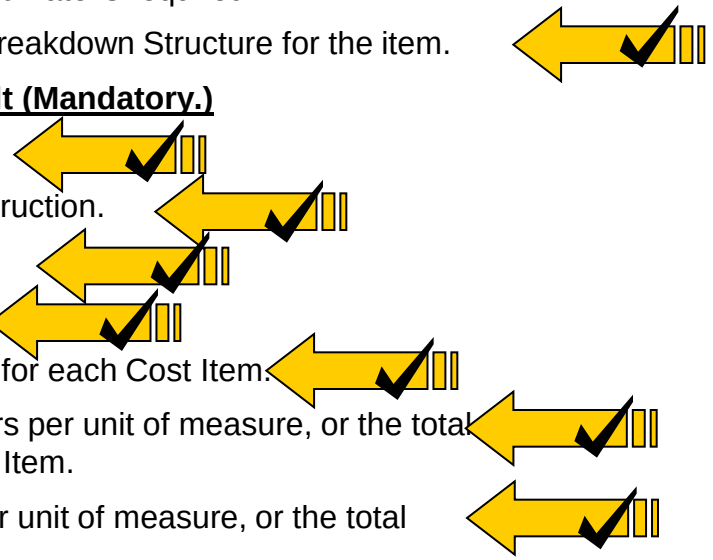
3. Define the Cost Information (Mandatory)

3.1. Determine the direct labor rates.

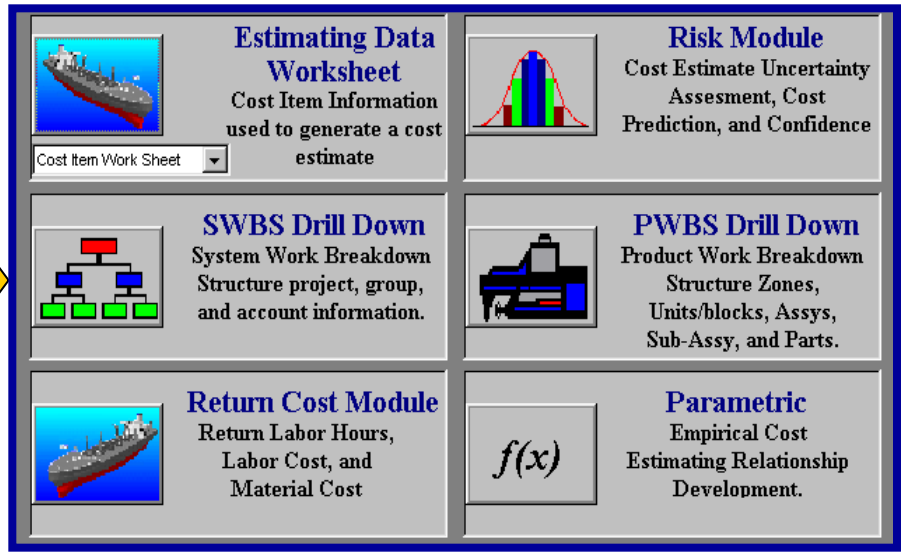


The standard procedure is now implementable within the PODAC Cost Model.

What This Effort Really Accomplished

A Procedure for Generating Product-Based CERs Based on NSRP Funded Work.

The PODAC Cost Model



The standard procedure supports and enables the PODAC Cost Model.

Demonstration - Example

- Baseline: A fabrication cost estimate is made of a simple steel structure Assembly, a tee-stiffened steel plate.

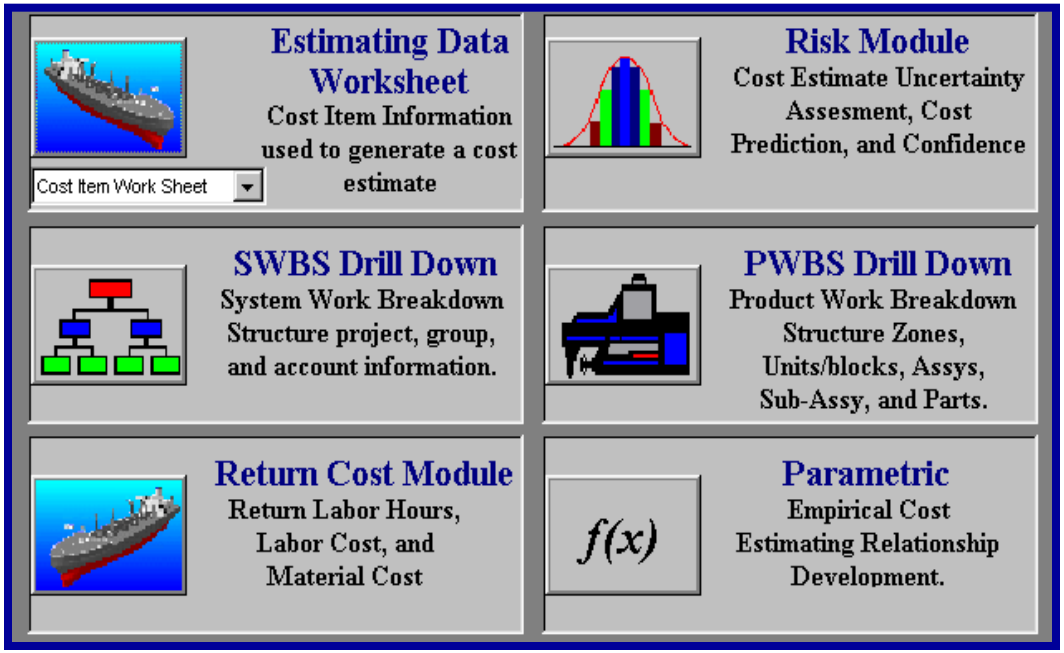
- Tradeoff #1:
  - Add a Maintenance Stage consisting of two (fabrication) Work Processes: "Surface Preparation - Blasting" and "Coating."
  - Re-blasting and re-painting required twice in a six-year period.

- Tradeoff #2:
  - Four bulb-stiffeners are substituted for every two tee-stiffeners.
  - Unit cost of the bulb-stiffeners is 75% greater than tee-stiffeners.
  - Blasting and painting of the bulb-stiffeners requires 50% less labor than the tee-stiffeners.
  - Re-blasting and re-painting are not required over the six-year period.

- Compare the costs of the Baseline, Tradeoff #1, and Tradeoff #2.

The PODAC Cost Model is flexible and tradeoffs are easy to perform.

Using the PODAC Cost Model



This is the PODAC Cost Model opening screen.

Defining the Product

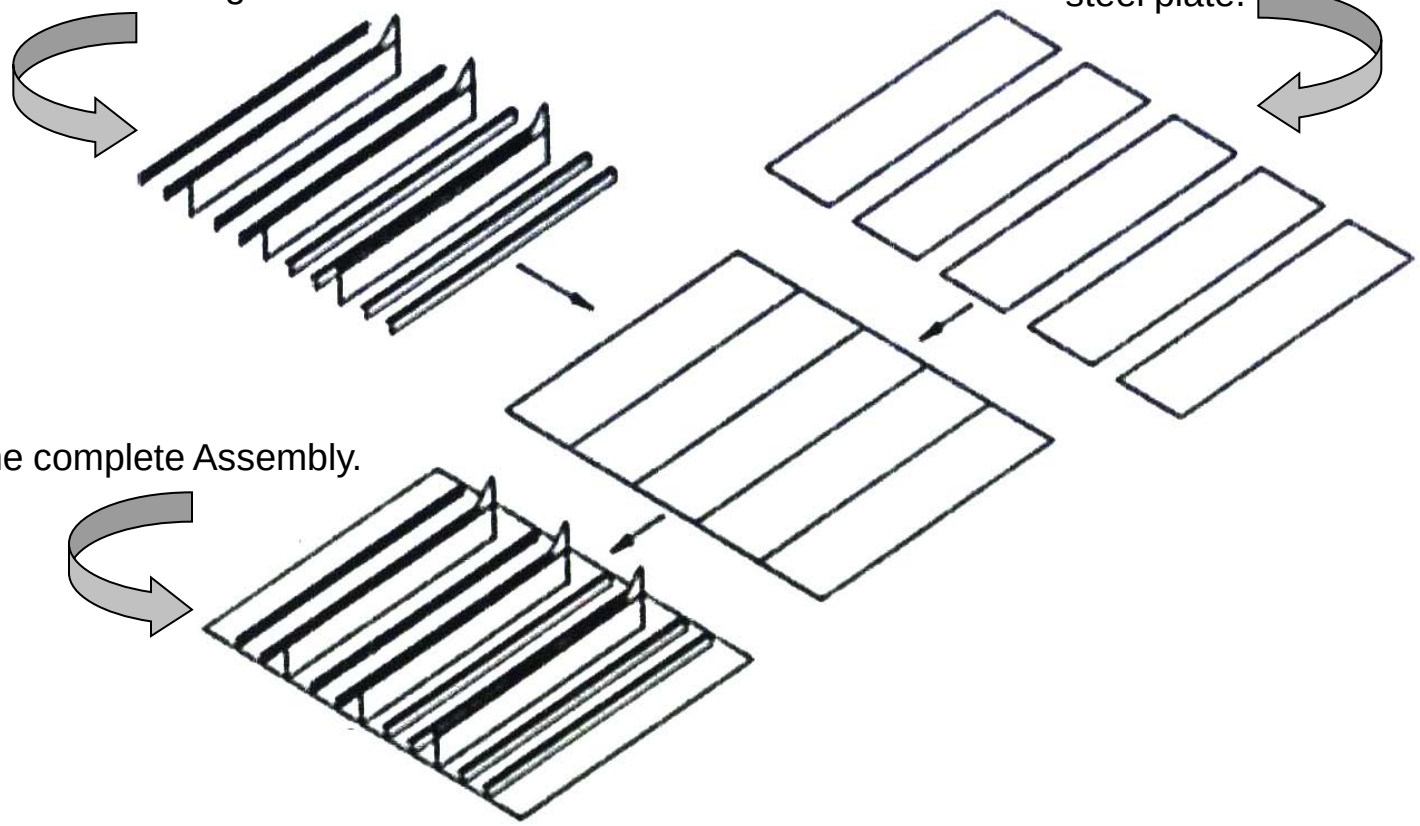
(Tee-Stiffened Panel Assembly)

Three WT 12 X 30.5 Straight Profiles with End Gussets

Eight WT 4 X 7.5 Straight Profiles

Five flat steel plates, butt-welded together to form one large flat steel plate.

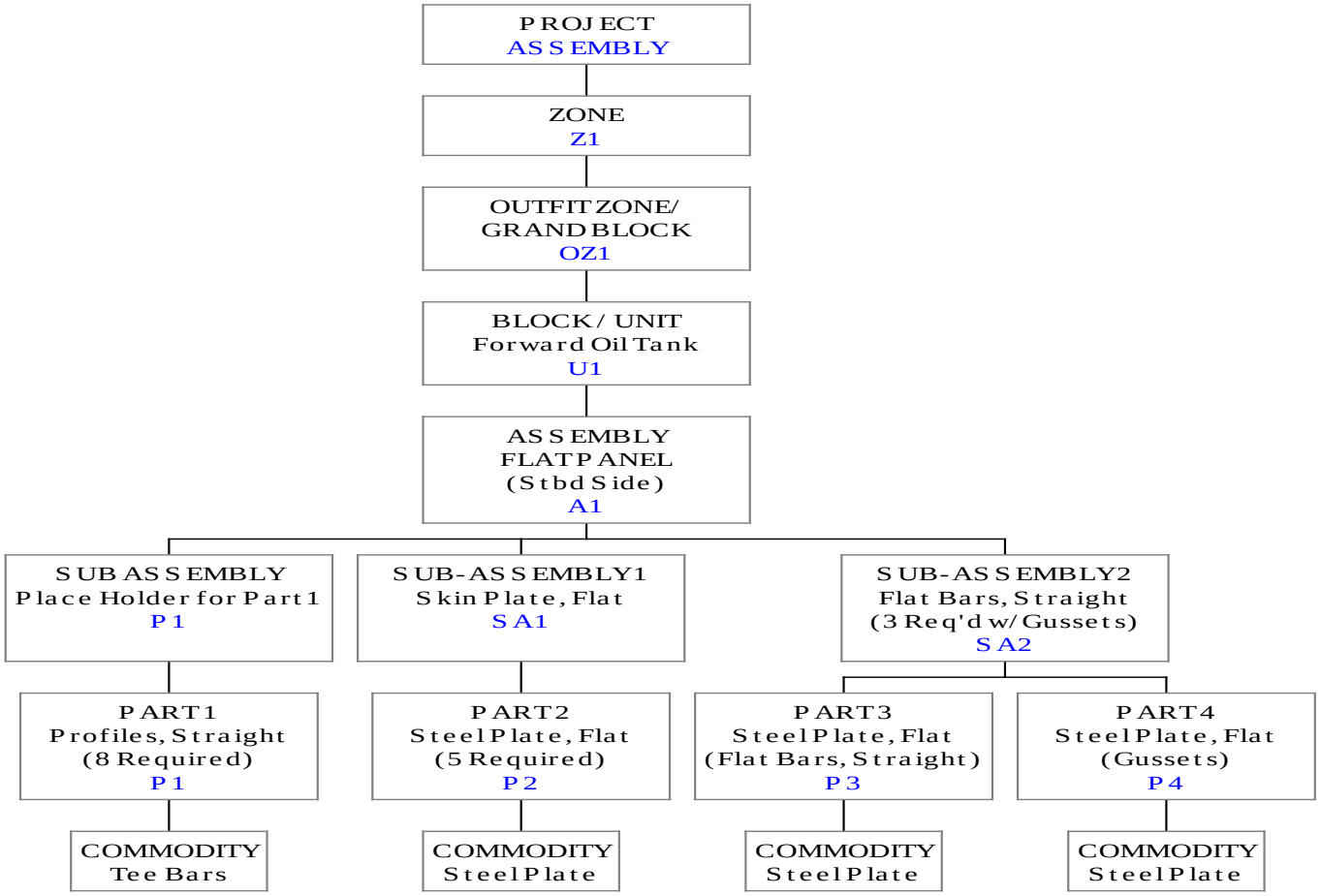
The complete Assembly.



This is the Assembly we modeled in the PODAC Cost Model.

Defining The Product

(Tee-Stiffened Panel PWBS)

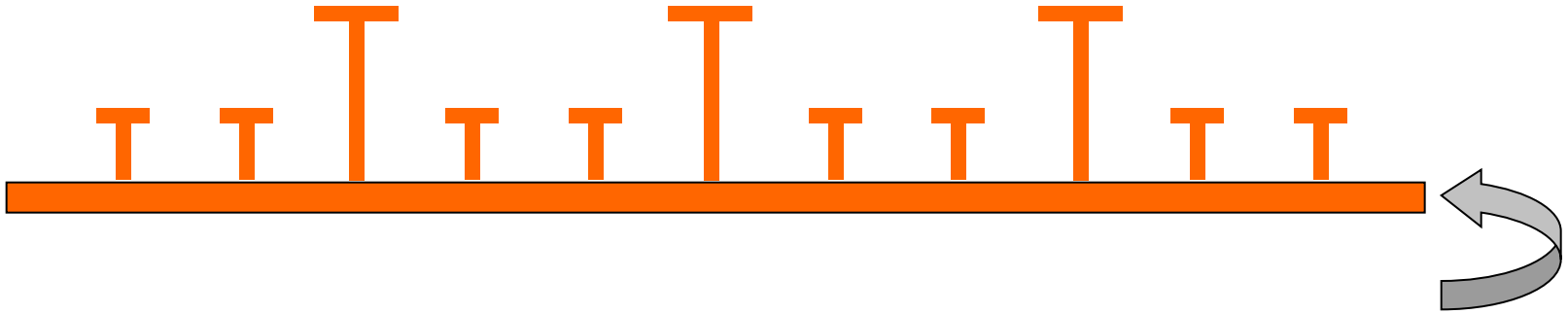


This is the Product Work Breakdown Structure of the Assembly.

Defining The Product

(Concentrate on the Steel Flat Plates)

Baseline: Tee-Stiffened Plate



Consists of 5, flat steel plates, butt-welded together to form one large flat steel plate.

This is an end-view of the Assembly.

Flat Steel Plate Interim Product

Product: **PART 2, #1-5, Steel Plate, Flat**
Location: **Hold Material**

Commodity Description

Item	Value Used	Data Source
Material:	Steel	MIT, Table 4-2
Material:	MIL-S-22698 Grade DH-36	MIT, Table 4-2
Density, Pound / Inch3	0.278	Calculated
Density, Pound / Feet3	480.00	Calculated
Thickness, Inches:	0.50	MIT, Table 4-2
Thickness, Feet:	0.0417	Calculated
$ / Pound:	$0.45	MIT, Table 4-2
Pre-Cut Dimensions		
Length, Meters:	11.06	NSRP 0406, Table C6.1
Width, Meters:	2.29	NSRP 0406, Table C6.1
Area, Meters2	25.33	Calculated
Length, Feet:	36.29	Calculated
Width, Feet	7.51	Calculated
Area, Feet2	272.62	Calculated
Weight, Pounds	5,452	Calculated
Cost, $	$2,453.60	
Cut Dimensions		
Length, Feet:	30.00	Calculated
Width, Feet	6.00	Calculated
Area, Feet2	180.00	Calculated
Weight, Pounds	3,600	Calculated
Cost, $	$1,620.00	Calculated

Interim product definition: the flat steel plate.

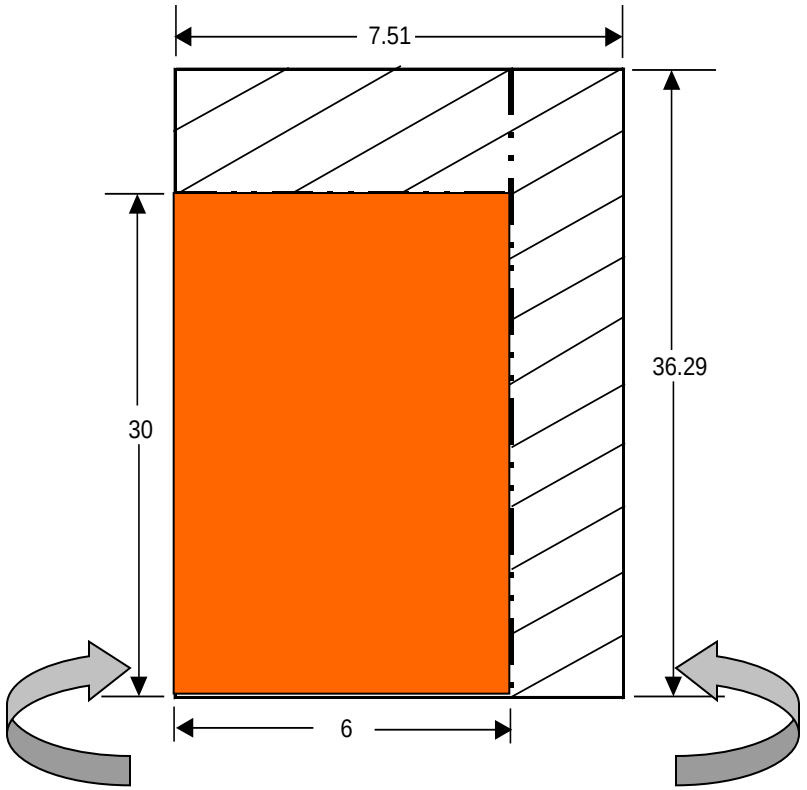
Flat Steel Plate Interim Product

Labor Required Work Processes:

1. Obtain Material: 545 Feet2
2. Flame Cut to size: 37.8 Feet
3. Edge Preparation: 72.0 Feet
4. Mark for inventory control: 1 Piece

Material:

Mild Steel: 0.50 Inch Thick
CER = $0.45 / Pound @ 5,452 Pounds



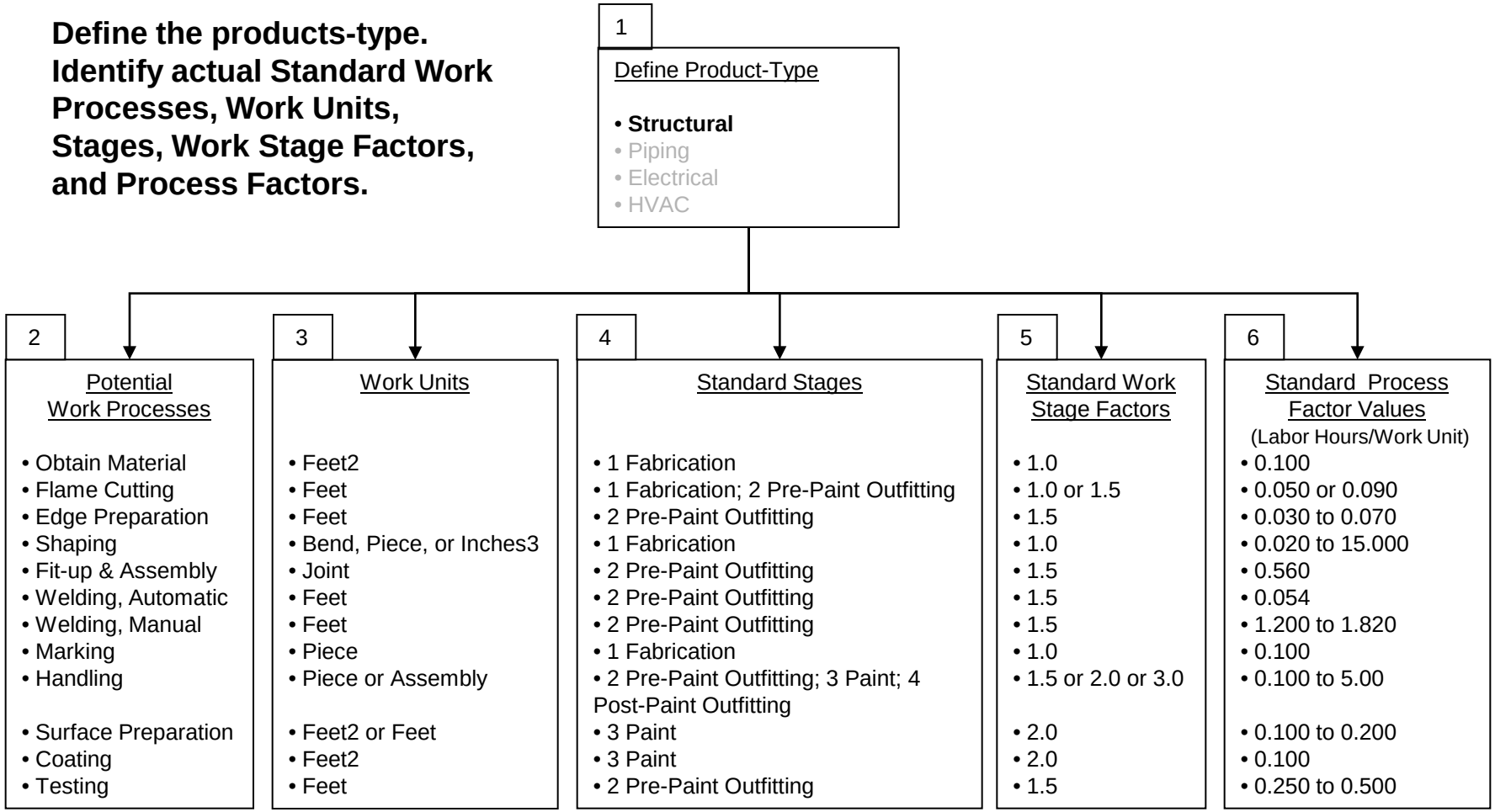
Cut Dimensions

Pre-Cut Dimensions

Interim product definition: the flat steel plate.

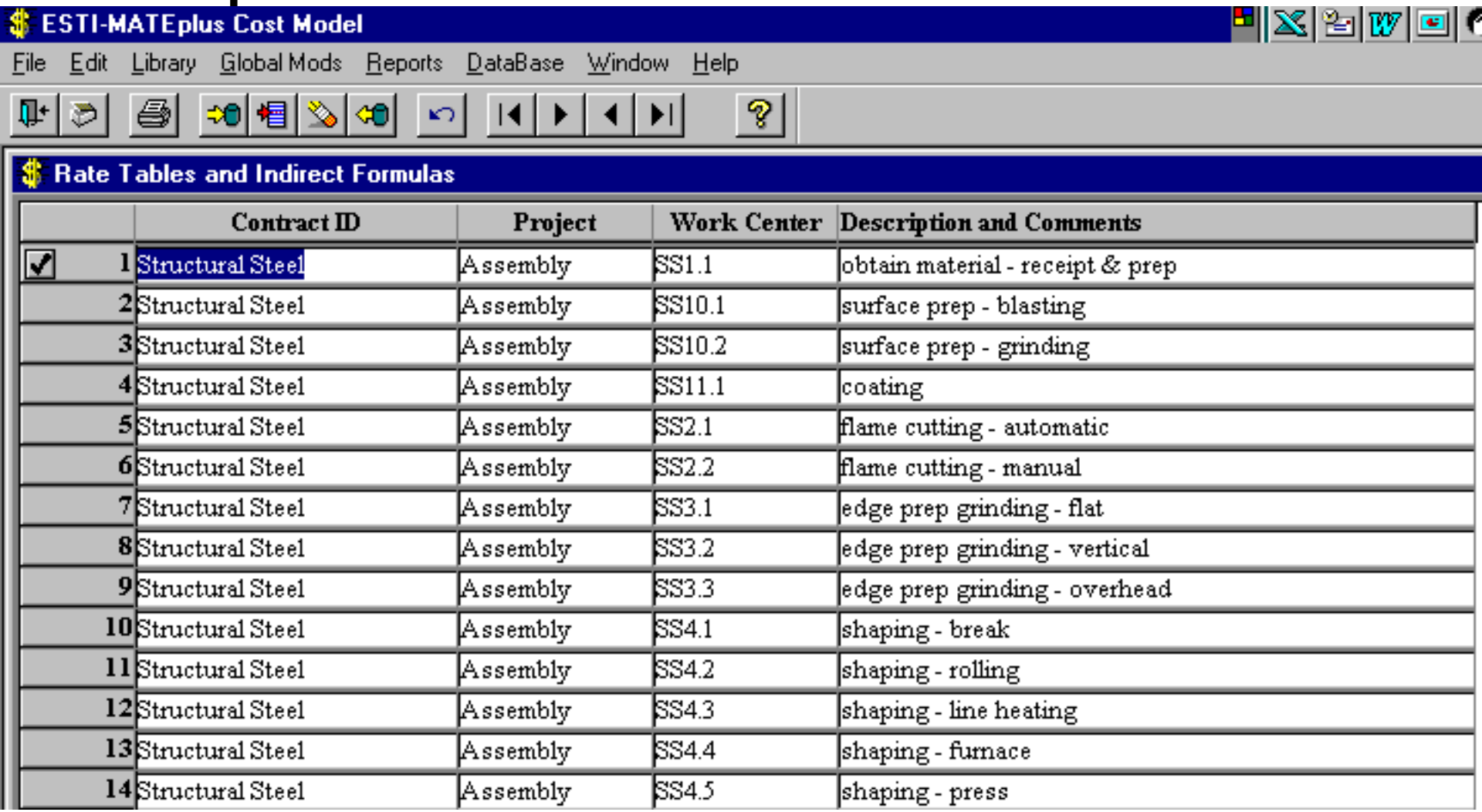
Setting up the Generic Procedure for Generating CERs

Define the products-type. Identify actual Standard Work Processes, Work Units, Stages, Work Stage Factors, and Process Factors.



The generic process is for a structural product-type.

Setting Up Work Centers to Equal Work Processes

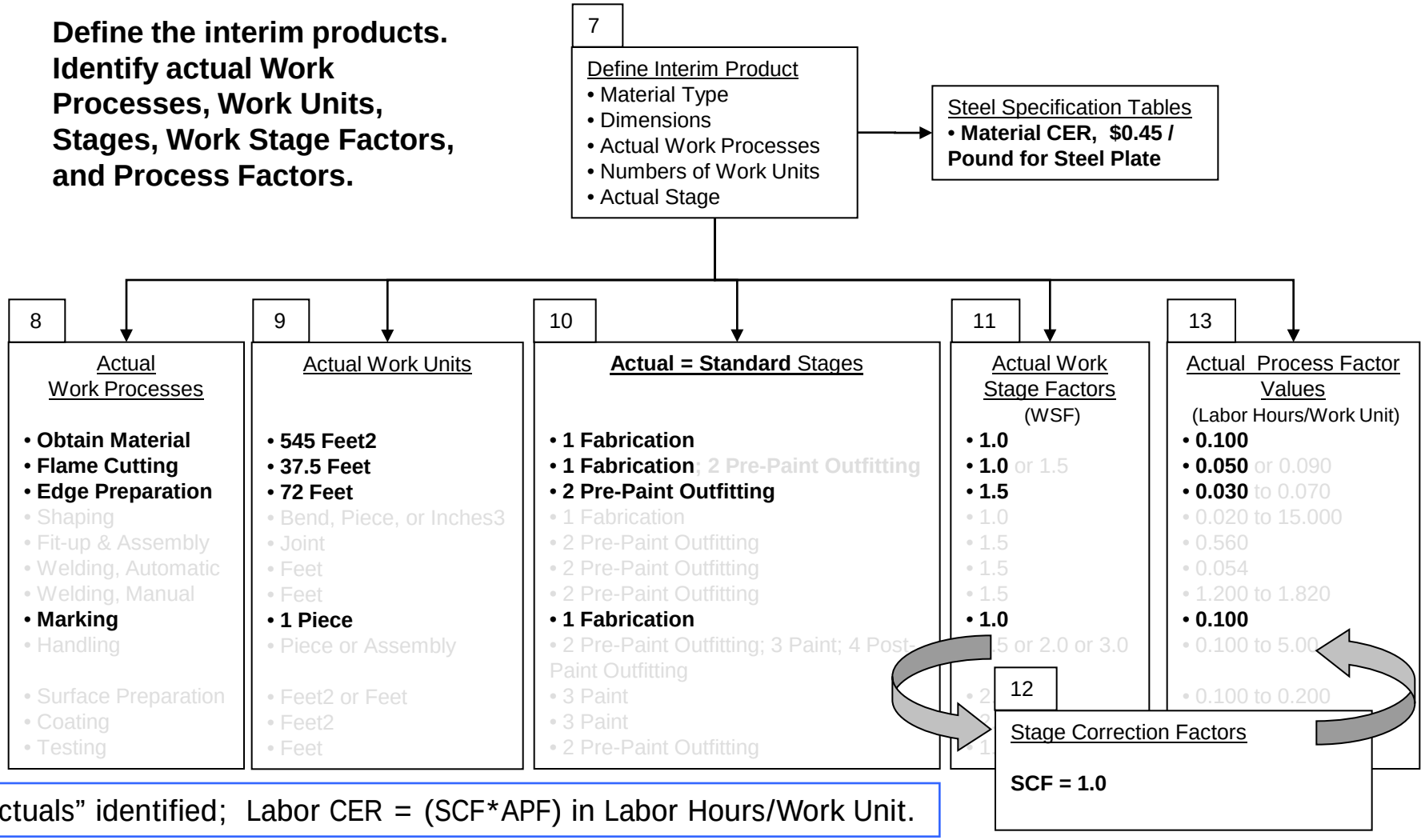


	Contract ID	Project	Work Center	Description and Comments
1	Structural Steel	Assembly	SS1.1	obtain material - receipt & prep
2	Structural Steel	Assembly	SS10.1	surface prep - blasting
3	Structural Steel	Assembly	SS10.2	surface prep - grinding
4	Structural Steel	Assembly	SS11.1	coating
5	Structural Steel	Assembly	SS2.1	flame cutting - automatic
6	Structural Steel	Assembly	SS2.2	flame cutting - manual
7	Structural Steel	Assembly	SS3.1	edge prep grinding - flat
8	Structural Steel	Assembly	SS3.2	edge prep grinding - vertical
9	Structural Steel	Assembly	SS3.3	edge prep grinding - overhead
10	Structural Steel	Assembly	SS4.1	shaping - break
11	Structural Steel	Assembly	SS4.2	shaping - rolling
12	Structural Steel	Assembly	SS4.3	shaping - line heating
13	Structural Steel	Assembly	SS4.4	shaping - furnace
14	Structural Steel	Assembly	SS4.5	shaping - press

Work Centers and Rate Tables mimic the structural Work Processes.

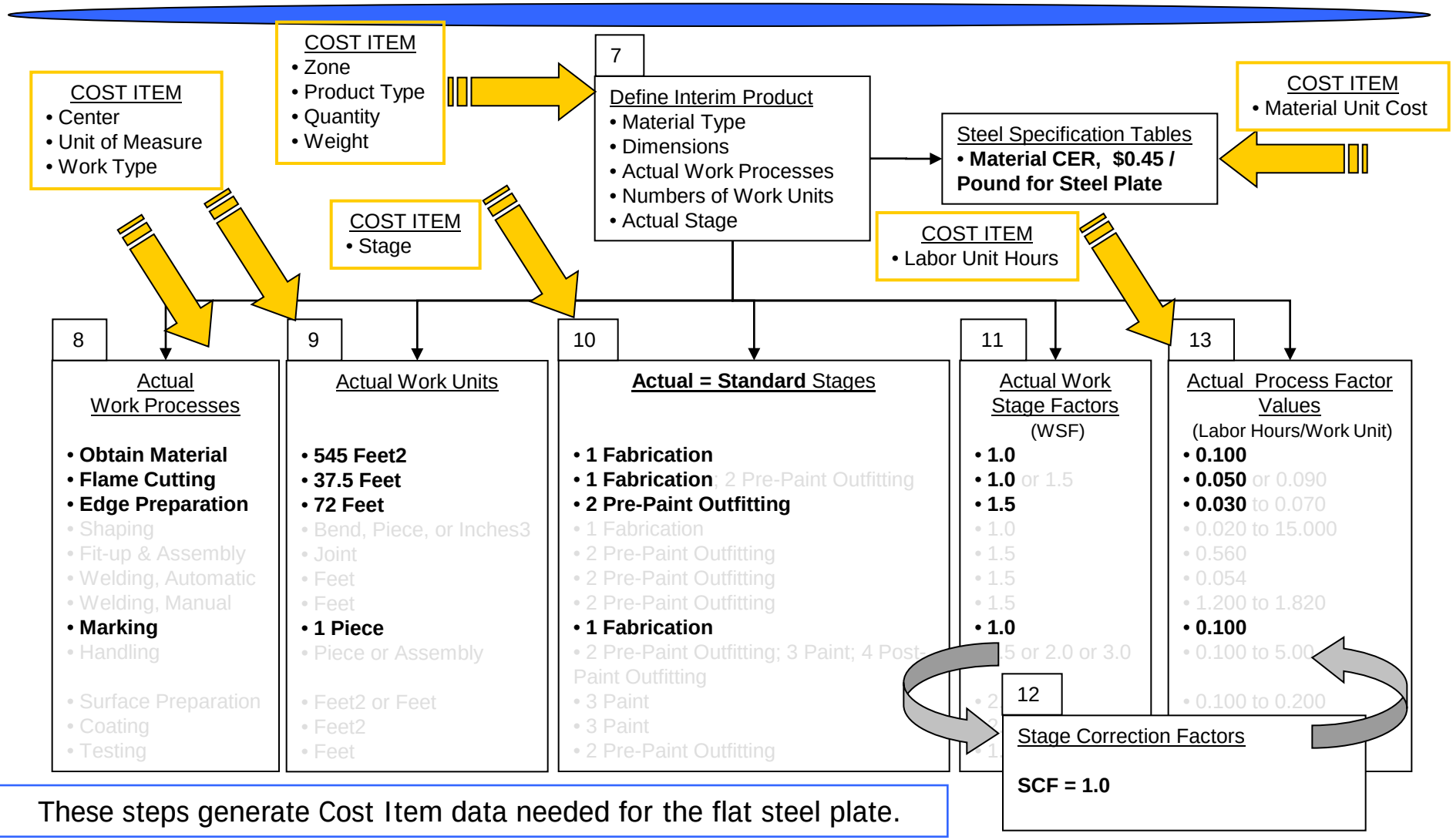
Applying the Procedure to Estimate Flat Steel Plate CERs

Define the interim products. Identify actual Work Processes, Work Units, Stages, Work Stage Factors, and Process Factors.



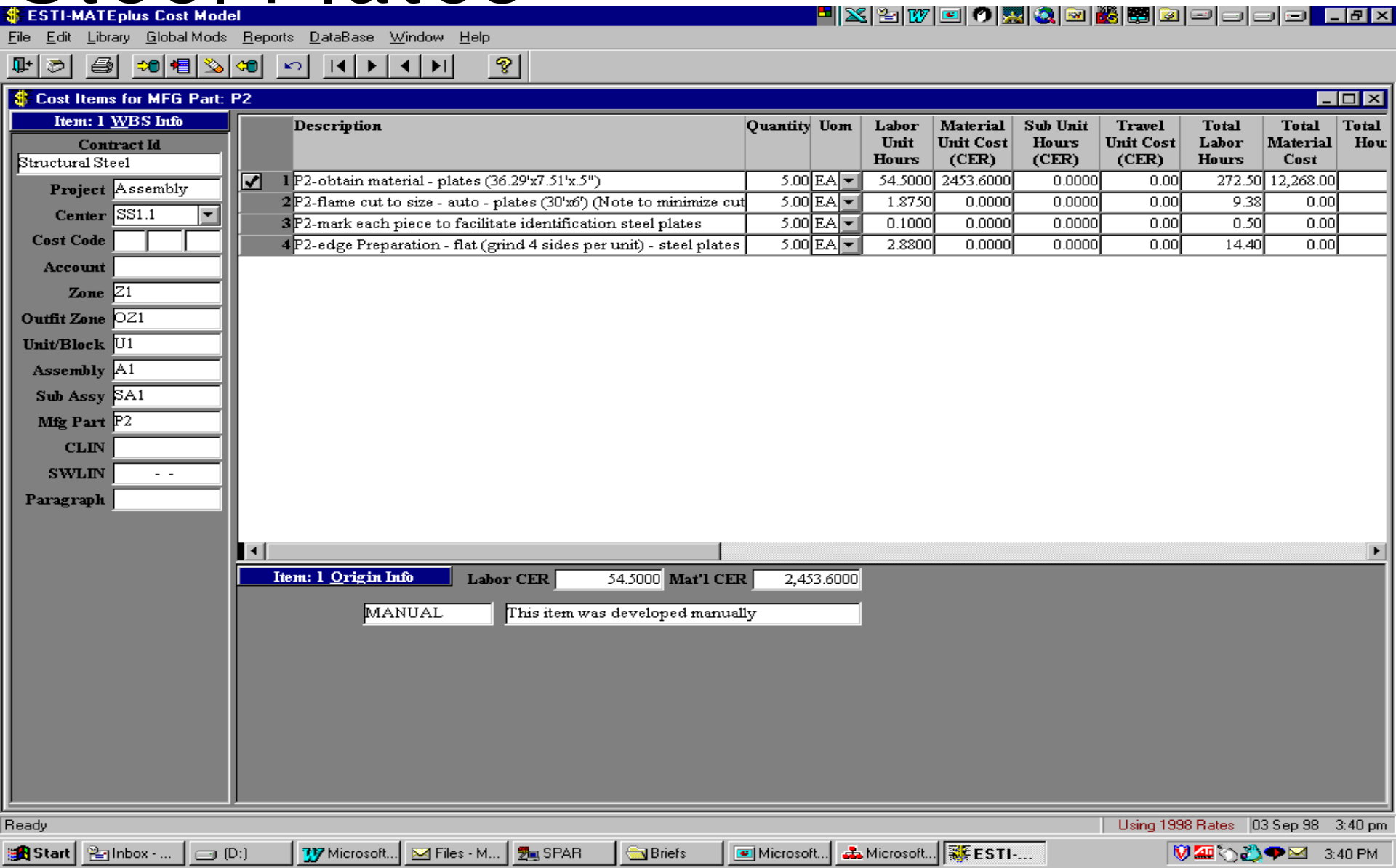
"Actuals" identified; Labor CER = (SCF*APF) in Labor Hours/Work Unit.

Generating PODAC Cost Model Input for the Flat Steel Plates



These steps generate Cost Item data needed for the flat steel plate.

“Cost Items” for the Five Flat Steel Plates



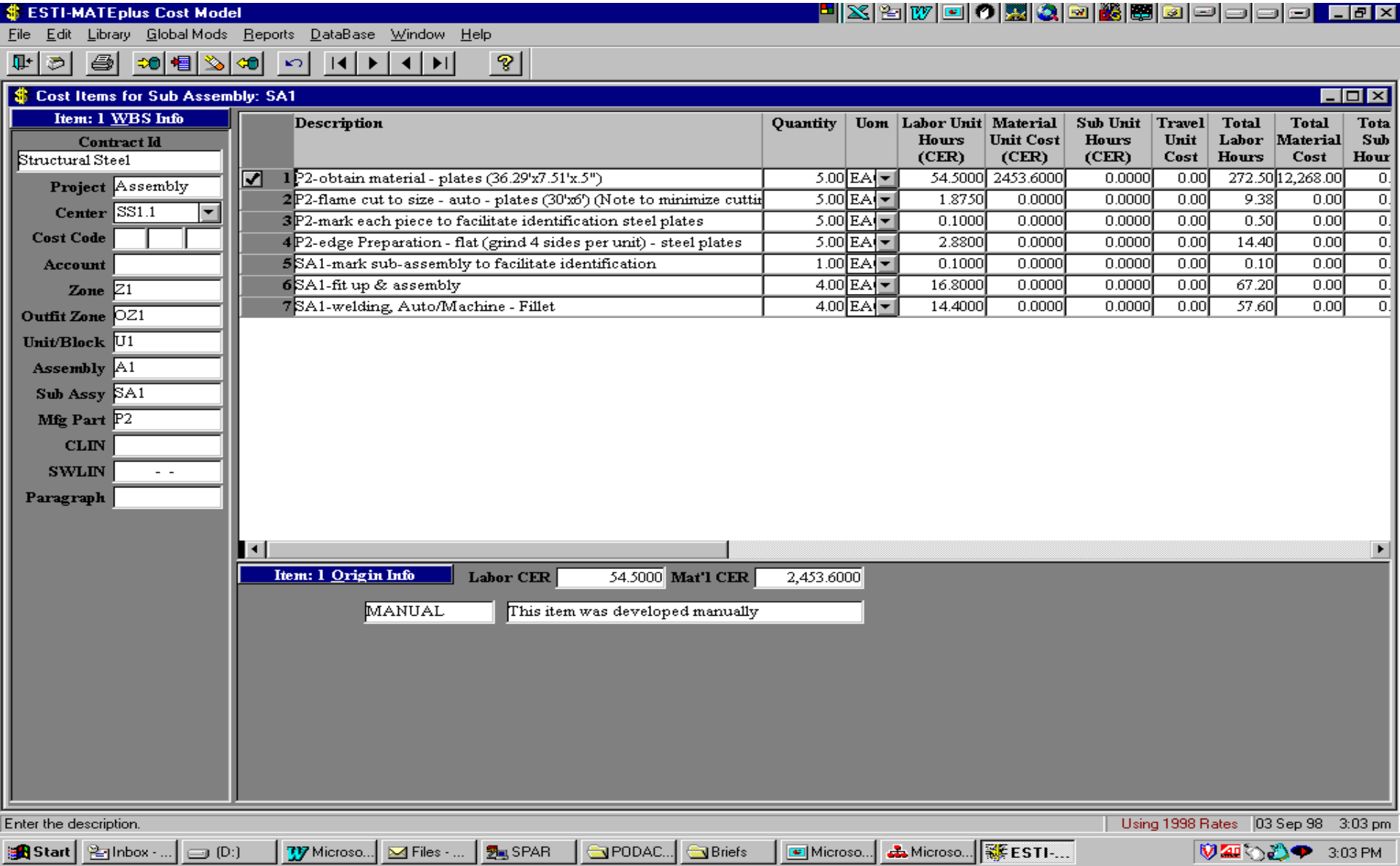
Options for Units of Measure vs Quantity

Interim Product Situation	Option #1	Option #2, Labor	Option #2, Material
Description	One or more, identical interim products	Unique, interim product	Unique, or more than one identical, interim products
Labor and/or Material Cost Item?	Labor and Material	Labor	Material
COST ITEM Worksheet Variable Uom (Unit of Measure)	(1) Each	(2) Feet2	(1) Each
Quantitiy	Total number of identical, interim products	Numer of Feet2 for the unique, interim product	Total number of identical, interim products
Labor Unit Hours (CER)	(3) Hours / Each	(4) Hours / Feet2	NA
Material Unit Cost (CER)	(1) $ / Each	NA	(1) $ / Each

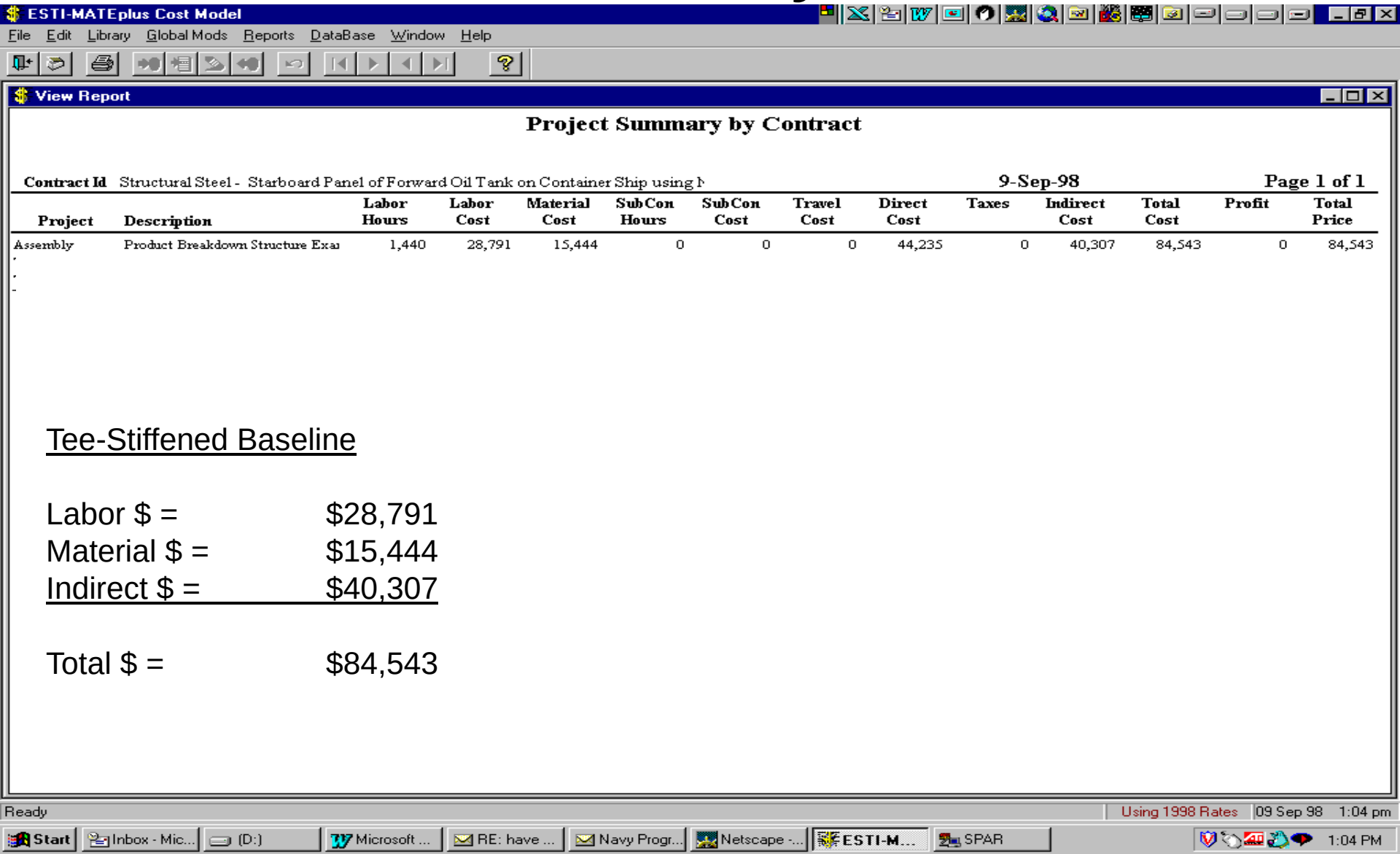
(1) Each = per unit, per pound, or per any other dimension of interest.
(2) Feet2 is a typical unit of measure.
(3) Hours / Each = (Feet2 / Each) * (Hours / Feet2)
(4) (Hours / Feet2) is the Actual Process Factor

Optional methods exist for using Units of Measure and Quantity.

“Cost Items” for Joining the Five Flat Steel Plates



The Baseline Study Results



Tee-Stiffened Baseline

Labor $ =	$28,791
Material $ =	$15,444
Indirect $ =	$40,307
Total $ =	$84,543

Tradeoff #1: Typical Adding of Maintenance "Stages"

We modeled two re-occurring Maintenance Stages using two fabrication Work Processes, Surface Preparation and Coating.

7

Define Interim Product
- Material Type
- Dimensions
- Actual Work Processes
- Numbers of Work Units
- Actual Stage

→ Steel Specification Tables
- Material CER, $/Pound, for profiles and plates

8 — Actual Work Processes

- Obtain Material
- Flame Cutting
- Edge Preparation
- Shaping
- Fit-up & Assembly
- Welding, Automatic
- Welding, Manual
- Marking
- Handling
- **Surface Preparation**
- **Coating**
- Testing

9 — Actual Work Units

- 545 Feet2
- 37.5 Feet
- 72 Feet
- Bend, Piece, or Inches3
- Joint
- Feet
- Feet
- 1 Piece
- Piece or Assembly
- **545 Feet2** or Feet
- **545 Feet2**
- Feet

10 — Actual Stages

- 1 Fabrication
- 1 Fabrication; 2 Pre-Paint Outfitting
- 2 Pre-Paint Outfitting
- 1 Fabrication
- 2 Pre-Paint Outfitting
- 2 Pre-Paint Outfitting
- 2 Pre-Paint Outfitting
- 1 Fabrication
- 2 Pre-Paint Outfitting; 3 Paint; 4 Post-Paint Outfitting
- **3 Paint**
- **3 Paint**
- 2 Pre-Paint Outfitting

11 — Actual Work Stage Factors (WSF)

- 1.0
- 1.0 or 1.5
- 1.5
- 1.0
- 1.5
- 1.5
- 1.5
- 1.0
- 1.5 or 2.0 or 3.0
- **2.**
- **2.**

13 — Actual Process Factor Values (Labor Hours/Work Unit)

- 0.100
- 0.050 or 0.090
- 0.030 to 0.070
- 0.020 to 15.000
- 0.560
- 0.054
- 1.200 to 1.820
- 0.100
- 0.100 to 5.00
- **0.100** to 0.200

12 — Stage Correction Factors

SCF = 1.0

Maintenance Stages can be identified for the flat steel plate.

More Thoughts on Adding Maintenance Stages

Level	Stage of Construction	Location	Standard Difficulty Factor
1	Fabrication	In Shop	1
2	Pre-Paint Outfitting	On Plate Line - Hot Work	1.5
3	Paint	Paint Shop / Stage	2
4	Post-Paint Outfitting	On Platen - Cold Work	3
5	Erection	Erection Site	4.5
6	On-Board Outfitting	Erection Site	7
7	Waterborne	Pierside After Launch	10

We modeled the two re-occurring Maintenance Stages, Surface Preparation and Coating, using Level 3 Standard Difficulty Factors.

Perhaps, we should have used Level 5 or 6.

More considerations should be given to the addition of Maintenance Stages.

The Baseline and Tradeoff #1 Study Results

ESTI-MATEplus Cost Model

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Project Summary by Contract

Contract Id Structural Steel - Starboard Panel of Forward Oil Tank on Container Ship using h 9-Sep-98 **Page 1 of 1**

Project	Description	Labor Hours	Labor Cost	Material Cost	SubCon Hours	SubCon Cost	Travel Cost	Direct Cost	Taxes	Indirect Cost	Total Cost	Profit	Total Price
Assembly	Product Breakdown Structure Exai	1,440	28,791	15,444	0	0	0	44,235	0	40,307	84,543	0	84,543
TO1	Trade Off - Tee stiffeners w/2 yr.	2,823	56,463	15,444	0	0	0	71,907	0	79,048	150,955	0	150,955

	Tee-Stiffened Baseline	Baseline w Maintenance
Labor $ =	$28,791	$56,463
Material $ =	$15,444	$15,444
Indirect $ =	$40,307	$70,048
Total $ =	$84,543	$150,955

We added two re-occurring Maintenance Stages, Surface Preparation and Coating, using fabrication Work Processes and Level 3 Standard Difficulty Factors, and we need to re-painting twice in the first six years.

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Tradeoffs: Changing the Product and the Assumptions

Baseline: Tee-Stiffened Plate

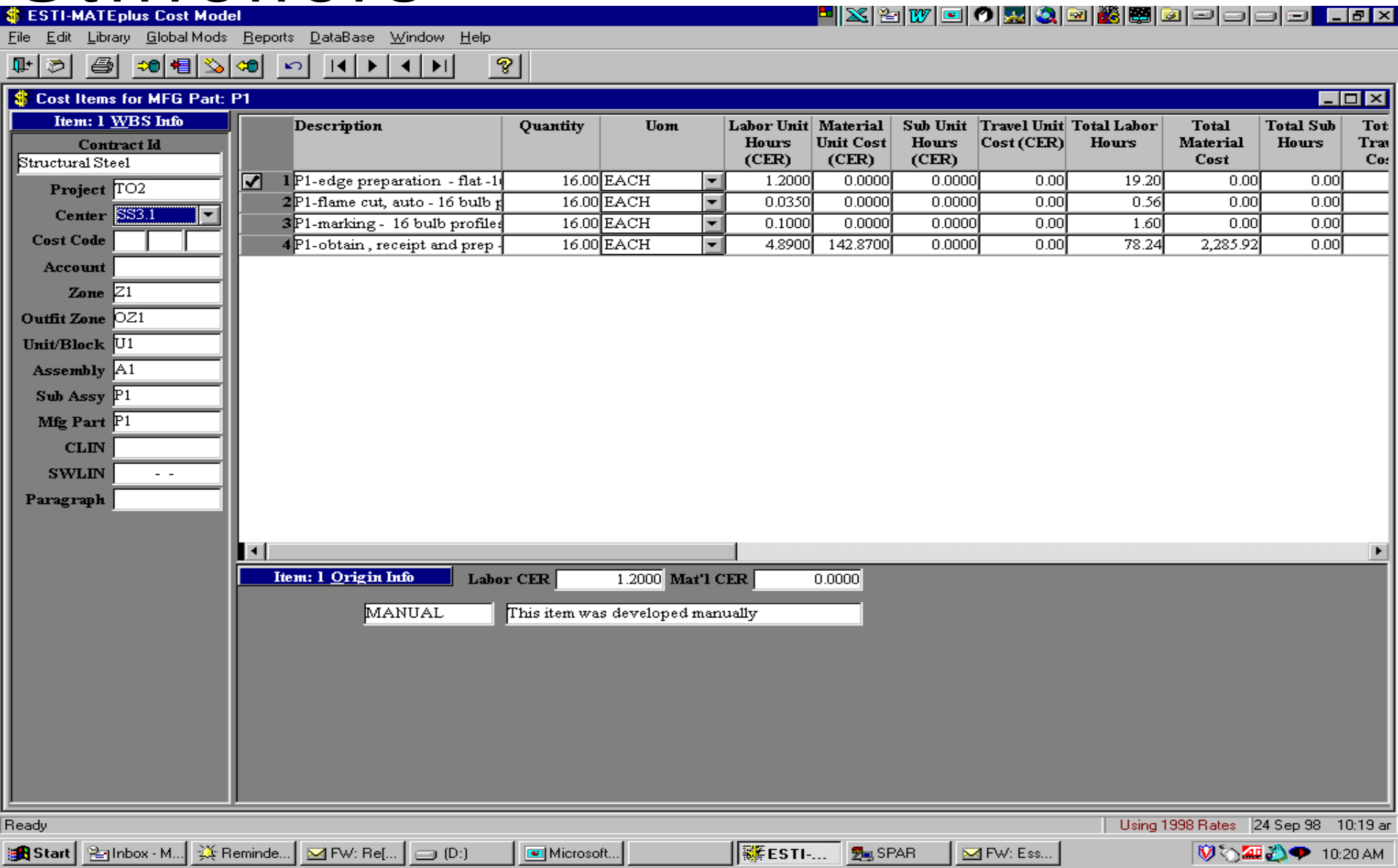
- Baseline: steel structure Assembly, a tee-stiffened steel plate.
- Tradeoff #1:
  - Add a Maintenance Stage: "Surface Preparation - Blasting" and "Coating."
  - Re-blasting and re-painting required twice in a six-year period.

Tradeoff: Bulb-Stiffened Plate

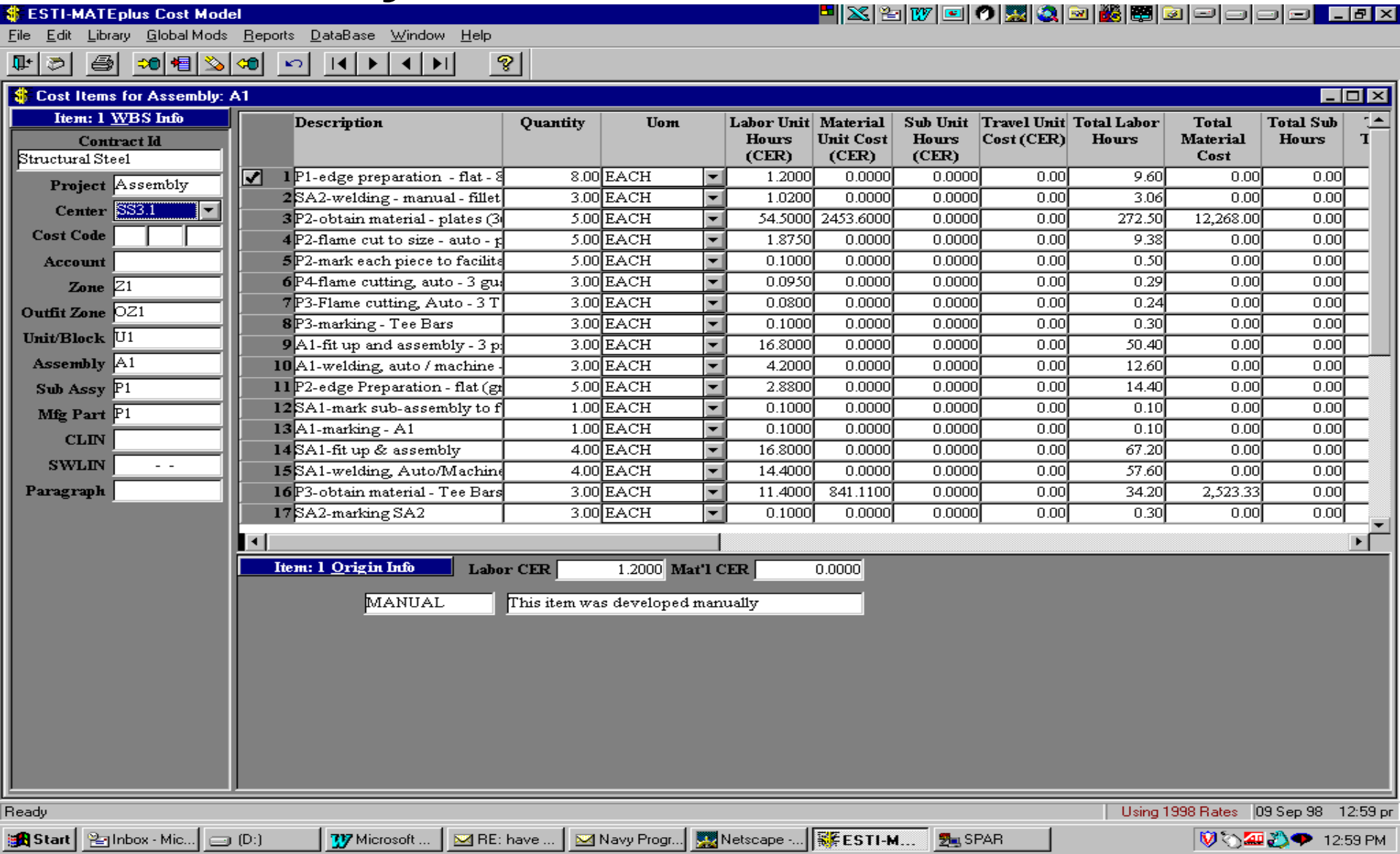
- Tradeoff #2:
  - Four bulb-stiffeners are substituted for every two tee-stiffeners.
  - Unit cost of the bulb-stiffeners is 75% greater than tee-stiffeners.
  - Blasting and painting of the bulb-stiffeners requires 50% less labor than the tee-stiffeners.
  - Re-blasting and re-painting are not required over the six-year period.

The structural details and the maintenance needs/philosophy change for Tradeoff #2.

“Cost Items” for the Bulb-Stiffeners



“Cost Item” Summary for the Assembly



	Description	Quantity	Uom	Labor Unit Hours (CER)	Material Unit Cost (CER)	Sub Unit Hours (CER)	Travel Unit Cost (CER)	Total Labor Hours	Total Material Cost	Total Sub Hours
☑ 1	P1-edge preparation - flat - 8	8.00	EACH	1.2000	0.0000	0.0000	0.00	9.60	0.00	0.00
2	SA2-welding - manual - fillet	3.00	EACH	1.0200	0.0000	0.0000	0.00	3.06	0.00	0.00
3	P2-obtain material - plates (3	5.00	EACH	54.5000	2453.6000	0.0000	0.00	272.50	12,268.00	0.00
4	P2-flame cut to size - auto - p	5.00	EACH	1.8750	0.0000	0.0000	0.00	9.38	0.00	0.00
5	P2-mark each piece to facilita	5.00	EACH	0.1000	0.0000	0.0000	0.00	0.50	0.00	0.00
6	P4-flame cutting, auto - 3 gu	3.00	EACH	0.0950	0.0000	0.0000	0.00	0.29	0.00	0.00
7	P3-Flame cutting, Auto - 3 T	3.00	EACH	0.0800	0.0000	0.0000	0.00	0.24	0.00	0.00
8	P3-marking - Tee Bars	3.00	EACH	0.1000	0.0000	0.0000	0.00	0.30	0.00	0.00
9	A1-fit up and assembly - 3 p	3.00	EACH	16.8000	0.0000	0.0000	0.00	50.40	0.00	0.00
10	A1-welding, auto / machine -	3.00	EACH	4.2000	0.0000	0.0000	0.00	12.60	0.00	0.00
11	P2-edge Preparation - flat (gr	5.00	EACH	2.8800	0.0000	0.0000	0.00	14.40	0.00	0.00
12	SA1-mark sub-assembly to f	1.00	EACH	0.1000	0.0000	0.0000	0.00	0.10	0.00	0.00
13	A1-marking - A1	1.00	EACH	0.1000	0.0000	0.0000	0.00	0.10	0.00	0.00
14	SA1-fit up & assembly	4.00	EACH	16.8000	0.0000	0.0000	0.00	67.20	0.00	0.00
15	SA1-welding, Auto/Machine	4.00	EACH	14.4000	0.0000	0.0000	0.00	57.60	0.00	0.00
16	P3-obtain material - Tee Bars	3.00	EACH	11.4000	841.1100	0.0000	0.00	34.20	2,523.33	0.00
17	SA2-marking SA2	3.00	EACH	0.1000	0.0000	0.0000	0.00	0.30	0.00	0.00

The Baseline, Tradeoff #1, and Tradeoff #2 Study Results

ESTI-MATEplus Cost Model

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Project Summary by Contract

Contract Id Structural Steel - Starboard Panel of Forward Oil Tank on Container Ship using N — **9-Sep-98** — **Page 1 of 1**

Project	Description	Labor Hours	Labor Cost	Material Cost	SubCon Hours	SubCon Cost	Travel Cost	Direct Cost	Taxes	Indirect Cost	Total Cost	Profit	Total Price
Assembly	Product Breakdown Structure Exai	1,440	28,791	15,444	0	0	0	44,235	0	40,307	84,543	0	84,543
TO1	Trade Off - Tee stiffeners w/2 yr.	2,823	56,463	15,444	0	0	0	71,907	0	79,048	150,955	0	150,955
TO2	Trade Off - 16 Bulb Stiffeners w/	1,311	26,229	17,077	0	0	0	43,306	0	36,721	80,027	0	80,027
	Contract: Structural Steel Totals	**5,574**	**111,483**	**47,966**	**0**	**0**	**0**	**159,449**	**0**	**156,076**	**315,525**	**0**	**315,525**

	Tee-Stiffened Baseline	Baseline w Maintenance	Bulb-Stiffened w New Maintenance
Labor $ =	$28,791	$56,463	$26,299
Material $ =	$14,444	$15,444	$17,077
Indirect $ =	$40,307	$70,048	$36,721
Total $ =	$84,543	$150,955	$80,027

We used bulb-stiffeners and we never need to re-paint in the first six years.

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Summary, Conclusions, and Recommendations

- Develop a Standard Procedure
  - Summary
    - PODAC Cost Model was related to UPA Cost Model.
    - **A generic procedure was developed and a structural products procedure was developed.**
    - **A process was defined for creating standard, work process, re-use packages for typical, fabricated, structural items.**
    - **Procedures for piping systems, electrical systems, and hull ventilation and air conditioning systems were suggested**.
    - **Procedures for outfitted structural products was suggested.**
    - A cost tradeoff study was performed.
  - Conclusions
    - **The PODAC Cost Model can replicate the UPA Model.**
    - ***Without specific shipyard data*, generic procedures can be developed for using the PODAC Cost Model.**
    - **The Navy can use the PODAC Cost Model to perform comparative, relative, tradeoff studies.**
  - Recommendations
    - Incorporate typical spreadsheet capabilities.
    - Refine the generic and structural product procedures.
    - Create standard, work process, re-use packages typical, fabricated, structural items.
    - Extend the generic procedure to piping systems, electrical systems, and hull ventilation and air conditioning systems.
    - Integrating the structural product procedure with the distributed system procedures.
    - Perform more PODAC Cost Model studies.

Summary, Conclusions, and Recommendations

- Determine the Benefits
  - Summary
    - **It provides a new cost estimating capability**.
    - **It estimates the cost of interim products according to the way in which they are fabricated.**
    - It provides multiple views of a cost estimate including by Project, by PWBS, by Work Center, by Cost Item Value by Work Center, and by Cost Item Value by PWBS.
    - **It is inherently flexible such that Maintenance Stages can be modeled; it is a life cycle cost model.**
    - **It allows rapid cost, tradeoff studies and it provides a variety of cost sensitivity capabilities.**
  - Conclusions
    - Training and example problem experience are required.
    - An understanding of several new issues is required.
    - New databases are required.
  - Recommendations
    - Training should be offered and an illustrative, example problem set should be created.
    - Training, supporting documentation, and databases should be made available.
    - The concept of a "cost estimating system," with the PODAC Cost Model as a key feature of the system, should be explored.
    - Enhancements to the model should be made: spreadsheet capability, construction sequence, schedule variations, dynamic feedback loops, and other manufacturing issues.