

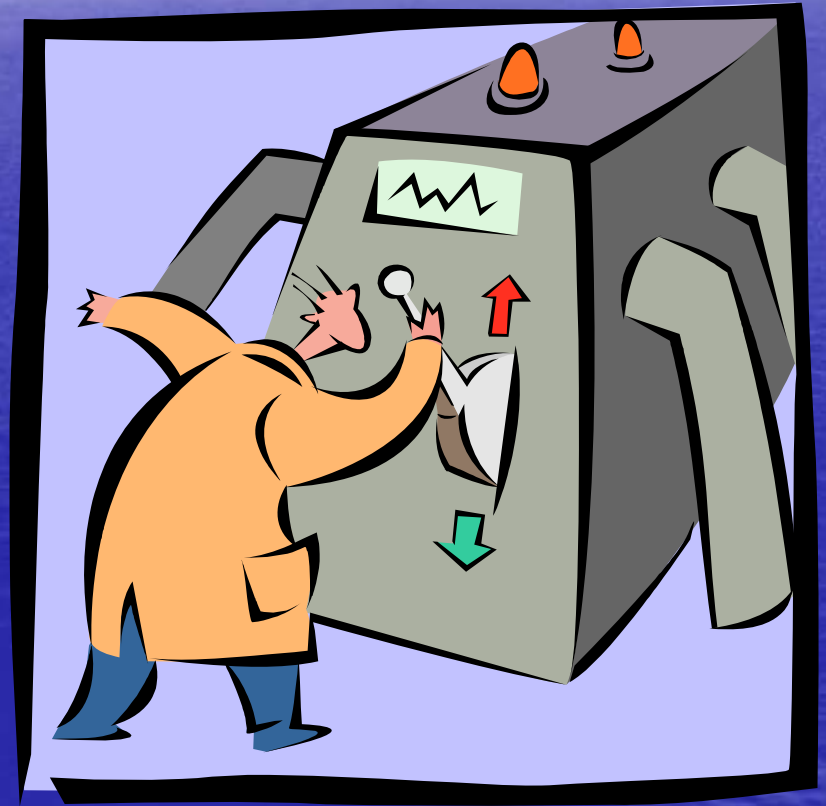
A comparative study of E-Factory and Pro-planner software applied to Lean Manufacturing and Product Lifecycle Management

Patricio Torres

ptorres@purdue.edu

E-Factory vs. Pro-Planner

- E-Factory
 - Factory CAD
 - Factory Plan
 - Factory Flow
 - Factory OPT
- Pro-Planner
 - Work-Place Planner
 - Flow Path Calculator



E-Factory vs. Pro-Planner

- Goals of Manufacturing Facilities and Material Handling
- Data Sources for Facilities Design
- Activity & Path Networks Charts
- Time & Distance Calculations
- Flow & Aisle Analysis
- Activity Relationship Analysis
- Workstation Design



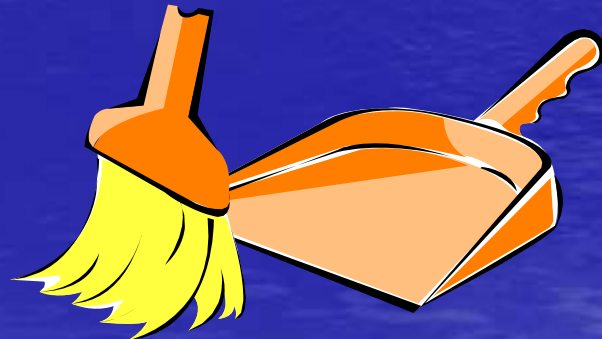
E-Factory vs. Pro-Planner

- Exemplify the design and operation of an automobile assembly plant.
- Efficiency and productivity in factories can be enhanced by decreasing waste.
- Waste can be defined as any activity or operation that adds no value to the product. Any action performed in the production process that would not be appreciated by the customer.
- The best way of avoiding “muda” is to achieve lean manufacturing. Lean procedures are oriented to efficient production of value.

Lean Manufacturing

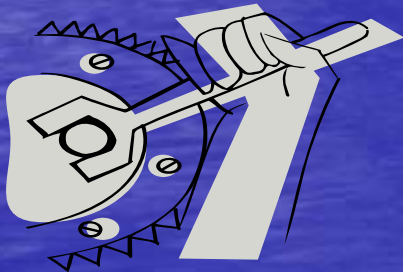
- **Lean manufacturing** is a concept whereby all production people work together to eliminate waste.
- *Muda* (waste) is defined as any expense that doesn't help to produce value. We want to do only work that will add value.
- There are **eight kinds of muda**: overproduction, waiting, transportation, processing, inventory, motion, rework, and poor people utilization.
- **Kanban** is another technique that affects the manufacturing facility design. It is referred to as a "pull" system, differs from the traditional inventory "push" system such as JIT and MRP.

Meyers, F.E. & Stephens, M.P. (2005). *Manufacturing facilities design and material handling* (3rd. ed.) Prentice Hall. ISBN: 0-13-112535-4; p 4



Product Life Cycle Management

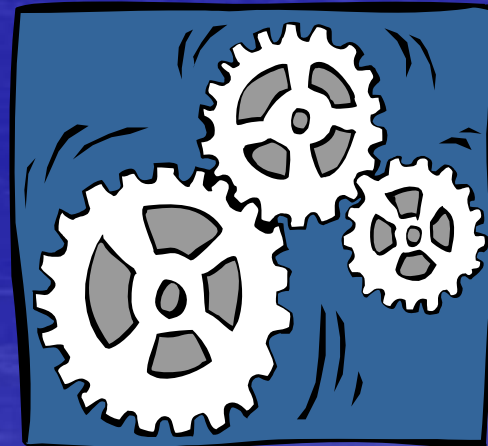
- **Product Life Cycle Management (PLCM)** is the discipline that deals with all the changes that affect the conditions under which products are sold. Different plans, approaches and tactics are considered as a product goes through its life cycle.



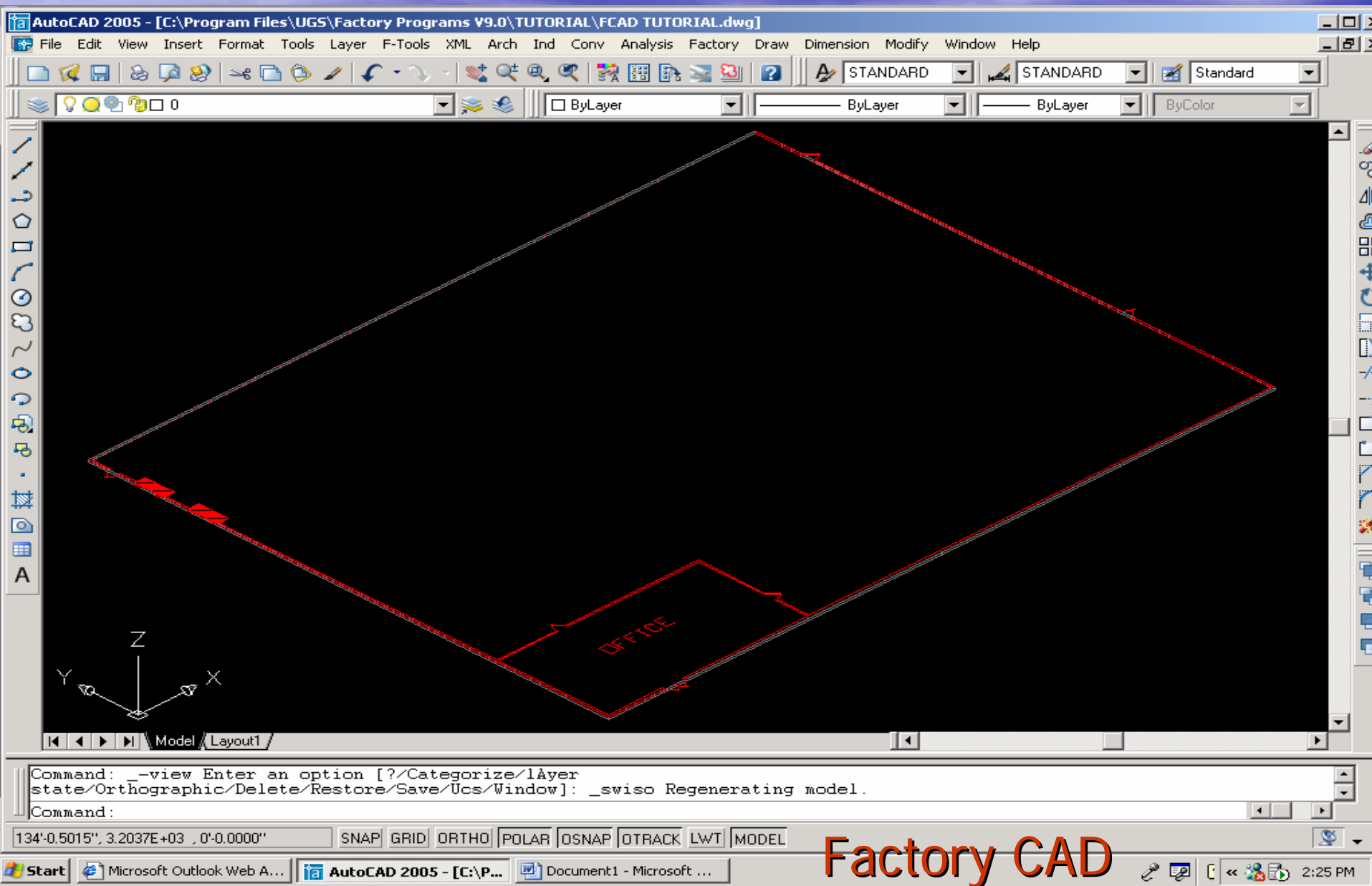
Relationship PLM-Facilities Design

- The application of Product Life Management allows operations management to achieve significant cost savings on its facility projects.
- "Manufacturing facilities design is the organization of the company's physical facilities to promote the efficient use of the company's resources such as people, equipment, material, and energy."

Meyers, F.E. & Stephens, M.P. (2005). *Manufacturing facilities design and material handling* (3rd. ed.) Prentice Hall. ISBN: 0-13-112535-4; p 1

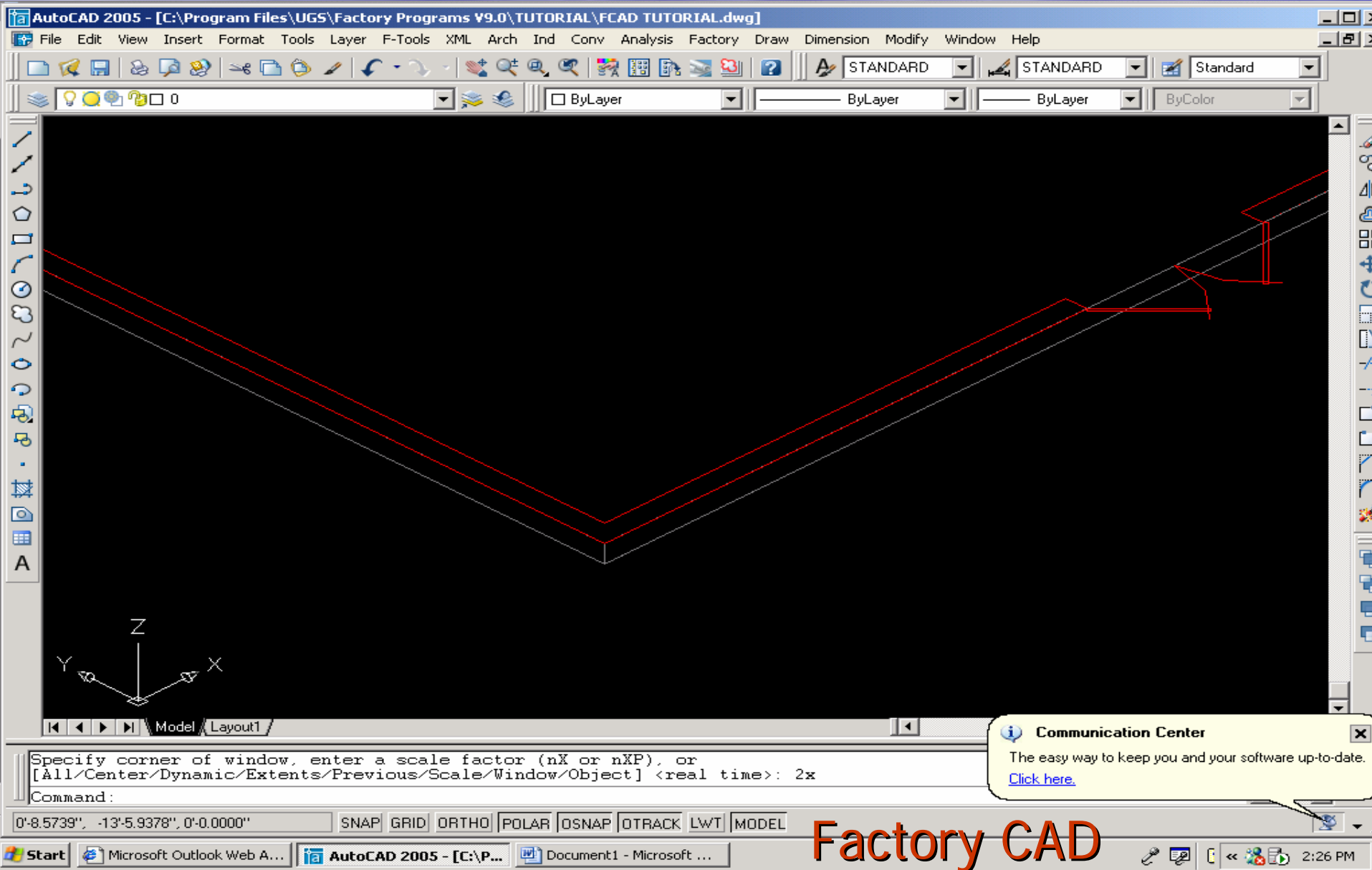


Material Minimization and Flexibility



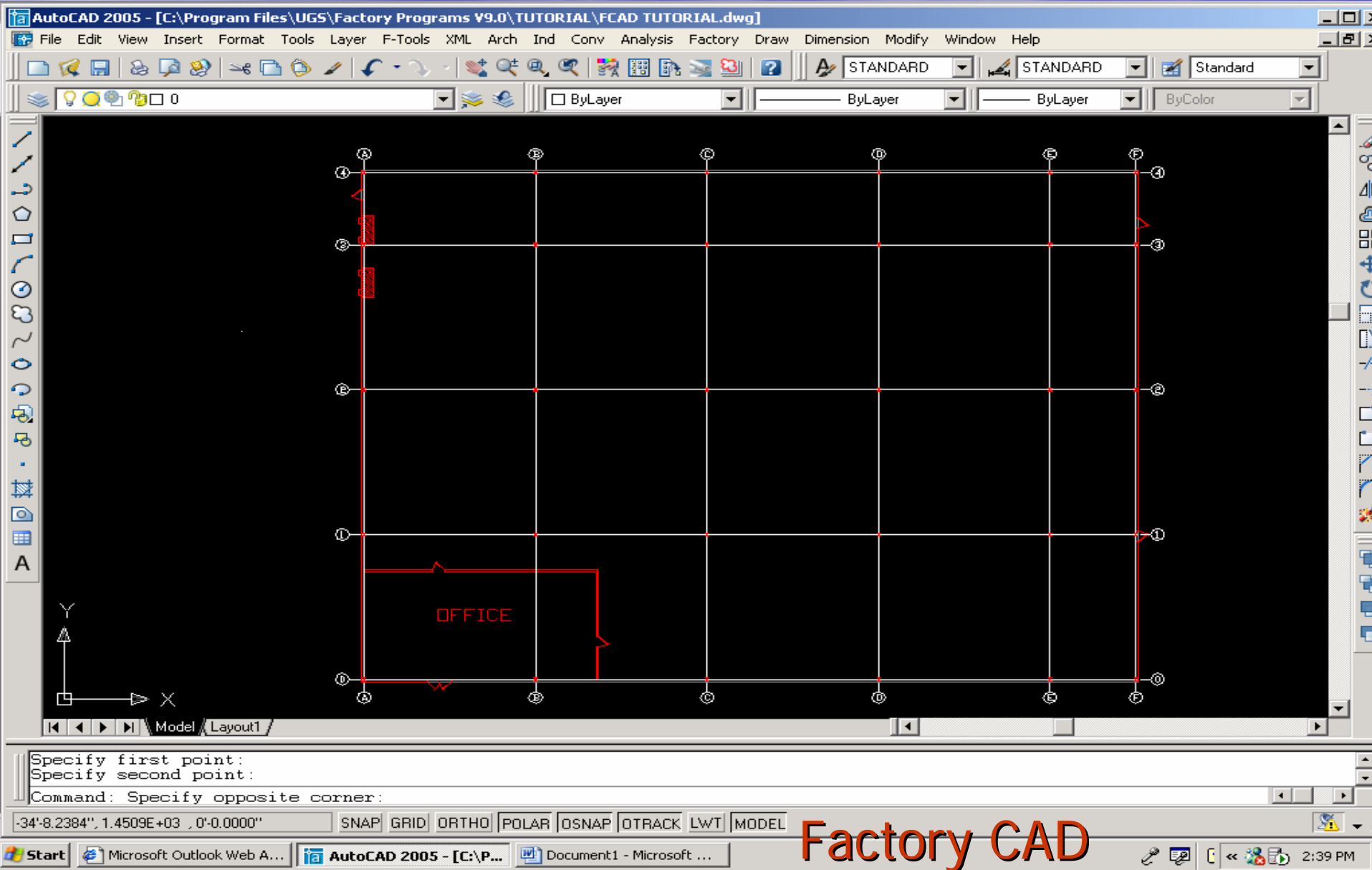
Factory CAD

Material Minimization and Flexibility

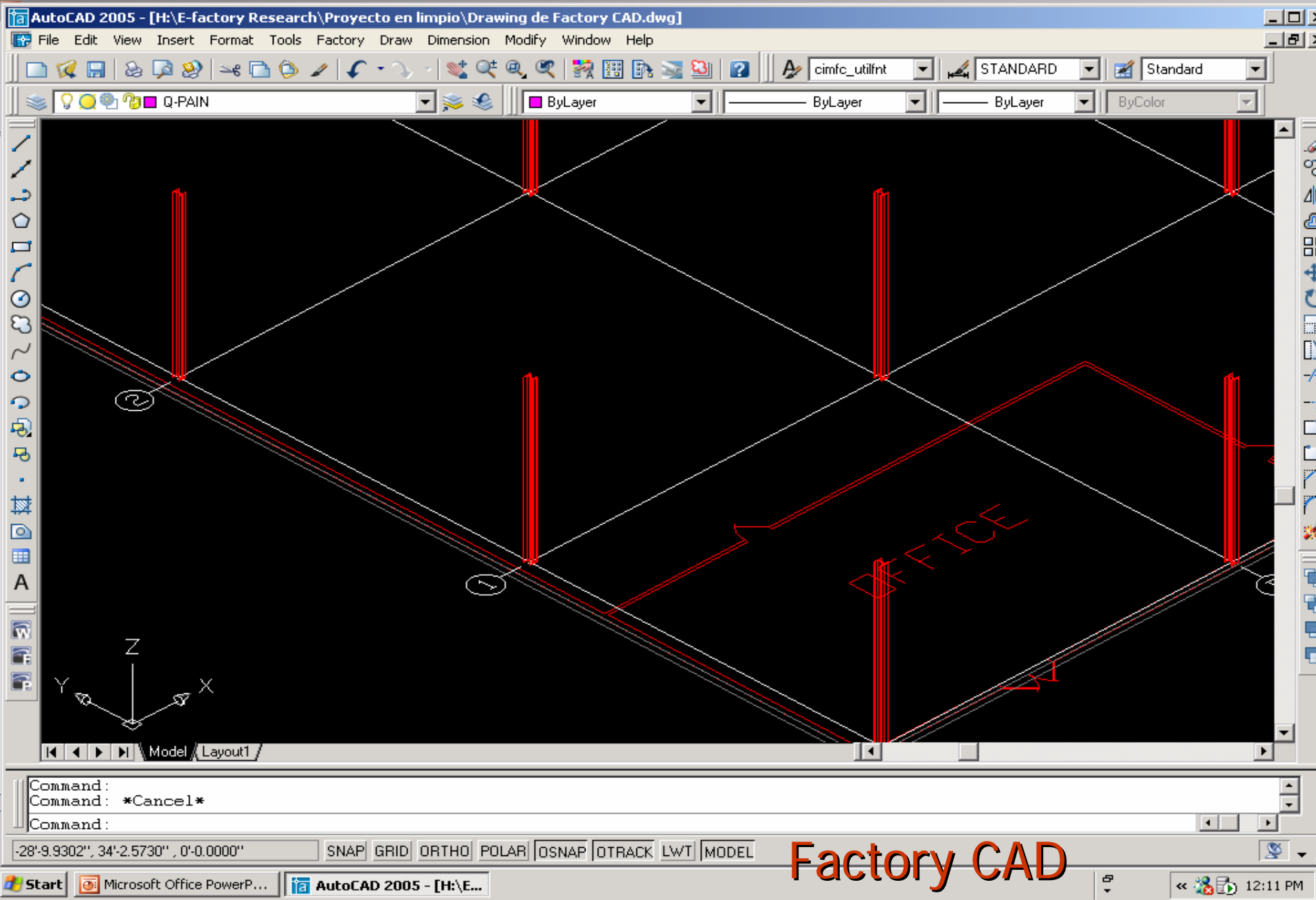


Factory CAD

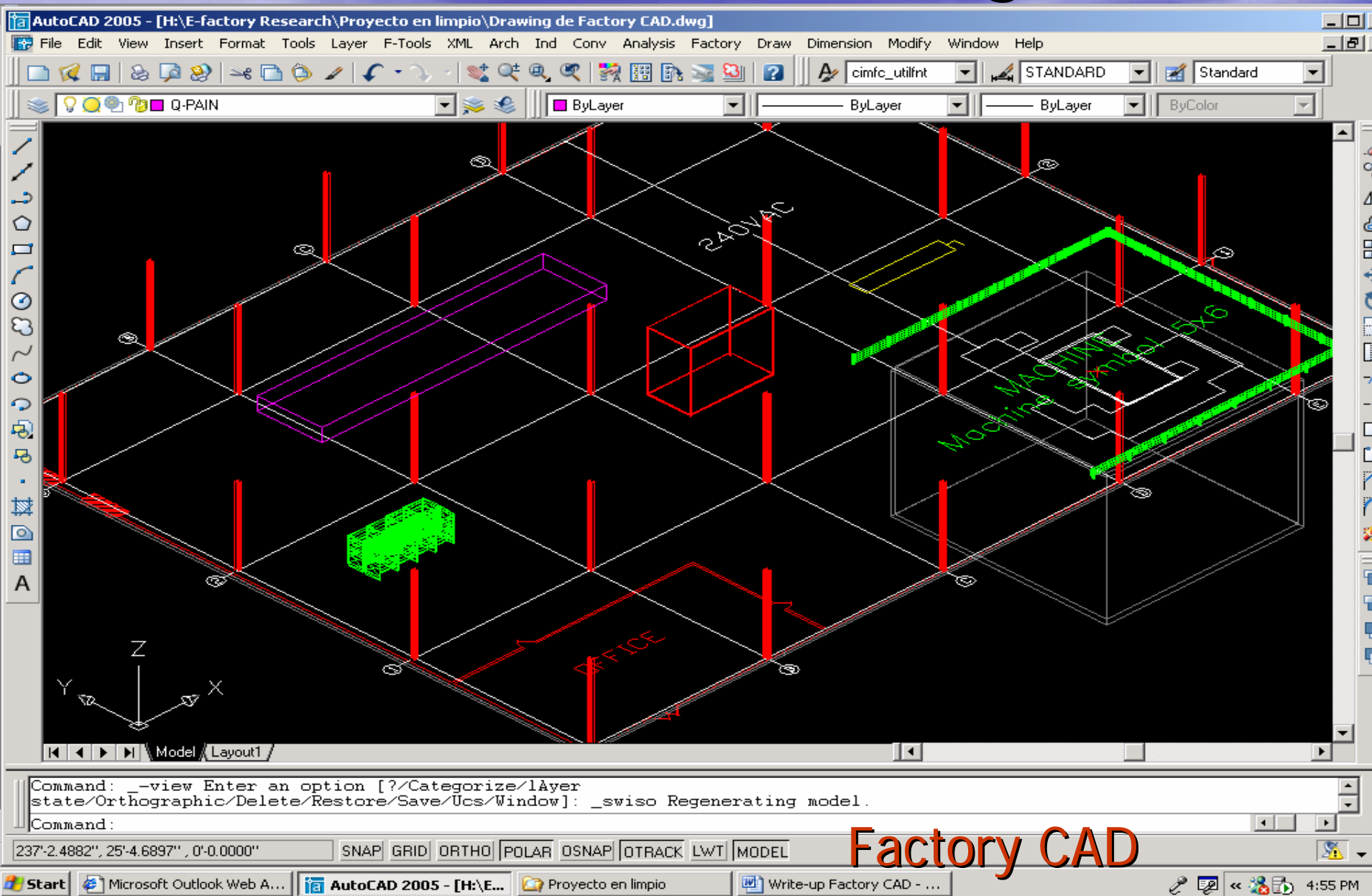
Material Minimization and Flexibility



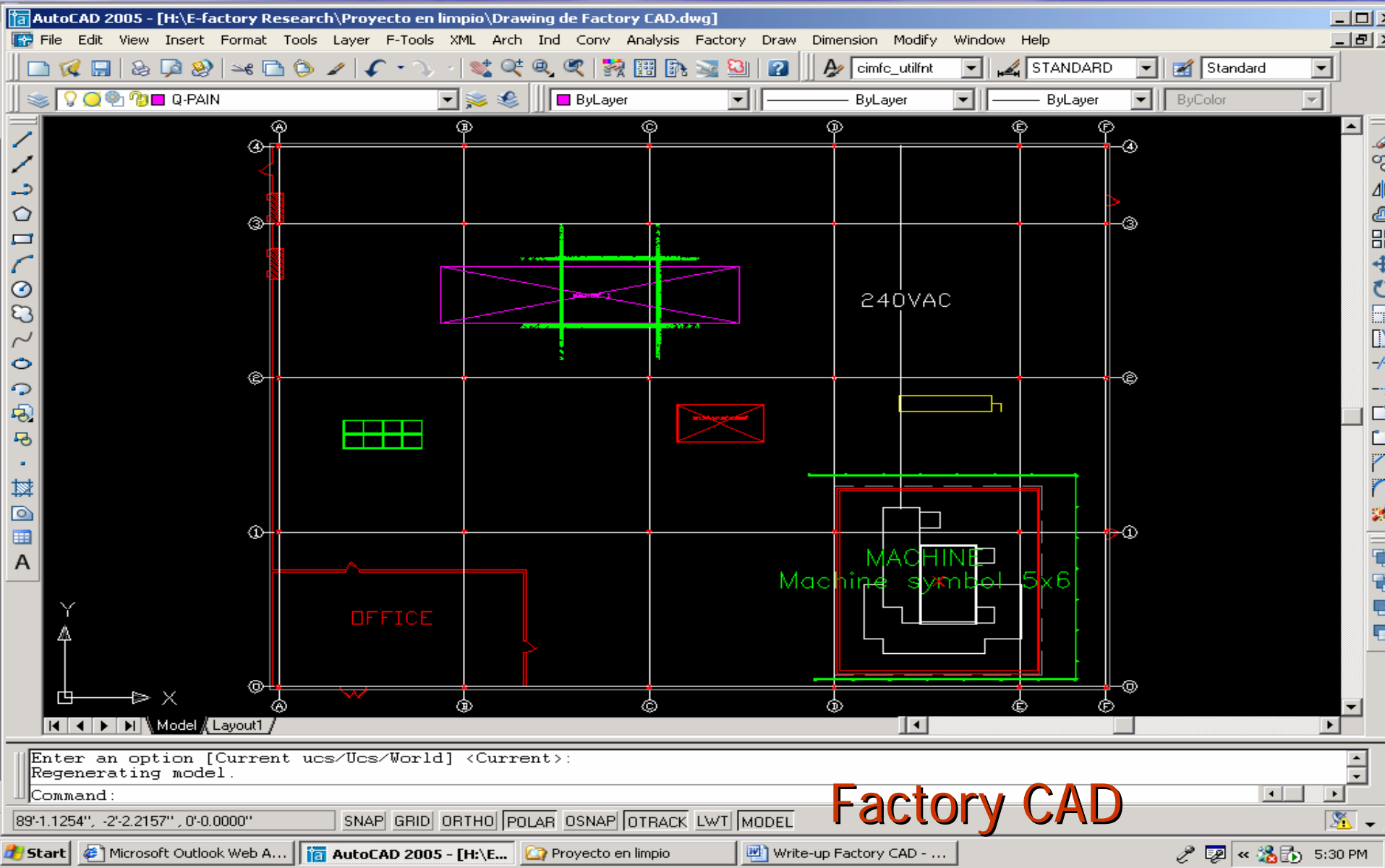
Material Minimization and Flexibility



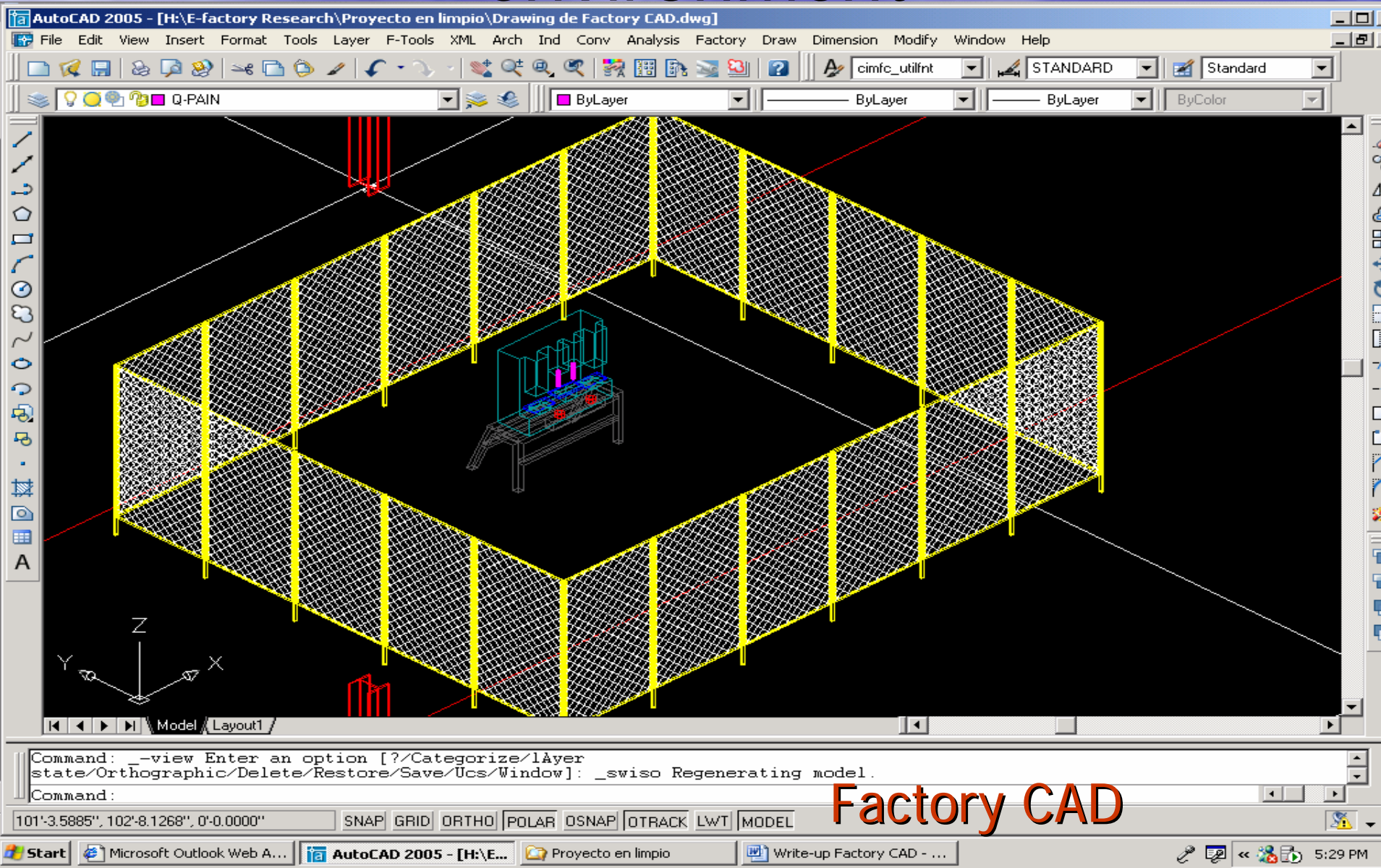
Increase of the Building Cube



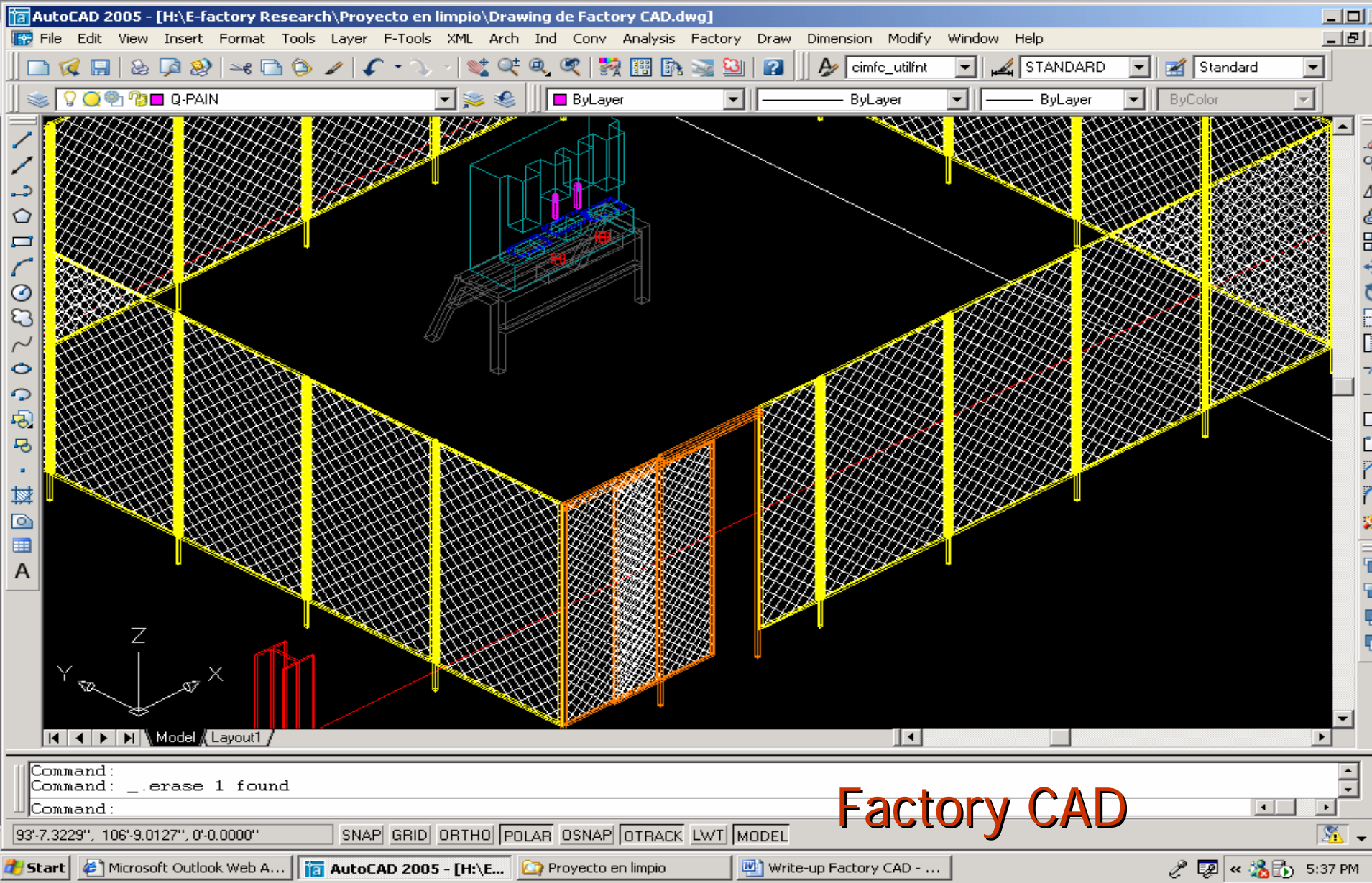
Providing a safe working environment



Providing a safe working environment

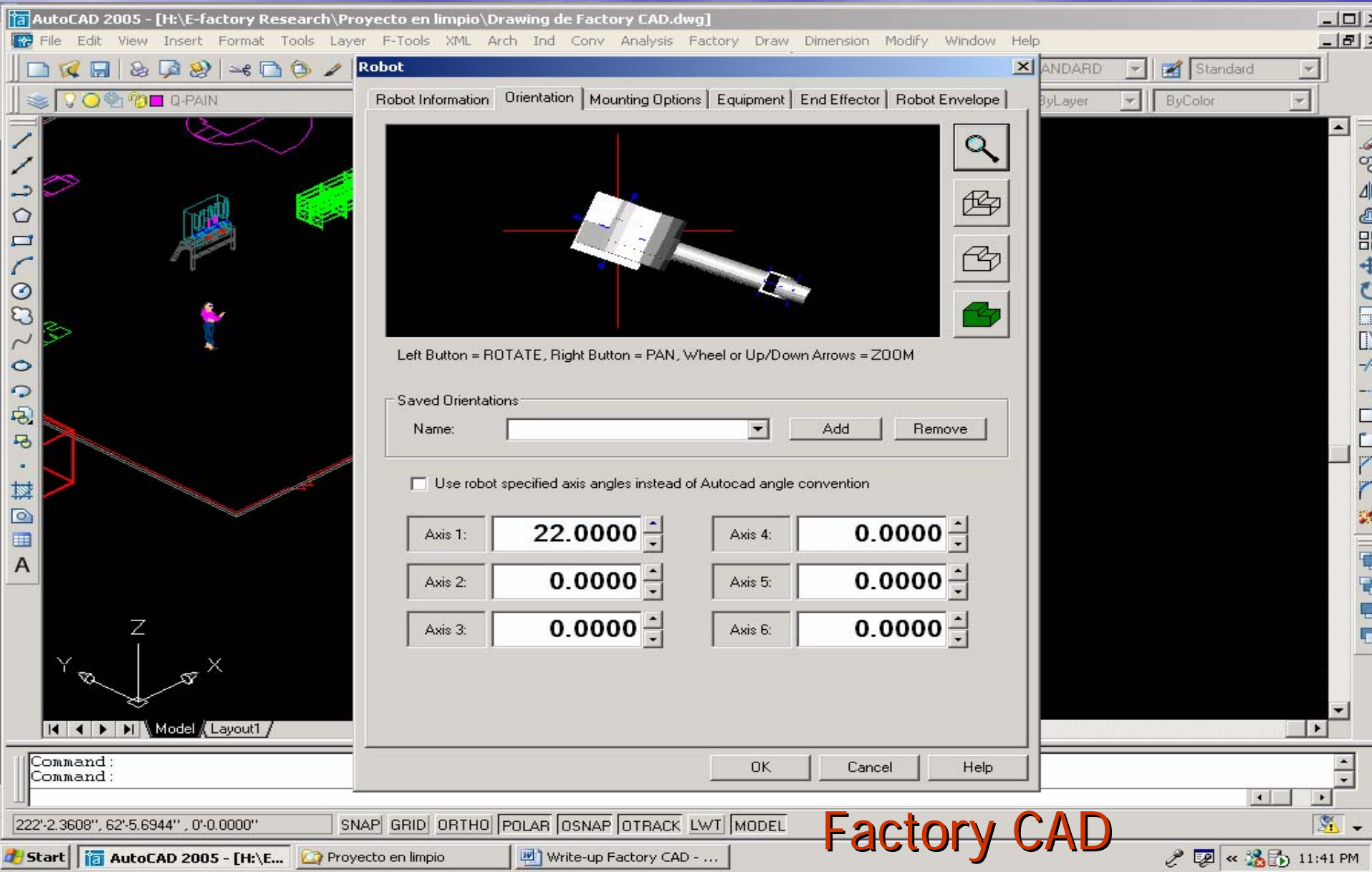


Providing a safe working environment



Factory CAD

Providing a safe working environment



Optimization of Quality & Cost Reduction

Proplanner - STUDENT CHAIR

File Edit View Tools Reports Help

mBOM Documents mBOM Authoring Charting Cost Estimation Work Instruction PFMEA Ergonomics

END40-0001: Student Chair

- OPR40-0001: END OPERATION
 - ACT40-0001: ASSEMBLY ACTIVITY
 - ACT40-0001-A1: DECAL ACTIVITY
 - ACT40-0001-A2: WARNING LABEL
 - ACT40-0001-A3: CUSTOMER SUPP
 - ACT40-0001-A4: BAR CODE ACTIVI
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 - ASY40-1004: Wheel Assembly
- ASY40-2002: Post Assembly
 - OPR40-2002: POST ASSEMBLY OPE
 - MFG50-5002: Post Rod
 - MFG10-5001: Post Tube

Production Rate: 10 pieces/hour

☐ Ignore Cost of this operation

Properties

General

Description	FINAL ASSEMBLY OPERATION FOR THE CHAIR
ID	OPR40-0001
Name	END OPERATION

Misc

TabType	mBOM
---------	------

Version

IsLocked	False
Version	1

Name

A more descriptive name used by the company.

FINAL ASSEMBLY OPERATION FOR THE CHAIR

Pro-Planner

Start Proplanner - STUDENT... Write-up Pro-Planner - M... 9:40 PM

Optimization of Quality & Cost Reduction

Proplanner - STUDENT CHAIR

File Edit View Tools Reports Help

Resources Documents Resource Management

Resource

User Class	ID	Name	Description	Category	Planned	Shared
Fastners	BOLT 1/4 - 2/3"				<input type="checkbox"/>	<input type="checkbox"/>
Tool Bits	CUTTING TOOL				<input type="checkbox"/>	<input type="checkbox"/>
Tool Bits	SHAPING TOOL				<input type="checkbox"/>	<input type="checkbox"/>
Adhesives	MATLOCK 707	MATLOCK 707			<input type="checkbox"/>	<input type="checkbox"/>
Lubricants	GREASE				<input type="checkbox"/>	<input type="checkbox"/>
Fastners	SCREW 3/4"				<input type="checkbox"/>	<input type="checkbox"/>
Fastners	SCREW 1/2"				<input type="checkbox"/>	<input type="checkbox"/>
Coolants	COOL109	COOLANT			<input type="checkbox"/>	<input type="checkbox"/>
Fastners	BOLT 1/2 - 3/8 "				<input type="checkbox"/>	<input type="checkbox"/>
Tool Bits	REAMER				<input type="checkbox"/>	<input type="checkbox"/>
Lubricants	OIL				<input type="checkbox"/>	<input type="checkbox"/>
Tool Bits	DRILL BIT				<input type="checkbox"/>	<input type="checkbox"/>

Properties

General

Description

Name Consumable

Misc

TabType Resources

Name

A more descriptive name used by the company.

Pro-Planner

Write-up Pro-Planner - Microsoft Word

Start Proplanner - STUDENT... Write-up Pro-Planner - M...

9:42 PM

Optimization of Quality & Cost Reduction

Proplanner - STUDENT CHAIR

File Edit View Tools Work Instruction Help

mBOM

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 - OPR40-2002: POST ASSEMBLY OPE
 - MFG50-5002: Post Rod
 - MFG10-5001: Post Tube

eBOM mBOM Plants Resources

Properties

General

Description	ASSEMBLE ASY40-0001 WITH A
ID	ACT40-0001
Name	ASSEMBLY ACTIVITY

Misc

TabType	mBOM
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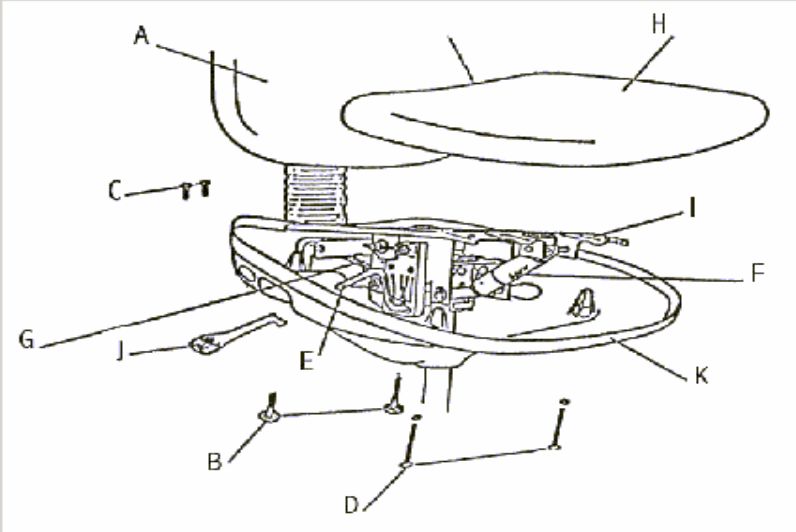
Version

IsLocked	False
Version	1

Name
A more descriptive name used by the company.

Documents | mBOM Authoring | Work Instruction | PFMEA | Ergonomics

Font



1. To operate chair back, press the top rocker switch on the side of the chair backrest. Press the bottom of the switch to recline the chair back, and the top of the switch to raise it.
2. To raise the chair base, press the top of the lower rocker switch. To lower the base, press the bottom of the rocker switch.
3. Auto Position (option) – Press the engraved side of the auto position switch, on position. The chair base will rise and the chair back will lower to its pre-set position. NOTE: After Auto Position has been pressed, it must be turned off before the manual control rocker switches can be used.
4. Auto Return – Press the engraved side (AR) of the auto return switch, on position. The chair back will

Design HTML

☒ Global ☐ Local ☐ Version

Edit Cancel Save

Design

ASSEMBLE ASY40-0001 WITH ASY40-1003

Start Proplanner - STUDENT... Write-up Pro-Planner - M...

Pro-Planner

9:51 PM

Optimization of Quality & Cost Reduction

Proplanner - STUDENT CHAIR

File Edit View Tools Reports Help

mBOM Documents | mBOM Authoring | Charting | Cost Estimation | Work Instruction

END40-0001: Student Chair

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 - OPR40-2002: POST ASSEMBLY OPE
 - MFG50-5002: Post Rod
 - MFG10-5001: Post Tube

Make Vs. Buy

- Make
 - OPR40-1001, SEAT ASSEMBLY OPERATION
- Buy
 - 1, RAW-MATERIAL SUPPLIERS INC. (Lot-Size=1000)
 - 2, PLASTIC MANUFACTURERS (Lot-Size=1000)

Notes

☐ Ignore Cost of this part (& its child parts)

--- Select Costing Program ---

--- Select Costing Program ---

- Project Investment
- Standard Cost
- Buying Options**
- Make vs Buy Comparison

Calculate

Properties

General

Description	
ID	ASY40-1001
Name	Seat Assembly
Quantity	1

Misc

TabType	mBOM
---------	------

Version

IsLocked	False
Version	1

Name

A more descriptive name used by the company.

Pro-Planner

Optimization of Quality & Cost Reduction

Proplanner - STUDENT CHAIR

File Edit View Tools Reports Help

mBOM

- END40-0001: Student Chair
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 - MFG50-5002: Post Rod
 - MFG10-5001: Post Tube

eBOM mBOM Plants Resources

Properties

General

Description	
ID	ASY40-1001
Name	Seat Assembly
Quantity	1

Misc

TabType	mBOM
---------	------

Version

IsLocked	False
Version	1

Name

A more descriptive name used by the company.

Documents | mBOM Authoring | Charting | **Cost Estimation** | Work Instruction

Make Vs. Buy

- Make
 - OPR40-1001, SEAT ASSEMBLY OPERATION
- Buy
 - 1, RAW-MATERIAL SUPPLIERS INC.(Lot-Size=1000)
 - 2, PLASTIC MANUFACTURERS(Lot-Size=1000)

Notes

☐ Ignore Cost of this part (& its child parts)

Buying Options

	Rank	Supplier ID	Supplier Name	Lot-Size	Cost	Discount	Tax	Shipping	Additional	Cost/Unit
▶	1	RAW-MATERI	RAW-MATERIAL SUPPLIE	1000	20000	5%	5%	2%	1%	20.52
	2	PLASTIC MAN	PLASTIC MANUFACTURER	1000	20500	6%	4%	2%	1%	20.6189

Pro-Planner

Optimization of Quality & Cost Reduction

Proplanner - STUDENT CHAIR

File Edit View Tools Reports Help

mBOM Documents mBOM Authoring Cost Estimation Work Instruction

Type: **PurchasedItem** Version: 1

ID: PUR60-0605 Status: Not Locked

Name: Post Cover Description:

Effectivity

From Date: Saturday, April 09, 2005

To Date: Saturday, April 09, 2005

☒ Disable Effectivity

Quantity: 1

Header

Product Custom Fields **Supplier Mapping**

	Rank	Supplier ID	Supplier Name	Lot-Size	Cost	Discount	Tax	Shipping	Additional	Cost/Unit
▶	1	LEATHER-CL	LEATHER-CLOTH MANUFA	1200	1200	2.5%	10%	5%	10%	1.2188

Properties

General

Description

ID: PUR60-0605

Name: Post Cover

Quantity: 1

Misc

TabType: mBOM

Version

IsLocked: False

Version: 1

Name

A more descriptive name used by the company.

Pro-Planner

Add Delete Edit

Start Proplanner - STUDENT... Write-up Pro-Planner - M... 9:56 PM

Data Sources for Facilities Planning

Cycle time, Bottleneck time & Takt Time

Proplanner - STUDENT CHAIR

File Edit View Tools Reports Help

mBOM Documents mBOM Authoring Charting Cost Estimation Work Instruction PFMEA Ergonomics

END40-0001: Student Chair

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- ASY40-2002: Post Assembly
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 - MFG50-5002: Post Rod
 - MFG10-5001: Post Tube

Gantt Chart

Activity	Duration (Seconds)
ACT40-0001	64.32
ACT40-0001-A1	6.71
ACT40-0001-A2	10.84
ACT40-0001-A3	29.32
ACT40-0001-A4	64.32

CycleTime: 30 BottleneckTime: 5 TaktTime: 25 Draw Time: 64.322 Units: Seconds

Properties

General

Description: FINAL ASSEMBLY OPERATION FOR THE CHAIR
ID: OPR40-0001
Name: END OPERATION

Misc

TabType: mBOM

Version

IsLocked: False
Version: 1

Name

A more descriptive name used by the company.

Gantt Chart Editor

Type: Operation Version: 1
ID: OPR40-0001 Status:
Name: END OPERATION Description: FINAL ASSEMBLY OPERATION FOR THE CHAIR

Effectivity

From Date: Saturday, April 09, 2005
To Date: Saturday, April 09, 2005
☒ Disable Effectivity

Boundary Mapping

Boundary: Manufacturing Attach Detach

Pro-Planner

Start Proplanner - STUDENT... Write-up Pro-Planner - M... 9:45 PM

Indented Bill of Materials

Report Viewer

eBOM Tree

Part ID	Part Name	Part Type	Part Description	Part Version	Op. ID	Op. Name	Op. Version
END40-0001	Student Chair	EndItem		1			

Level	Part ID	Name	Description	Type	Ver.	Status	Optional	Qty.	Op. ID	Name	Ver.
0	END40-0001	Student Chair		EndItem	1	Not Locked		1			
1	ASY40-1001	Seat Assembly		Assembly	1	Not Locked		1			
2	ASY40-2001	Back Support Bar Assembly		Assembly	1	Not Locked	*	1			
3	MFG10-3003	Back Support Bar		ManufacturedItem	1	Not Locked		1			
3	PUR60-0603	Back Support Bar Cover		PurchasedItem	1	Not Locked		1			
3	PUR60-0614	Oval Tube Cover		PurchasedItem	1	Not Locked		1			
2	ASY40-1002	Bottom Assembly		Assembly	1	Not Locked		1			
3	MFG30-3001	Seat Foam		ManufacturedItem	1	Not Locked		1			
3	MFG30-4003	Seat Mesh		ManufacturedItem	1	Not Locked		1			
3	MFG20-2001	Seat Base		ManufacturedItem	1	Not Locked		1			
3	MFG30-5001	Seat Leather-BLUE/BLACK		ManufacturedItem	1	Not Locked		1			
3	MFG30-4011	Seat Cloth-BLUE/BLACK		ManufacturedItem	1	Not Locked		1			
3	MFG10-3001	Seat Support		ManufacturedItem	1	Not Locked		1			
3	PUR60-0611	Washers 1/2"		PurchasedItem	1	Not Locked		15			
3	PUR60-0610	Screws (1/4" X 7/8")		PurchasedItem	1	Not Locked		25			
3	PUR60-0612	Washers 3/4"		PurchasedItem	1	Not Locked		20			
3	PUR60-0613	Lock Washers 3/4"		PurchasedItem	1	Not Locked		20			
3	PUR60-0601	Plywood Bolts 1/4" X 7/8"		PurchasedItem	1	Not Locked		25			
3	PUR60-0615	Steel Staples		PurchasedItem	1	Not Locked		100			
3	PUR60-0616	Black Staples		PurchasedItem	1	Not Locked		100			

Page Setup Print Preview Print... Save as HTML Export to CSV Close

Pro-Planner

Start Proplanner - STUDENT... Write-up Pro-Planner - M... 8:58 PM

Structure Tree

Write-up Factory Flow - Microsoft Word

File Edit View Insert Format Tools Table Window Help

Type a question for help

100% Times New Roman 12 B I U

UGS Factory Flow - Chair.flo

File Edit Flow Diagram Data Analysis Activity Points Paths Reports Zoom AutoCAD® Options Help

Assembly Data

- Automobile
- Doors
- Windows
- Tires
- Fluids
- Gasoline

Activity Points

Material Handling Equipme

Part	From	To	Percentage	Material Handling Device	Cont./Trip	Container I
------	------	----	------------	--------------------------	------------	-------------

Factory Flow Flow diagram Zoom Level: 100%

Getting Started

Microsoft Office Online

- Connect to Microsoft Office Online
- Get the latest news about using Word
- Automatically update this list from the web

More...

Search for:

Example: "Print more than one copy"

Open

- Write-up Factory OPT
- Write-up
- Fotos de Portland
- Assignment 5
- More...
- Create a new document...

Factory Flow & Pro-Planner

Page 1 Sec 1 1/3 At 1.1" Ln 2 Col 15 REC TRK EXT OVR

Start AutoCAD 2005 - [C:\Pro... UGS Factory Flow - Ch... Write-up Factory Flow - ...

4:38 PM

Gantt Charts

Proplanner - STUDENT CHAIR

File Edit View Tools Reports Help

mBOM Documents mBOM Authoring Charting Cost Estimation Work Instruction PFMEA Ergonomics

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eBOM mBOM Plants Resources

Properties

General

Description: FINAL ASSEMBLY OPERATION FOR THE CHAIR

ID: OPR40-0001

Name: END OPERATION

Misc

TabType: mBOM

Version

IsLocked: False

Version: 1

Name

A more descriptive name used by the company.

Gantt Chart

Header | Time | Gantt Chart Editor | Process Custom Fields | Time Rollup | Resource Rollup | History

Type: Operation Version: 1

ID: OPR40-0001 Status:

Name: END OPERATION Description: FINAL ASSEMBLY OPERATION FOR THE CHAIR

Effectivity

From Date: Saturday, April 09, 2005

To Date: Saturday, April 09, 2005

☒ Disable Effectivity

Last Modified By: PROPLANNER\bandyo

Last Modified On: 11/10/2003 2:48:35 PM

Boundary Mapping

Boundary: Manufacturing Attach Detach

CycleTime: BottleneckTime: TaktTime: Draw Time: 64.322 Units: Seconds

ACT40-0001 3.11

ACT40-0001-A1 6.71

ACT40-0001-A2 10.84

ACT40-0001-A3 29.32

ACT40-0001-A4 64.32

0.00 10.00 20.00 30.00 40.00 50.00 60.00 70.00

FINAL ASSEMBLY OPERATION FOR THE CHAIR

Pro-Planner

Pert-CPM Graph

Proplanner - STUDENT CHAIR

File Edit View Tools Help

mBOM

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eBOM mBOM Plants Resources

Properties

General

Description	FINAL ASSEMBLY OPERATION F
ID	OPR40-0001
Name	END OPERATION

Misc

TabType	mBOM
---------	------

Version

IsLocked	False
Version	1

Name

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FINAL ASSEMBLY OPERATION FOR THE CHAIR

Documents | mBOM Authoring | **Charting** | Cost Estimation | Work Instruction | PFMEA | Ergonomics

Precedence Graph

Precedence Graph Sequence Graph Process Graph ☒ Show Operations Only

```
graph LR; A[ACT40-0001] --> B[ACT40-0001-A1]; B --> C[ACT40-0001-A3]; B --> D[ACT40-0001-A2]; C --> E[ACT40-0001-A4]; D --> E;
```

Edit Cancel Save

Start Proplanner - STUDENT... Write-up Pro-Planner - M...

Pro-Planner

9:37 PM

Pert-CPM Graph

Proplanner - STUDENT CHAIR

File Edit View Tools Help

mBOM

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- MFG10-5001: Post Tube

eBOM mBOM Plants Resources

Properties

General

Description	FINAL ASSEMBLY OPERATION FOR THE CHAIR
ID	OPR40-0001
Name	END OPERATION

Misc

TabType	mBOM
---------	------

Version

IsLocked	False
Version	1

Name

A more descriptive name used by the company.

Documents | mBOM Authoring | Charting | Cost Estimation | Work Instruction | PFMEA | Ergonomics

Sequence Graph

Precedence Graph Sequence Graph Process Graph ☒ Show Operations Only

```
graph LR; A[ACT40-0001] --> B[ACT40-0001-A1]; B --> C[ACT40-0001-A3]; B --> D[ACT40-0001-A2]; C --> E[ACT40-0001-A4]; D --> E;
```

Edit Cancel Save

Pro-Planner

Process Flow Chart

Proplanner - STUDENT CHAIR

File Edit View Tools Help

mBOM

Documents | mBOM Authoring | Charting | Cost Estimation | Work Instruction

END40-0001: Student Chair

- OPR40-0001: END OPERATION
 - ACT40-0001: ASSEMBLY ACTIVITY
 - ACT40-0001-A1: DECAL ACTIVITY
 - ACT40-0001-A2: WARNING LABEL AC
 - ACT40-0001-A3: CUSTOMER SUPPORT
 - ACT40-0001-A4: BAR CODE ACTIVITY
- ASY40-1001: Seat Assembly
- ASY40-1003: Base Assembly
- ITM60-0904: Label Warning 2
- ITM60-0903: Label Warning
- ITM60-0902: Label Packaging1
- ITM60-0901: Label Customer Support
- ITM60-0900: UPC Bar Code
- ITM60-0902: Label Packaging1

eBOM | mBOM | Plants | Resources

Properties

General

Description	
ID	END40-0001
Name	Student Chair
Quantity	1

Misc

TabType	mBOM
---------	------

Version

IsLocked	False
Version	1

Name

A more descriptive name used by the company.

Process Flow Chart

Precedence Graph Sequence Graph Process Graph ☐ Show Operations Only

Pro-Planner Edit Cancel Save

Start Proplanner - STUDENT... Write-up Pro-Planner - M... 9:07 PM

Process Flow Chart

Proplanner - STUDENT CHAIR

File Edit View Tools Help

mBOM

END40-0001: Student Chair

- OPR40-0001: END OPERATION
 - ACT40-0001: ASSEMBLY ACTIVITY
 - ACT40-0001-A1: DECAL ACTIVITY
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 - ACT40-0001-A3: CUSTOMER SUPPORT
 - ACT40-0001-A4: BAR CODE ACTIVITY
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- ITM60-0901: Label Customer Support
- ITM60-0900: UPC Bar Code
- ITM60-0902: Label Packaging1

Properties

General

Description	
ID	END40-0001
Name	Student Chair
Quantity	1

Misc

TabType	mBOM
---------	------

Version

IsLocked	False
Version	1

Name

A more descriptive name used by the company.

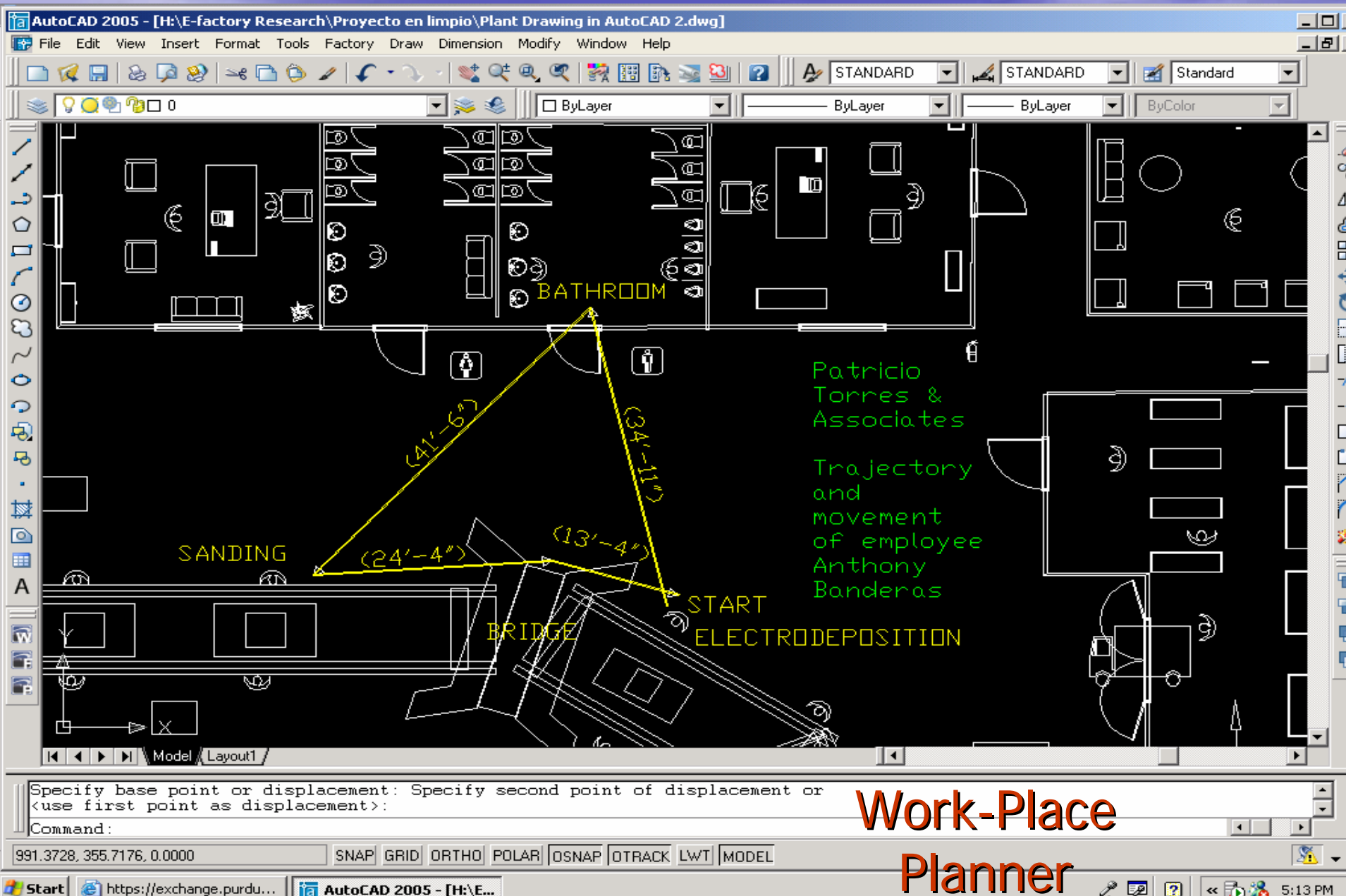
Documents | mBOM Authoring | Charting | Cost Estimation | Work Instruction

Process Flow Chart

Precedence Graph Sequence Graph Process Graph ☒ Show Operations Only

OPR40-1002 OPR40-1003 OPR40-1003-01 MP200-4002 MP200-2001 MP200-5001 MP200-5002 MP200-4001 MP200-4002 MP200-4003 MP200-5002 MP200-5003 MP200-5004 MP200-5005 MP200-5006 MP200-5007 OPR40-1004 OPR40-1005 OPR40-1006 OPR40-1007 OPR40-1008 OPR40-1009 OPR40-1010 OPR40-1011 OPR40-1012 OPR40-1013 OPR40-1014 OPR40-1015 OPR40-1016 OPR40-1017 OPR40-1018 OPR40-1019 OPR40-1020 OPR40-1021 OPR40-1022 OPR40-1023 OPR40-1024 OPR40-1025 OPR40-1026 OPR40-1027 OPR40-1028 OPR40-1029 OPR40-1030 OPR40-1031 OPR40-1032 OPR40-1033 OPR40-1034 OPR40-1035 OPR40-1036 OPR40-1037 OPR40-1038 OPR40-1039 OPR40-1040 OPR40-1041 OPR40-1042 OPR40-1043 OPR40-1044 OPR40-1045 OPR40-1046 OPR40-1047 OPR40-1048 OPR40-1049 OPR40-1050 OPR40-1051 OPR40-1052 OPR40-1053 OPR40-1054 OPR40-1055 OPR40-1056 OPR40-1057 OPR40-1058 OPR40-1059 OPR40-1060 OPR40-1061 OPR40-1062 OPR40-1063 OPR40-1064 OPR40-1065 OPR40-1066 OPR40-1067 OPR40-1068 OPR40-1069 OPR40-1070 OPR40-1071 OPR40-1072 OPR40-1073 OPR40-1074 OPR40-1075 OPR40-1076 OPR40-1077 OPR40-1078 OPR40-1079 OPR40-1080 OPR40-1081 OPR40-1082 OPR40-1083 OPR40-1084 OPR40-1085 OPR40-1086 OPR40-1087 OPR40-1088 OPR40-1089 OPR40-1090 OPR40-1091 OPR40-1092 OPR40-1093 OPR40-1094 OPR40-1095 OPR40-1096 OPR40-1097 OPR40-1098 OPR40-1099 OPR40-1100 OPR40-1101 OPR40-1102 OPR40-1103 OPR40-1104 OPR40-1105 OPR40-1106 OPR40-1107 OPR40-1108 OPR40-1109 OPR40-1110 OPR40-1111 OPR40-1112 OPR40-1113 OPR40-1114 OPR40-1115 OPR40-1116 OPR40-1117 OPR40-1118 OPR40-1119 OPR40-1120 OPR40-1121 OPR40-1122 OPR40-1123 OPR40-1124 OPR40-1125 OPR40-1126 OPR40-1127 OPR40-1128 OPR40-1129 OPR40-1130 OPR40-1131 OPR40-1132 OPR40-1133 OPR40-1134 OPR40-1135 OPR40-1136 OPR40-1137 OPR40-1138 OPR40-1139 OPR40-1140 OPR40-1141 OPR40-1142 OPR40-1143 OPR40-1144 OPR40-1145 OPR40-1146 OPR40-1147 OPR40-1148 OPR40-1149 OPR40-1150 OPR40-1151 OPR40-1152 OPR40-1153 OPR40-1154 OPR40-1155 OPR40-1156 OPR40-1157 OPR40-1158 OPR40-1159 OPR40-1160 OPR40-1161 OPR40-1162 OPR40-1163 OPR40-1164 OPR40-1165 OPR40-1166 OPR40-1167 OPR40-1168 OPR40-1169 OPR40-1170 OPR40-1171 OPR40-1172 OPR40-1173 OPR40-1174 OPR40-1175 OPR40-1176 OPR40-1177 OPR40-1178 OPR40-1179 OPR40-1180 OPR40-1181 OPR40-1182 OPR40-1183 OPR40-1184 OPR40-1185 OPR40-1186 OPR40-1187 OPR40-1188 OPR40-1189 OPR40-1190 OPR40-1191 OPR40-1192 OPR40-1193 OPR40-1194 OPR40-1195 OPR40-1196 OPR40-1197 OPR40-1198 OPR40-1199 OPR40-1200 OPR40-1201 OPR40-1202 OPR40-1203 OPR40-1204 OPR40-1205 OPR40-1206 OPR40-1207 OPR40-1208 OPR40-1209 OPR40-1210 OPR40-1211 OPR40-1212 OPR40-1213 OPR40-1214 OPR40-1215 OPR40-1216 OPR40-1217 OPR40-1218 OPR40-1219 OPR40-1220 OPR40-1221 OPR40-1222 OPR40-1223 OPR40-1224 OPR40-1225 OPR40-1226 OPR40-1227 OPR40-1228 OPR40-1229 OPR40-1230 OPR40-1231 OPR40-1232 OPR40-1233 OPR40-1234 OPR40-1235 OPR40-1236 OPR40-1237 OPR40-1238 OPR40-1239 OPR40-1240 OPR40-1241 OPR40-1242 OPR40-1243 OPR40-1244 OPR40-1245 OPR40-1246 OPR40-1247 OPR40-1248 OPR40-1249 OPR40-1250 OPR40-1251 OPR40-1252 OPR40-1253 OPR40-1254 OPR40-1255 OPR40-1256 OPR40-1257 OPR40-1258 OPR40-1259 OPR40-1260 OPR40-1261 OPR40-1262 OPR40-1263 OPR40-1264 OPR40-1265 OPR40-1266 OPR40-1267 OPR40-1268 OPR40-1269 OPR40-1270 OPR40-1271 OPR40-1272 OPR40-1273 OPR40-1274 OPR40-1275 OPR40-1276 OPR40-1277 OPR40-1278 OPR40-1279 OPR40-1280 OPR40-1281 OPR40-1282 OPR40-1283 OPR40-1284 OPR40-1285 OPR40-1286 OPR40-1287 OPR40-1288 OPR40-1289 OPR40-1290 OPR40-1291 OPR40-1292 OPR40-1293 OPR40-1294 OPR40-1295 OPR40-1296 OPR40-1297 OPR40-1298 OPR40-1299 OPR40-1300 OPR40-1301 OPR40-1302 OPR40-1303 OPR40-1304 OPR40-1305 OPR40-1306 OPR40-1307 OPR40-1308 OPR40-1309 OPR40-1310 OPR40-1311 OPR40-1312 OPR40-1313 OPR40-1314 OPR40-1315 OPR40-1316 OPR40-1317 OPR40-1318 OPR40-1319 OPR40-1320 OPR40-1321 OPR40-1322 OPR40-1323 OPR40-1324 OPR40-1325 OPR40-1326 OPR40-1327 OPR40-1328 OPR40-1329 OPR40-1330 OPR40-1331 OPR40-1332 OPR40-1333 OPR40-1334 OPR40-1335 OPR40-1336 OPR40-1337 OPR40-1338 OPR40-1339 OPR40-1340 OPR40-1341 OPR40-1342 OPR40-1343 OPR40-1344 OPR40-1345 OPR40-1346 OPR40-1347 OPR40-1348 OPR40-1349 OPR40-1350 OPR40-1351 OPR40-1352 OPR40-1353 OPR40-1354 OPR40-1355 OPR40-1356 OPR40-1357 OPR40-1358 OPR40-1359 OPR40-1360 OPR40-1361 OPR40-1362 OPR40-1363 OPR40

Time & Distance Calculations



Time & Distance Calculations

Animate

33.5 Sec

E...	Oper	Time	Desc
2	1	11	
3	1	6.9	
4	1	1.5	
5	1	4.2	

Rerun Stop Return

g in AutoCAD.dwg]

Window Help

STANDARD STANDARD Standard

Layer ByLayer ByLayer ByColor

(41'-6")

(34'-11")

Model Layout1

Automatic save to C:\Temp\Plant Drawing in AutoCAD_1_1_1811.svs\$...
Command: Regenerating model.
Command:

403.9616, 812.5356, 0.0000 SNAP GRID ORTHO POLAR OSNAP OTRACK LWT MODEL

Start Microsoft Outlook Web A... Purdue University School... AutoCAD 2005 - [H:\E... Write-up Pro-Planner - M...

Work-Place Planner

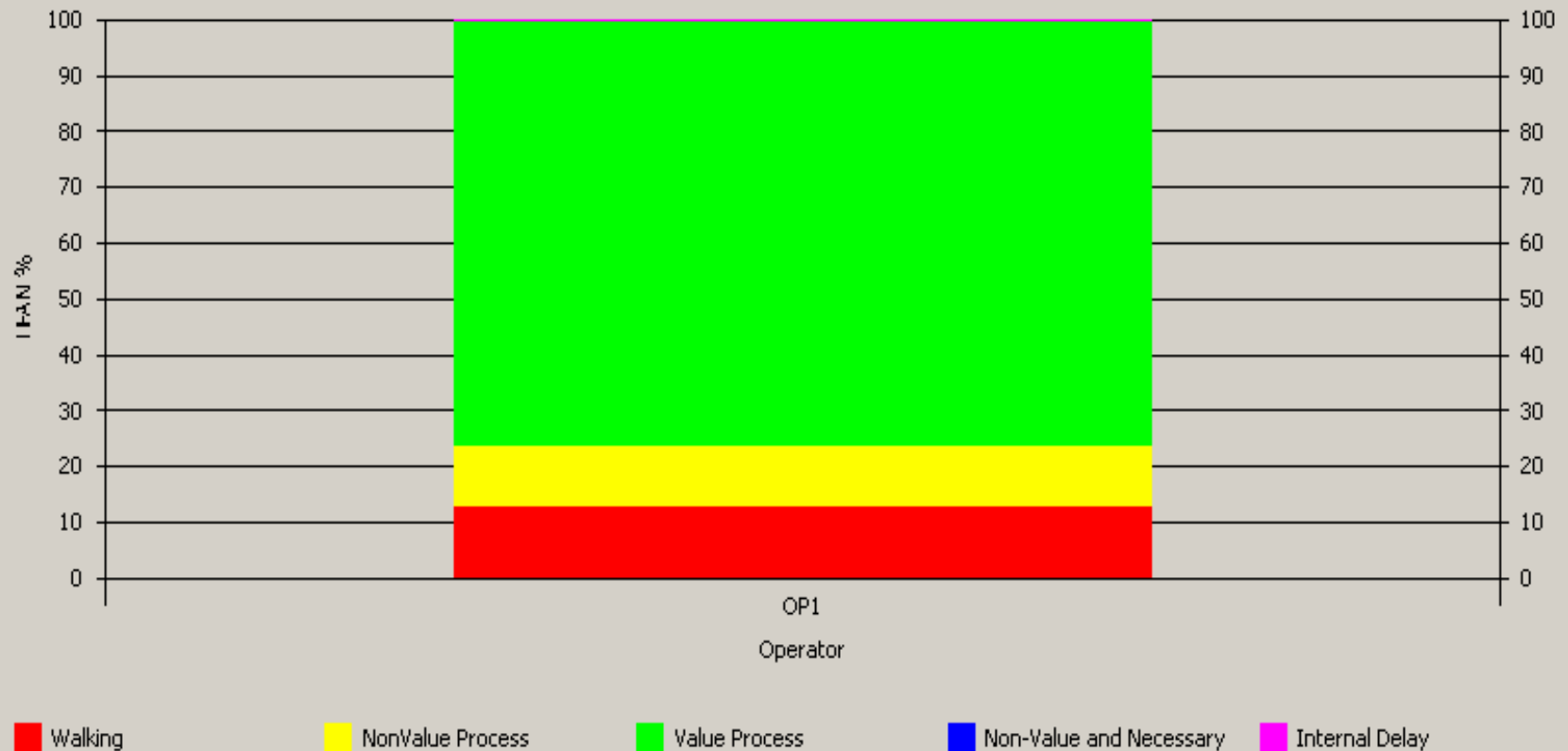
Microphone 5:44 PM

Walking Speed

Proplanner Workplace Planner

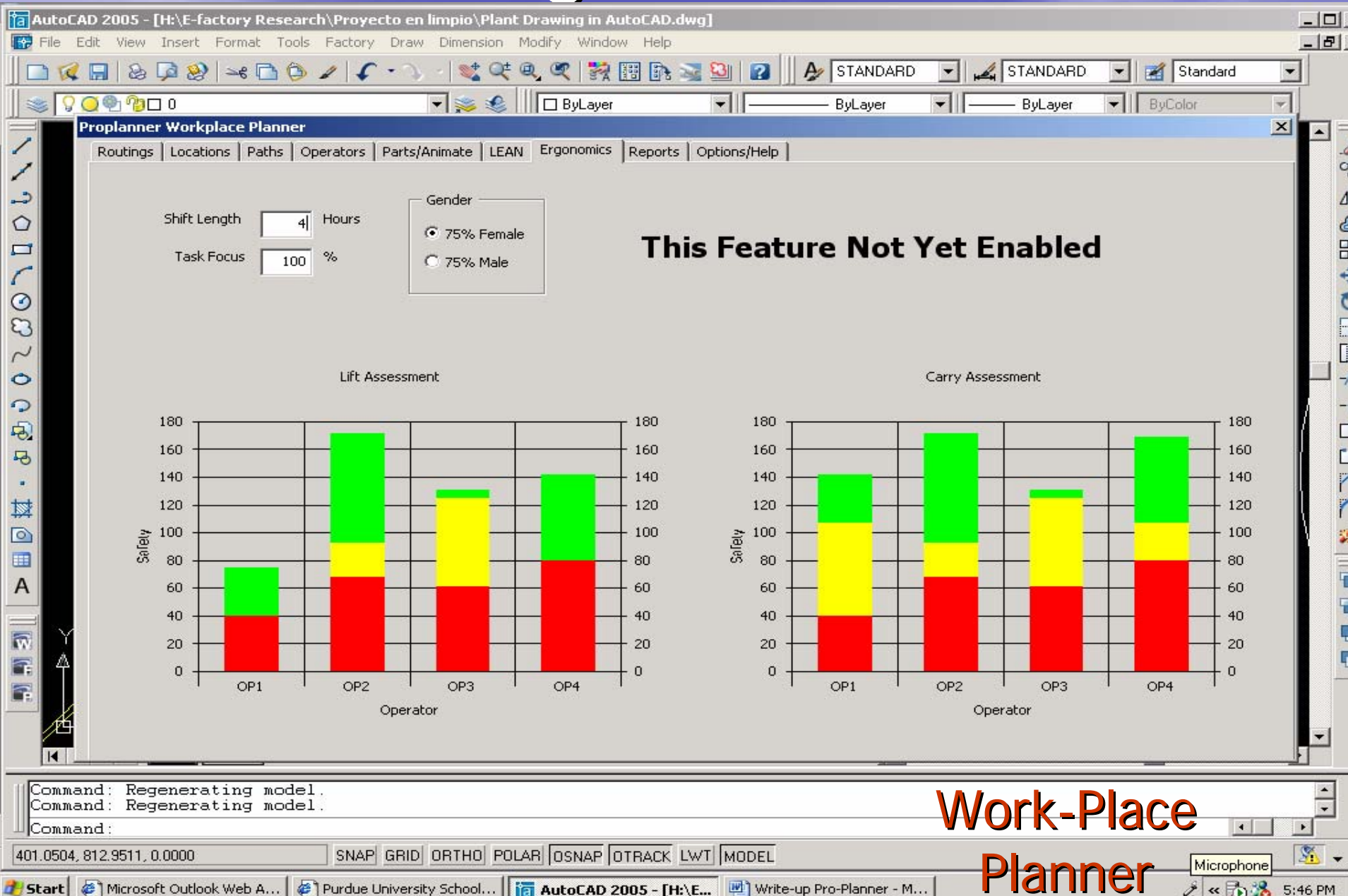
Routings | Locations | Paths | Operators | Parts/Animate | **LEAN** | Ergonomics | Options/Help

LEAN Assessment



Work-Place
Planner

Ergonomics



Simulations

Animate

22.4 Sec

E...	Oper	Time	Desc
14	OPR1	1.4	DescL14
15	OPR1	1.7	DescL15
16	OPR1	4	DescL16
17	OPR1	5	DescL17

Rerun Stop Return

math-2D.dwg]

Window Help

Standard Standard Standard

Layer ByLayer ByLayer ByColor

Fixture

TABLE

START

Rack

Rack

Rack 4

Rack 3

BAR1

Fixture2

Y

X

Model Layout1

Command:

Command: Regenerating model.

Command:

0'-0 7/8", 60'-9 3/16", 0'-0"

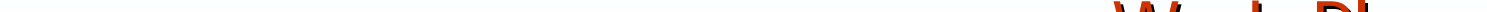
SNAP GRID ORTHO POLAR OSNAP OTRACK LWT MODEL

Start Microsoft Outlook Web A... Purdue University School... Write-up Pro-Planner - M... AutoCAD 2005 - [C:\P...

Microphone

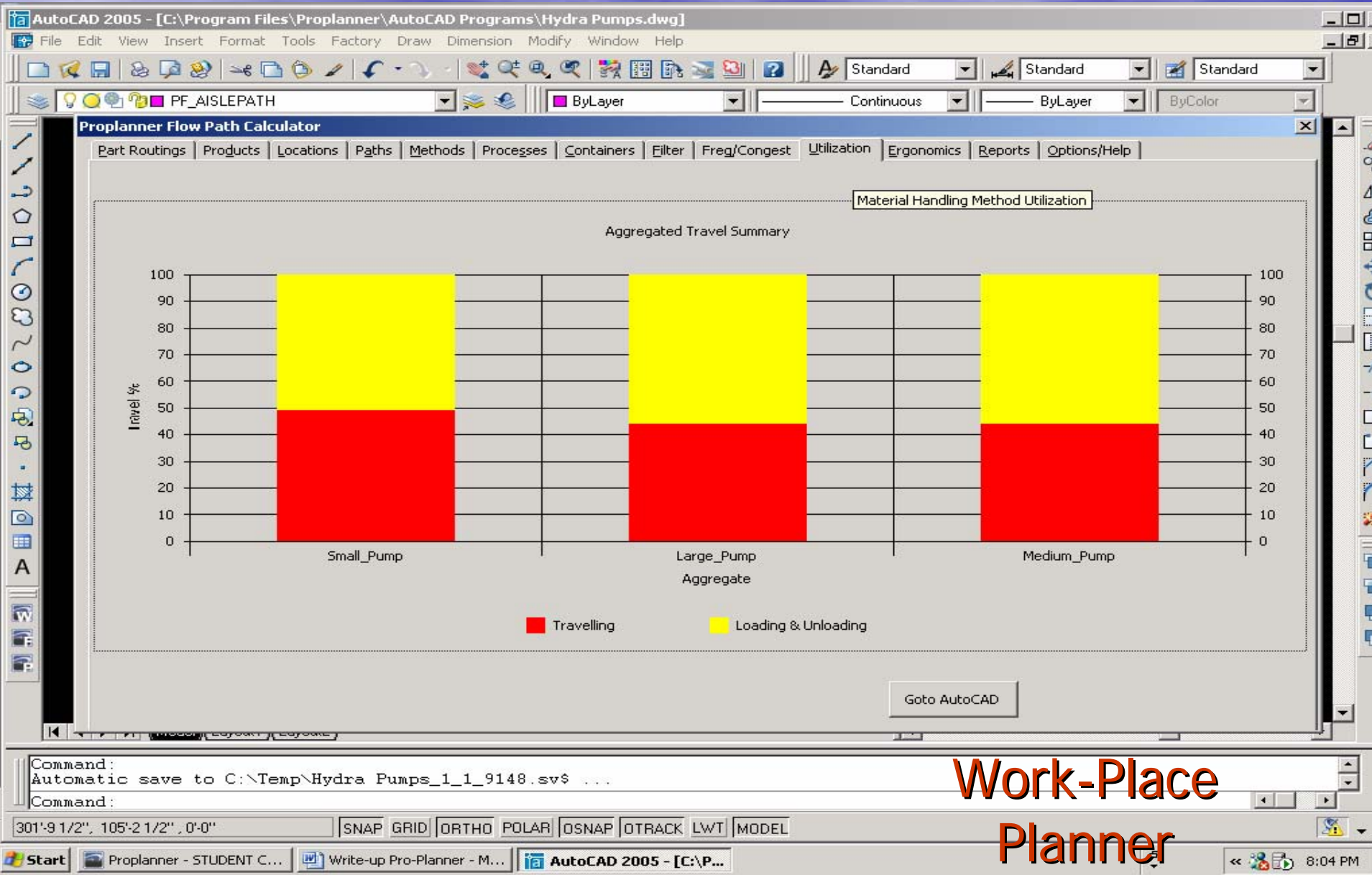
7:32 PM

Work-Place Planner

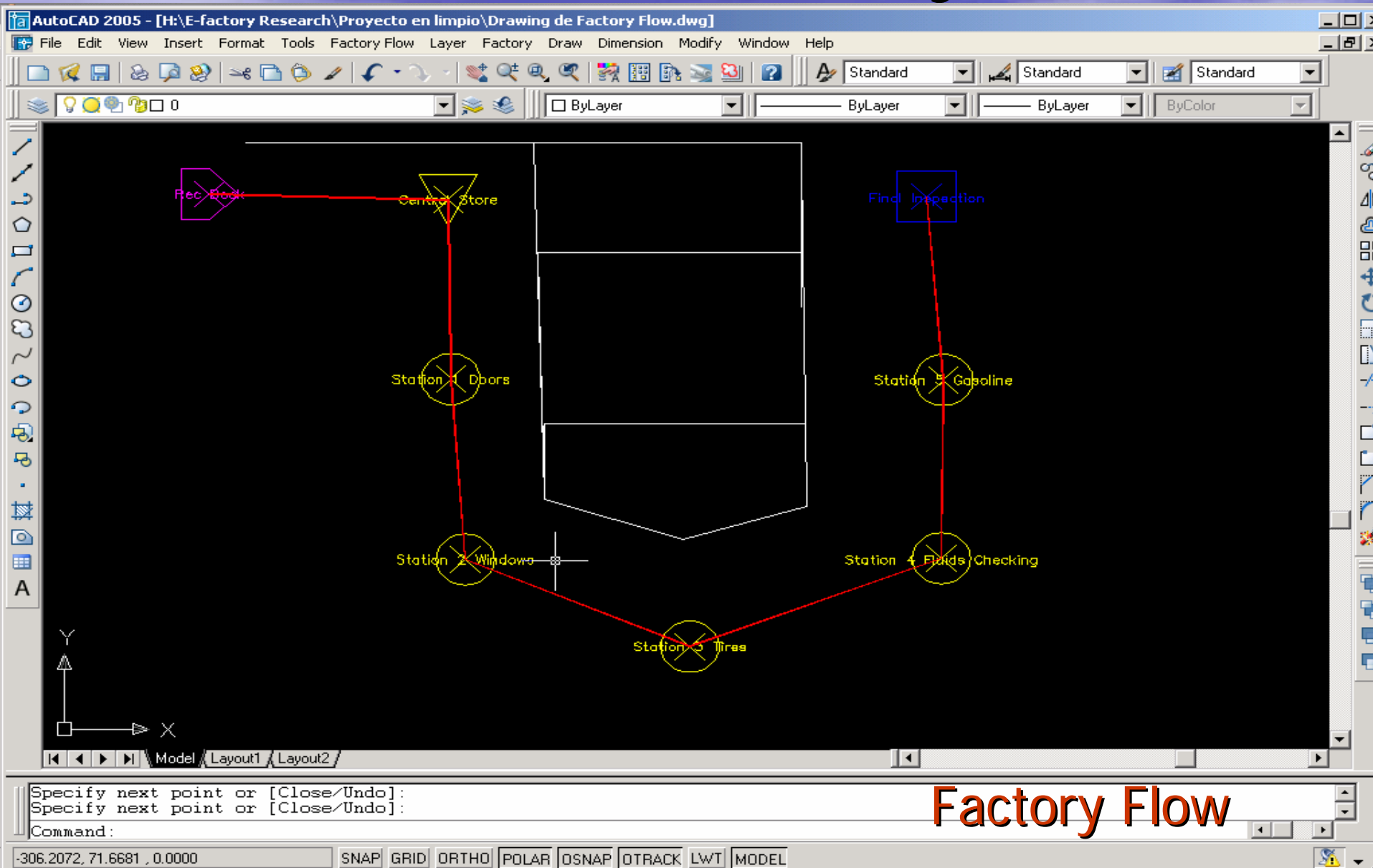
[illegible]

A screenshot of the AutoCAD 2005 software interface. The title bar at the top reads "AutoCAD 2005 - [C:\P...". The command line at the top left shows "Command:" three times. Below it, the coordinate "0'-9 11/16", 91'-4 5/16", 0'-0"" is displayed. A toolbar contains buttons for SNAP, GRID, ORTHO, POLAR, OSNAP, OTRACK, LWT, and MODEL. The Windows taskbar at the bottom shows the Start button and several open applications: Microsoft Outlook Web A..., Purdue University School..., Write-up Pro-Planner - M..., and AutoCAD 2005 - [C:\P... The system clock in the bottom right corner shows 7:47 PM. Overlaid on the right side of the image is the text "Work-Place Planner" in a large, stylized font, with "Work-Place" in orange and "Planner" in red.

Flow Paths & Congestion Calculations

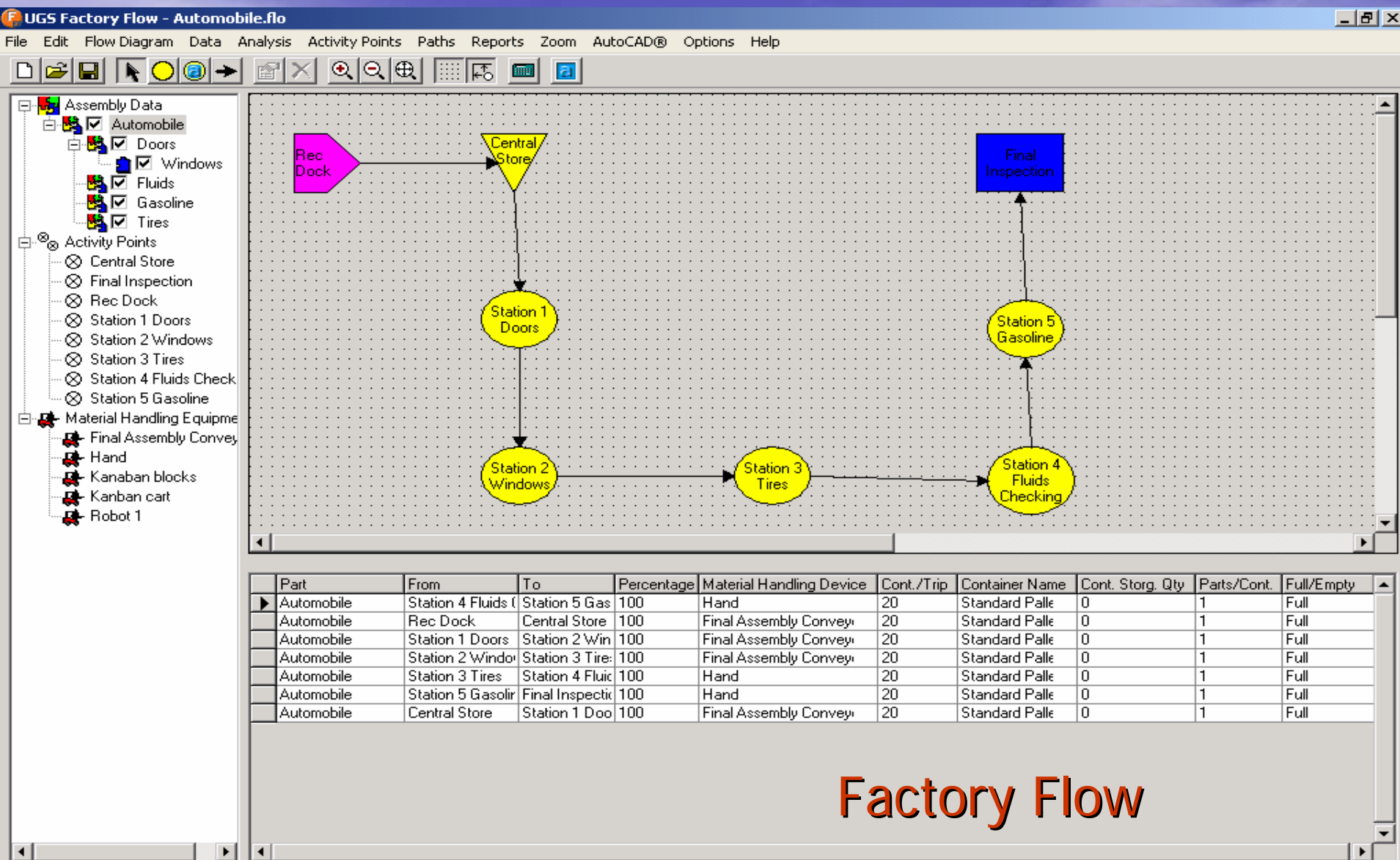


Flow & Aisle Analysis



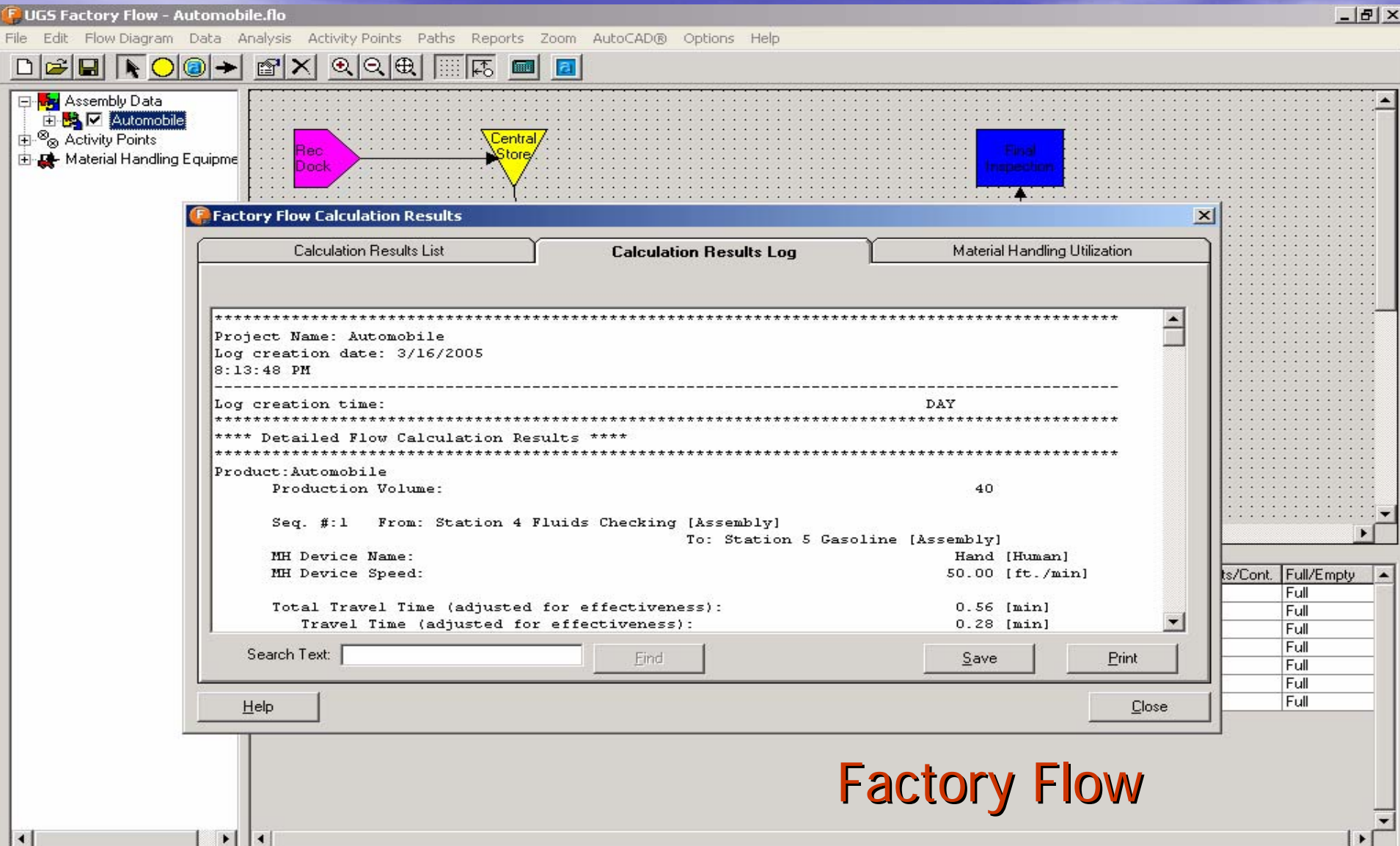
Factory Flow

Flow Calculations



Factory Flow

Routing Calculations



Factory Flow

Euclidean Calculations

Automobile_1_Calculation - WordPad

File Edit View Insert Format Help

***** Detailed Flow Calculation Results *****

Product: Automobile

Production Volume: 40

Seq. #:1 From: Station 4 Fluids Checking [Assembly] To: Station 5 Gasoline [Assembly]

MH Device Name: Hand [Human]
MH Device Speed: 50.00 [ft./min]

Total Travel Time (adjusted for effectiveness): 0.56 [min]
Travel Time (adjusted for effectiveness): 0.28 [min]
Point-to-Point Distance: 6.98 [ft.]
Distance (adjusted for effectiveness): 13.96 [ft.]

Container: Standard Pallet [Pallet -- Full]

Load/Unload Time: [per trip, delivery, container, part] 4.40 [min]
Load Time: 2.00 [min]
Load Template: Fork Load (Using material handling device default)
1. Load Activity [Per trip] 1.00 * 2.00 = 2.00 [min]

Unload Time: 2.40 [min]
Unload Template: Fork Unload (Using material handling device default)
1. Unload Activity [Per trip] 1.20 * 2.00 = 2.40 [min]

Frequency: 2.00 [trips]
Parts Moved: 40.00 [parts]
Parts per Container: 1.00 [parts]
Containers per Trip: 20.00 [containers]

Total Time: 4.96 [min]

Total Cost: 3.31 [\$]
Fixed Cost: 0.00 [\$]
Variable Cost: 3.31 [\$]

Seq. #:2 From: Rec Dock [Dock] To: Central Store [Storage]
MH Device Name: Final Assembly Conveyor [Conveyor]

For Help, press F1

Start Microsoft Office PowerP... Automobile_1_Calcul...

NUM 10:38 AM

Factory Flow

Congestion Calculations

AutoCAD 2005 - [C:\Program Files\Proplanner\AutoCAD Programs\Hydra Pumps.dwg]

File Edit View Insert Format Tools Factory Draw Dimension Modify Window Help

Standard Standard Standard

PF_AISLEPATH ByLayer Continuous ByLayer ByColor

Return to FPC

Return To Flow Path Calc

QueryPath Erase Path

Update Path Add Loc

Add Labels Erase Labels

Add Arrows Erase Arrow

Model Layout1 Layout2

Command:
Command:
Command:

126'-9 1/2", -23'-11 1/2", 0'-0"

SNAP GRID LORTUS POLAR LORNA TRACK LWT MODEL

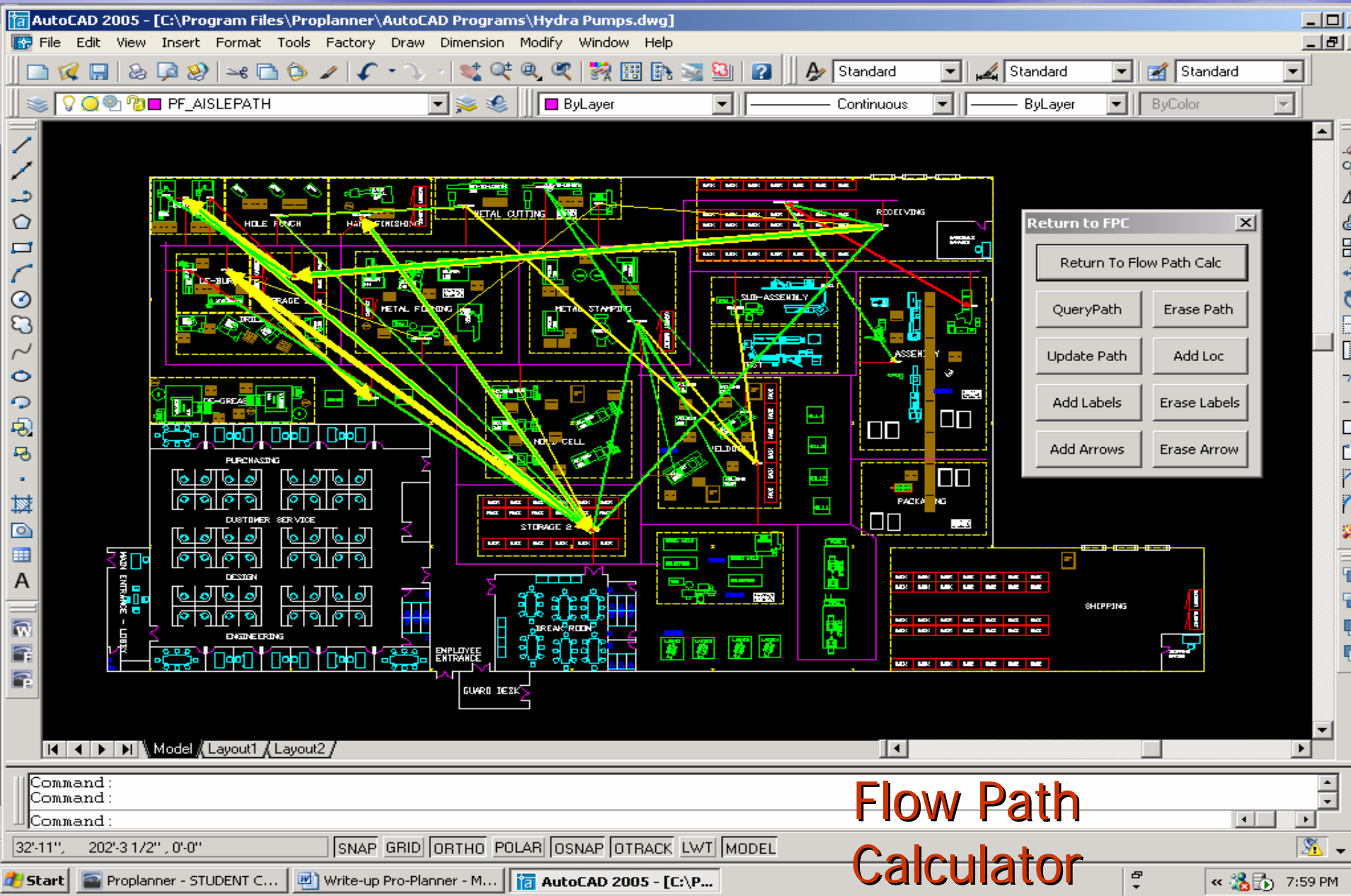
Write-up Pro-Planner - Microsoft Word

Start Proplanner - STUDENT C... Write-up Pro-Planner - M... AutoCAD 2005 - [C:\P...

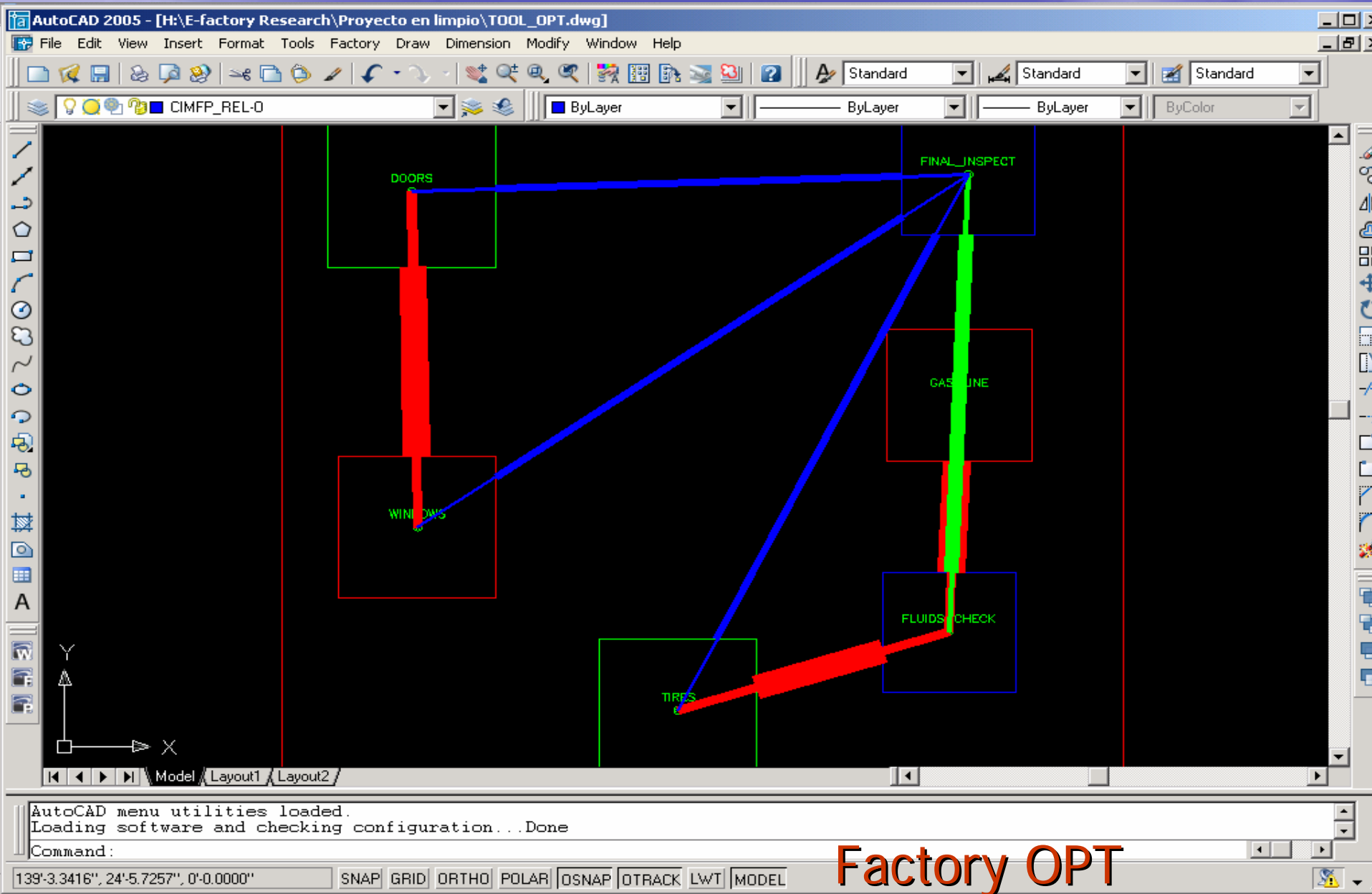
Flow Path Calculator

8:22 PM

Activity Relationship Analysis

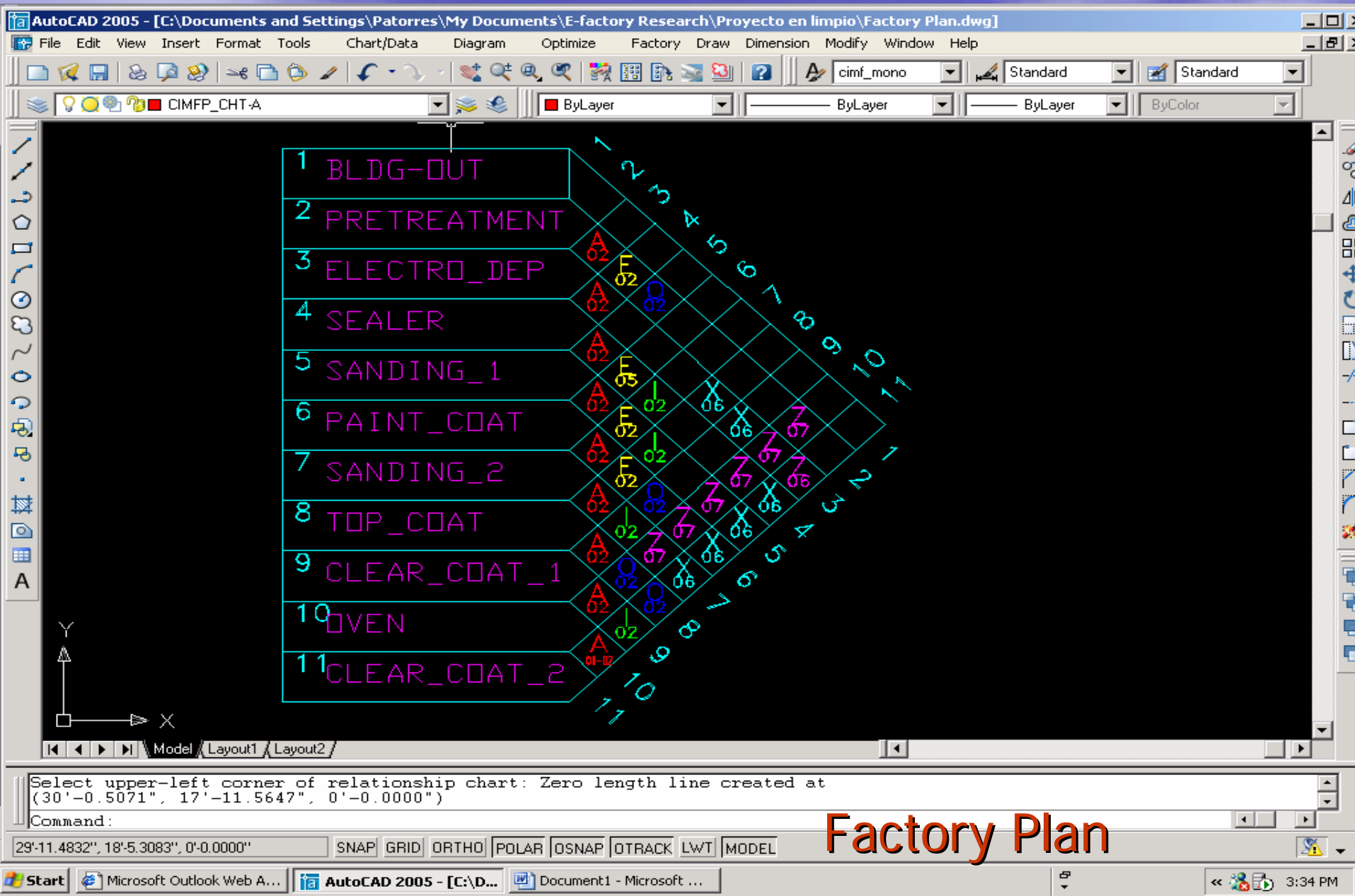


Activity Relationship Analysis

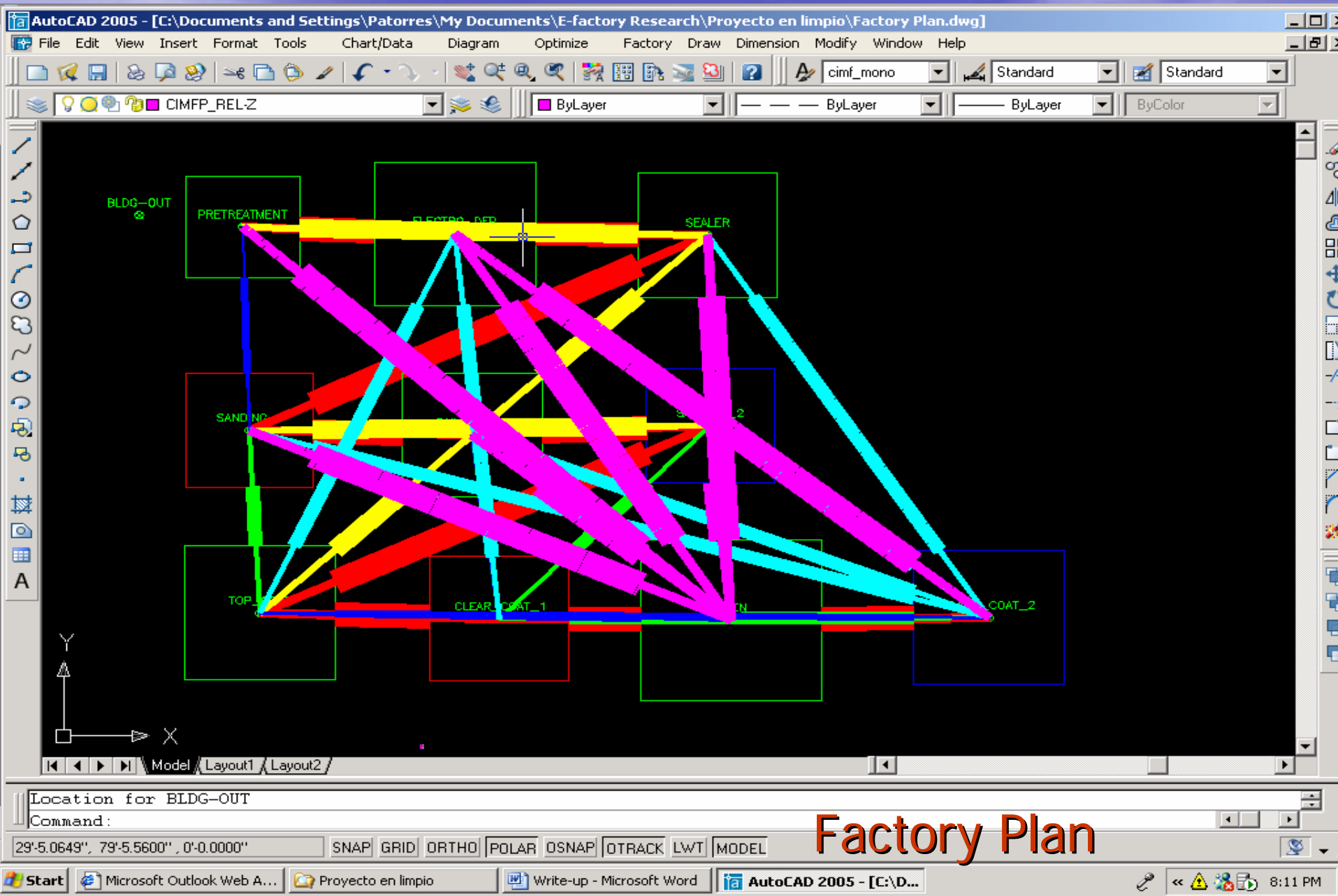


Factory OPT

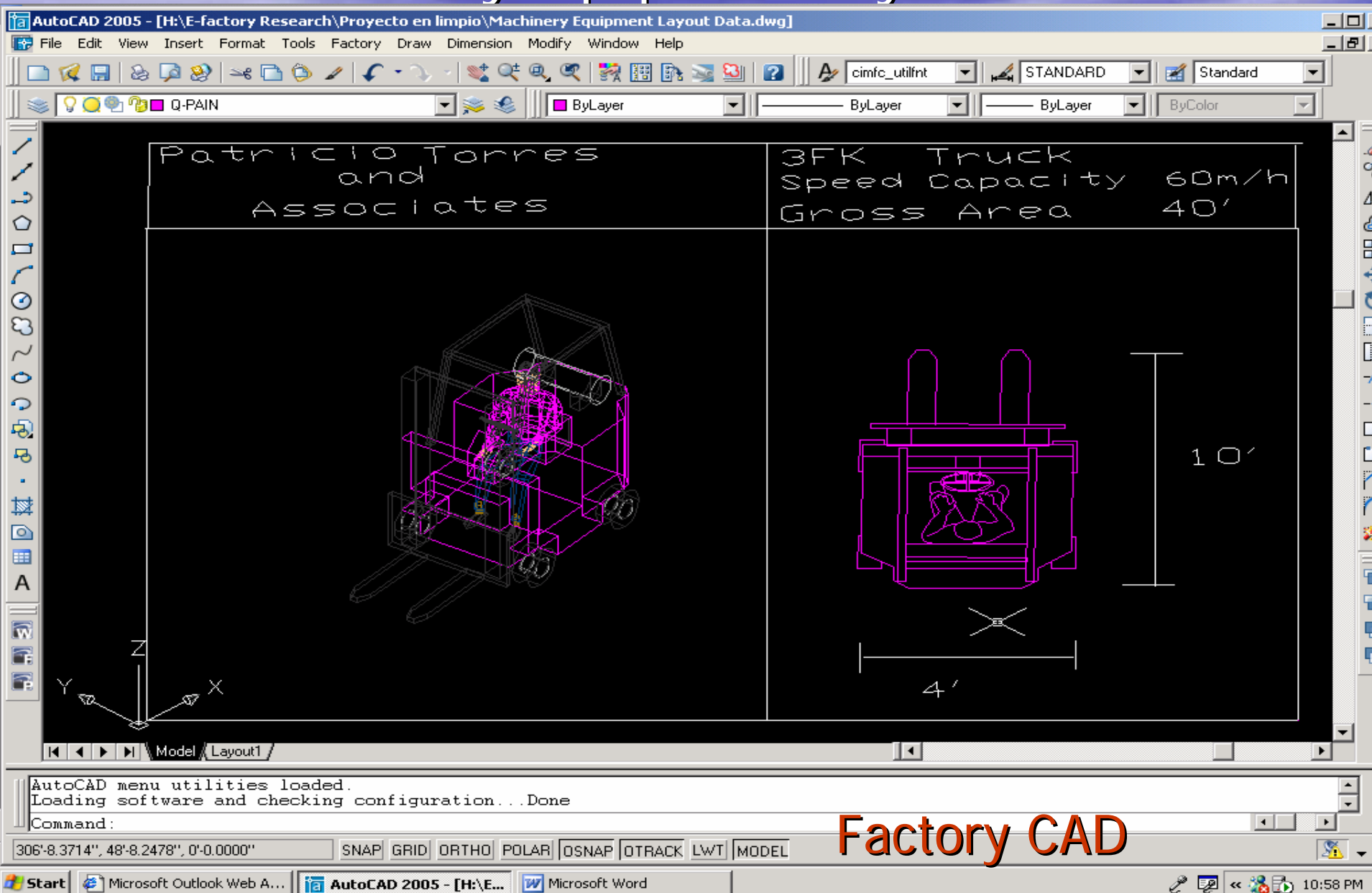
Activity Relations Diagram



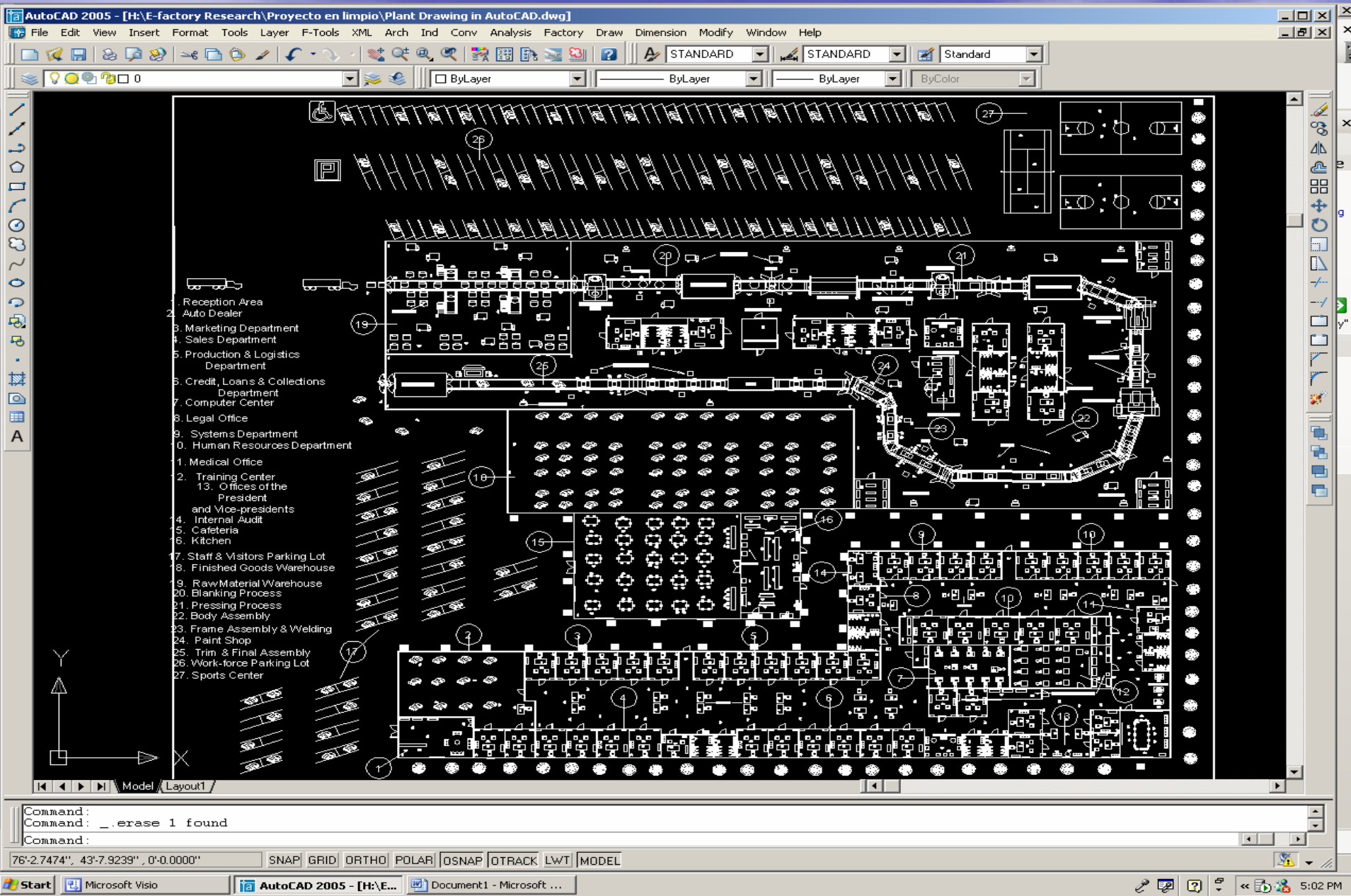
Flow Relationship Diagram



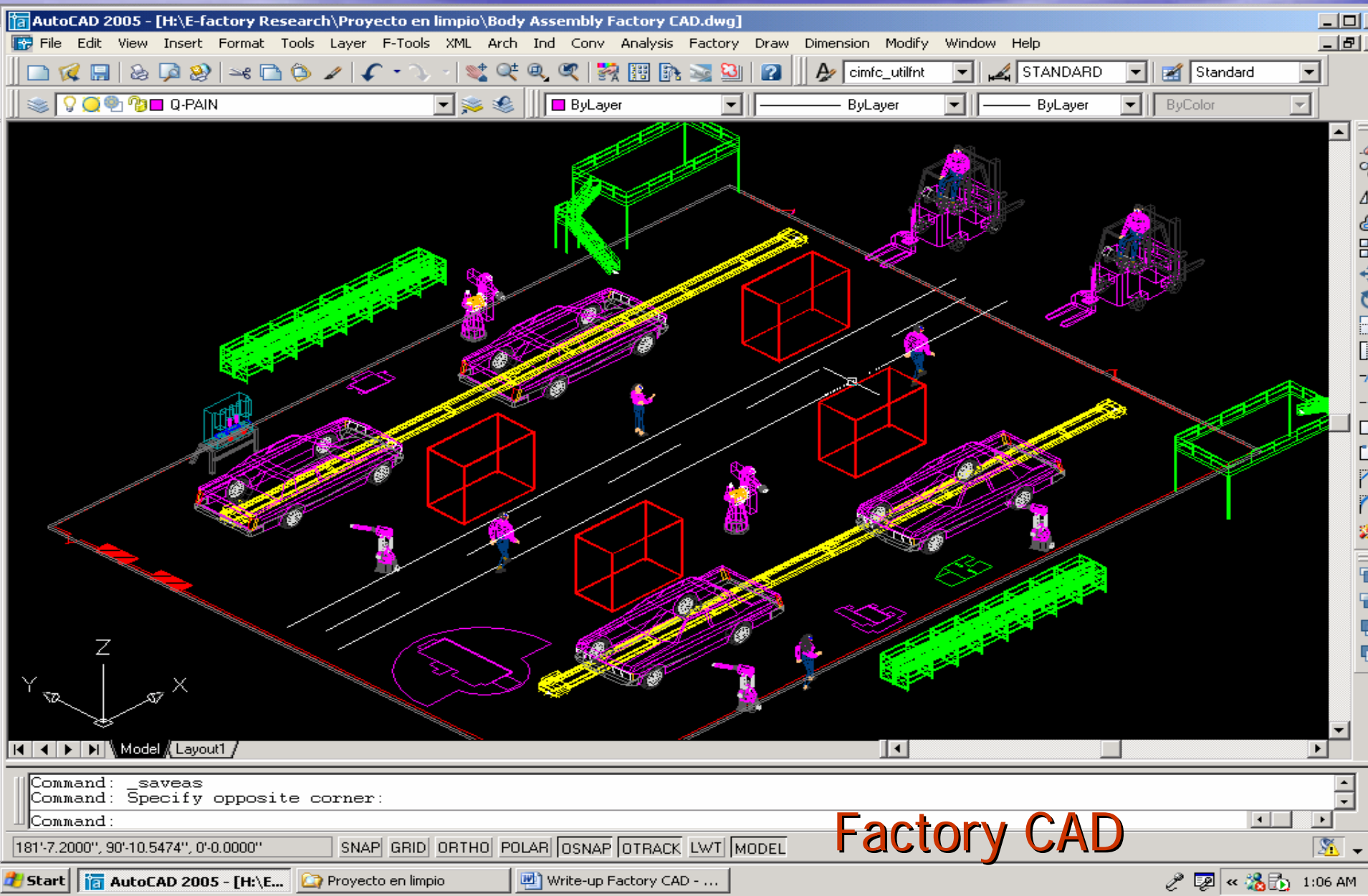
Workstation Design-Space Determination Machinery Equipment Layout Data



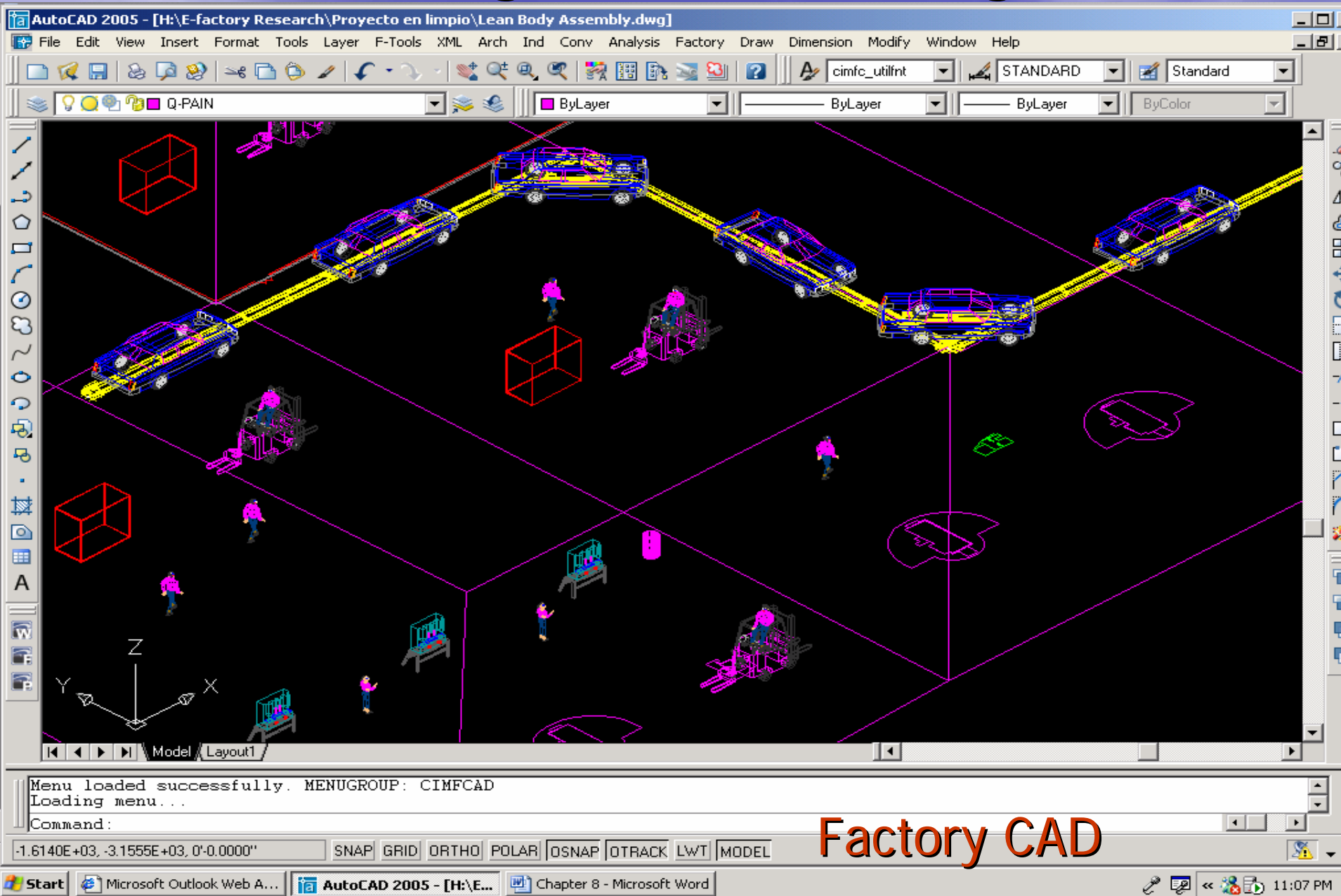
Designing Facilities & Layouts



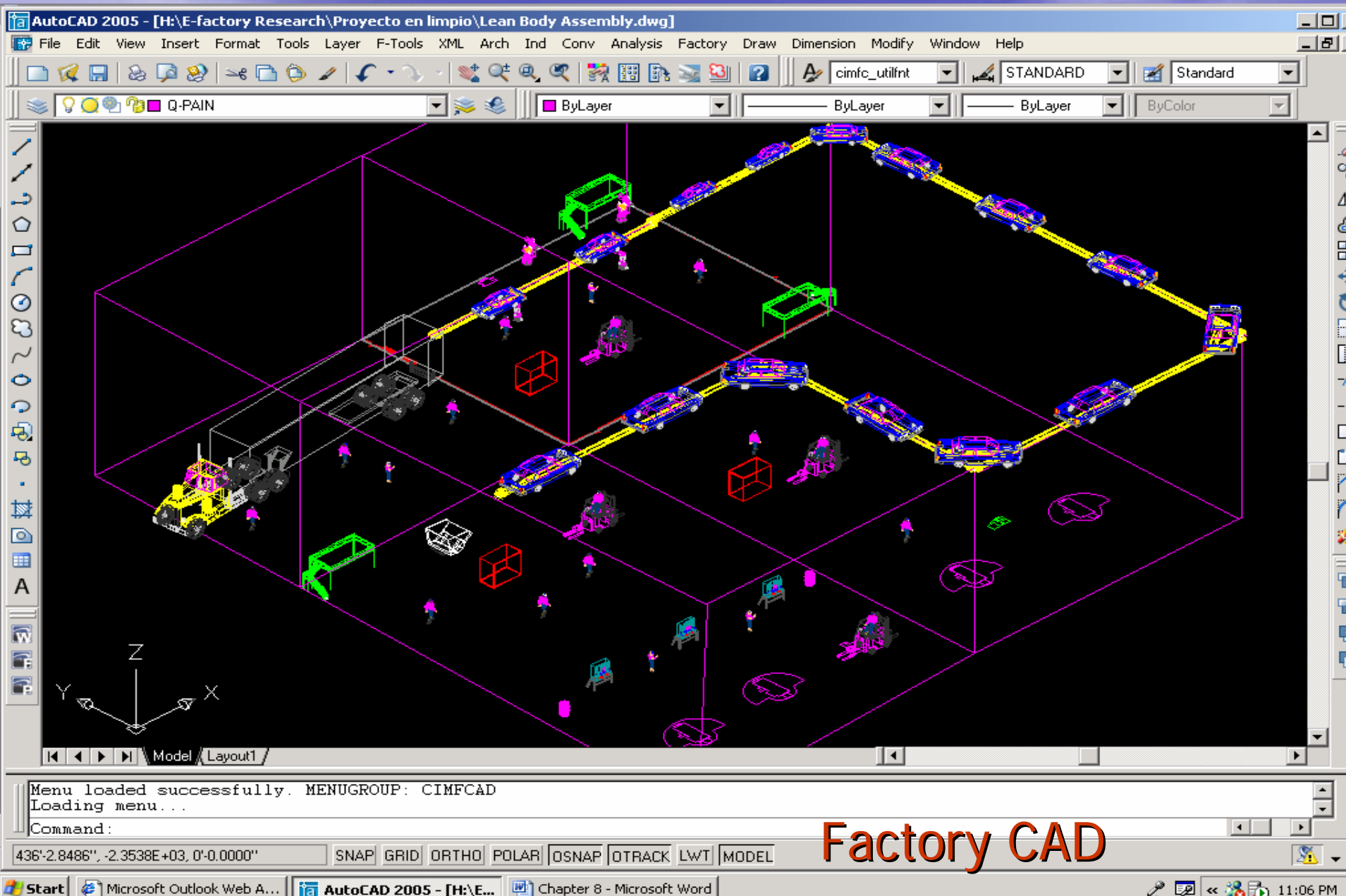
Designing Workstations



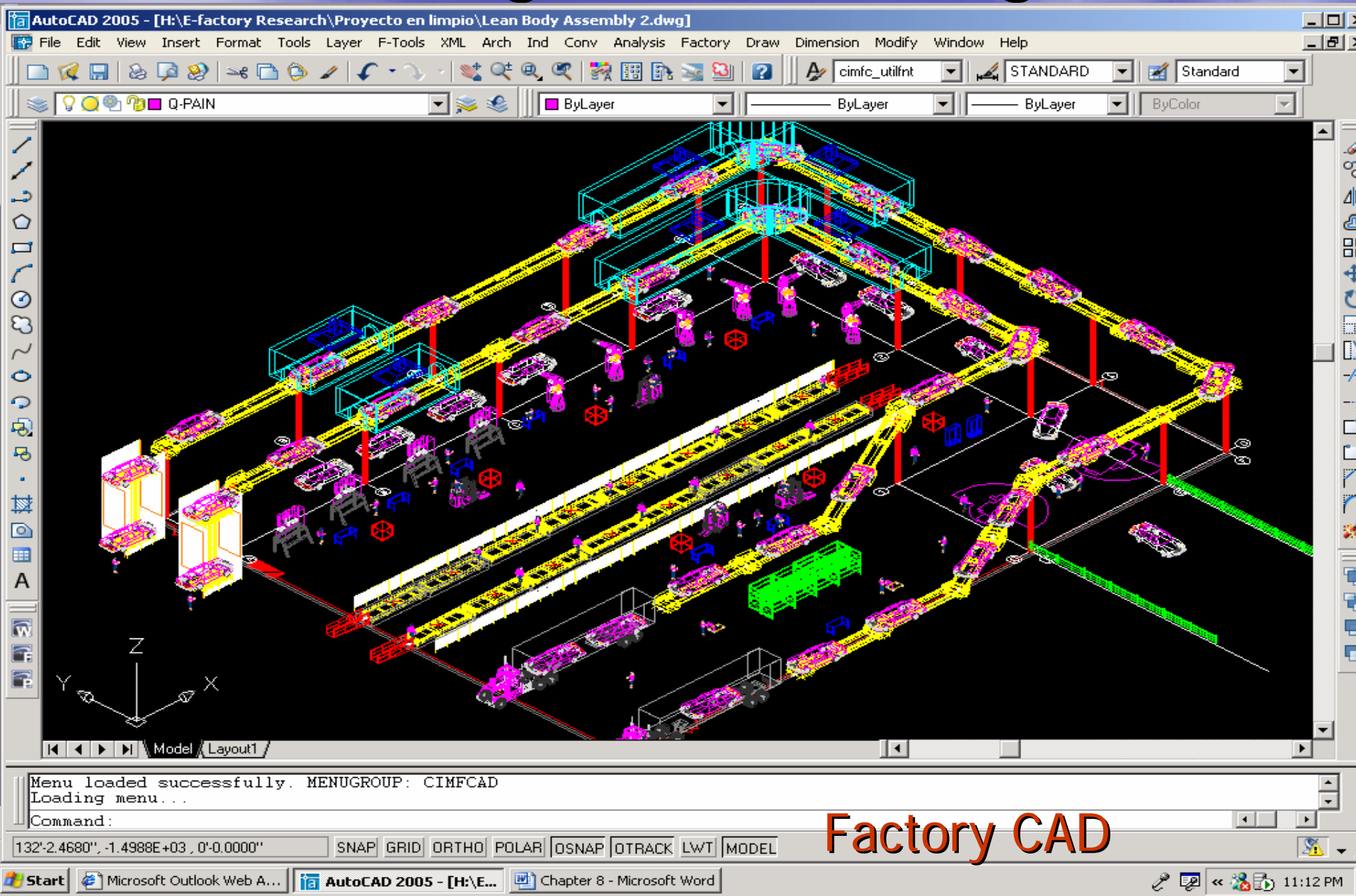
Creating "Lean" Designs



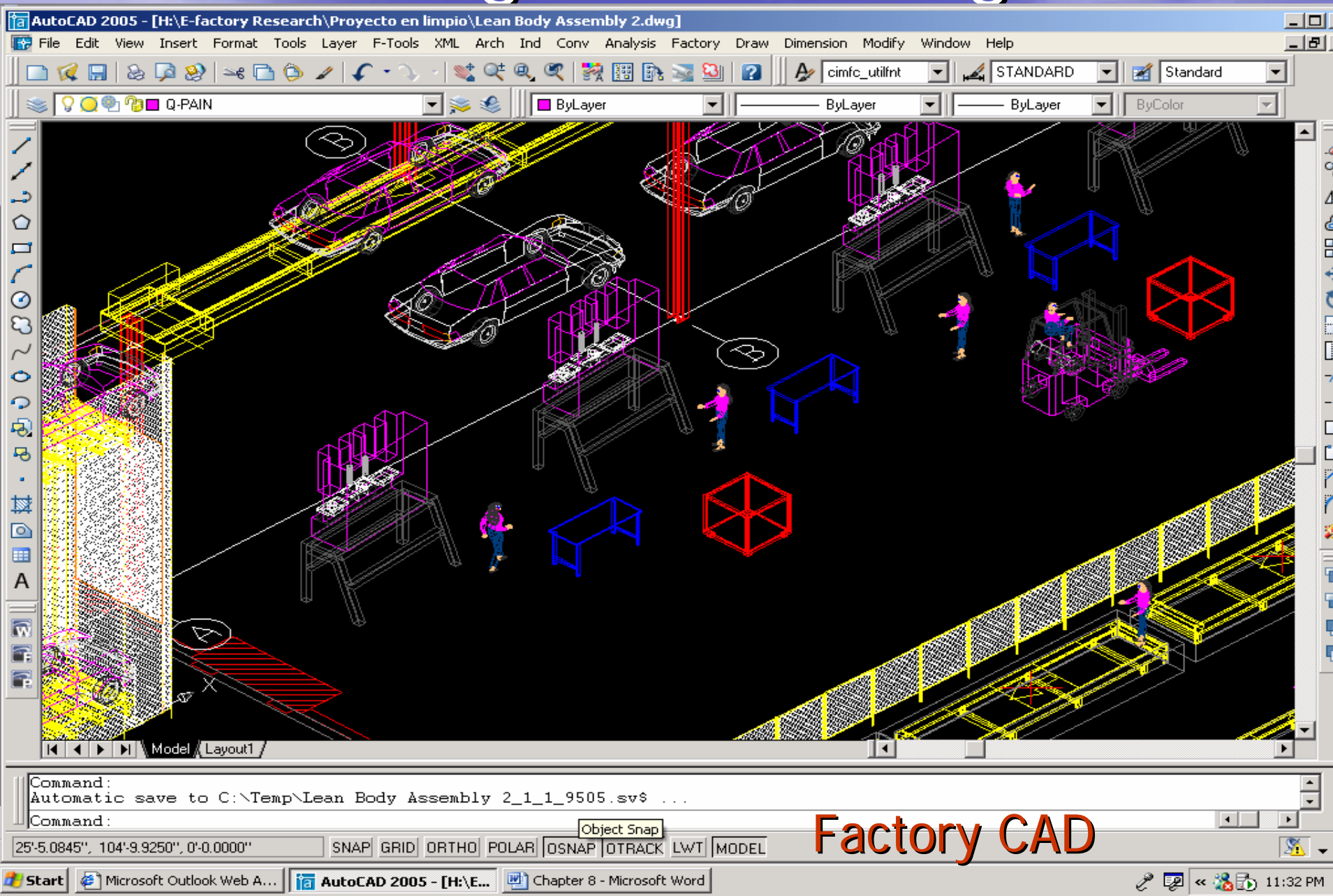
Creating "Lean" Designs



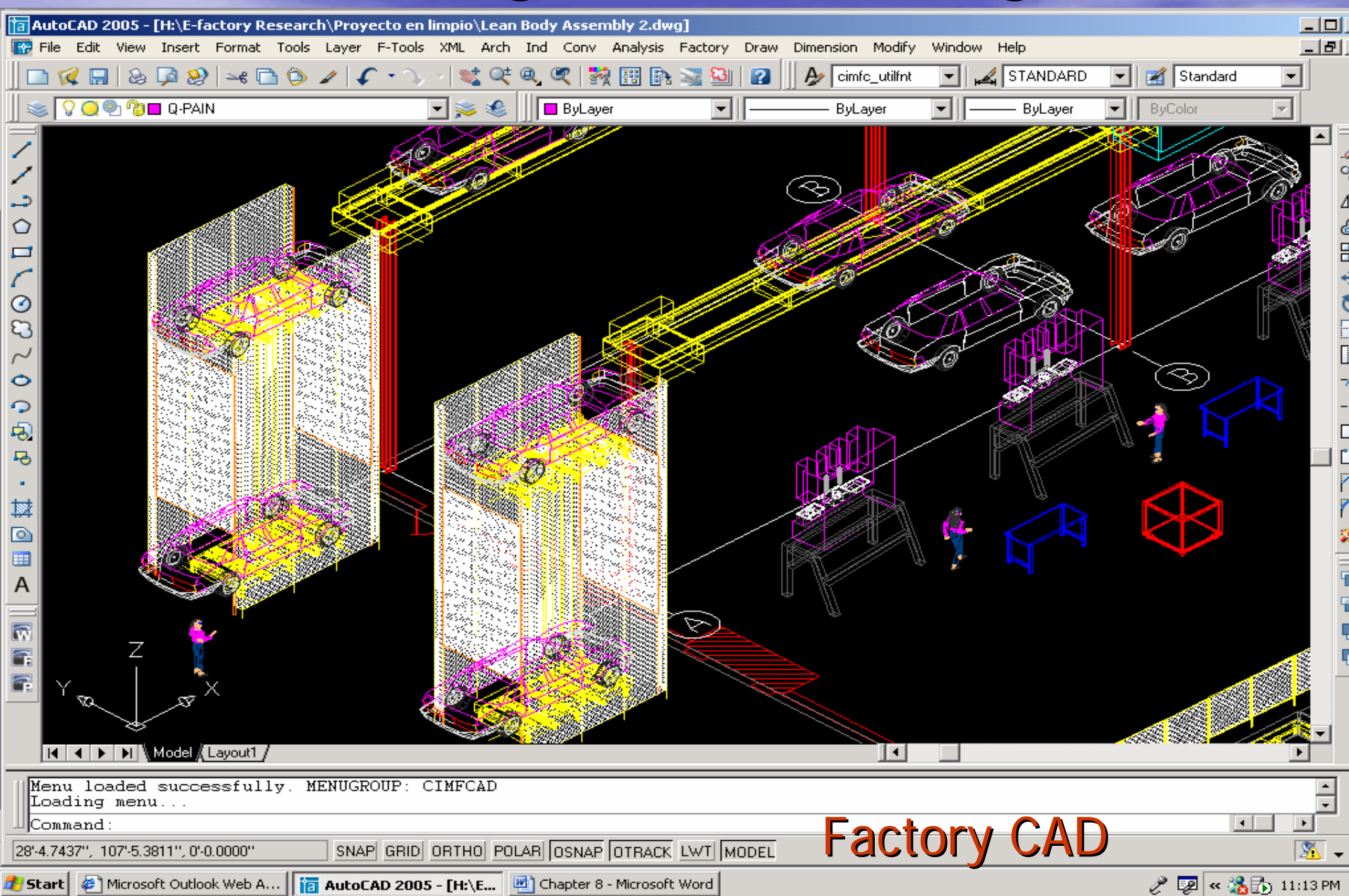
Creating "Lean" Designs



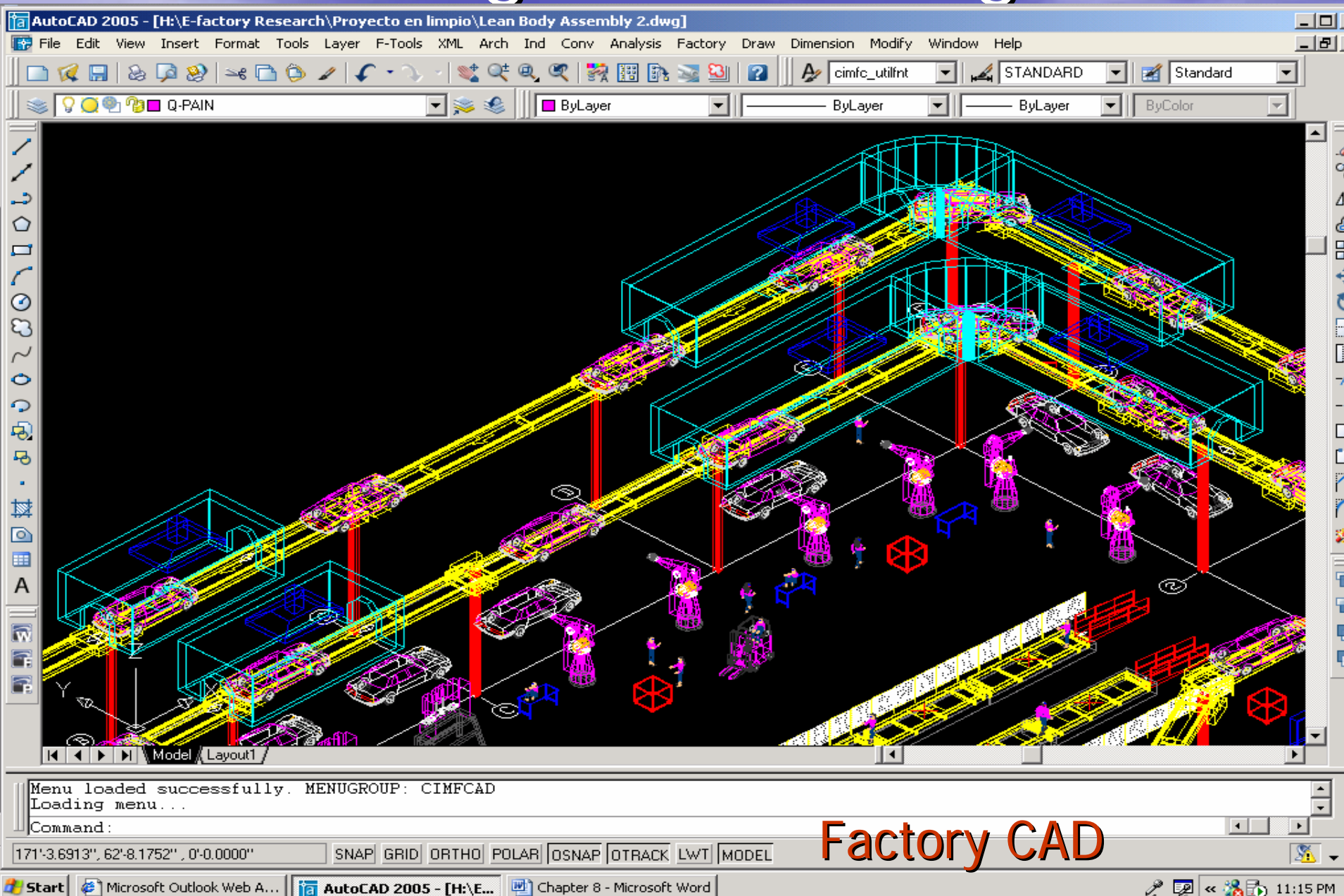
Creating "Lean" Designs



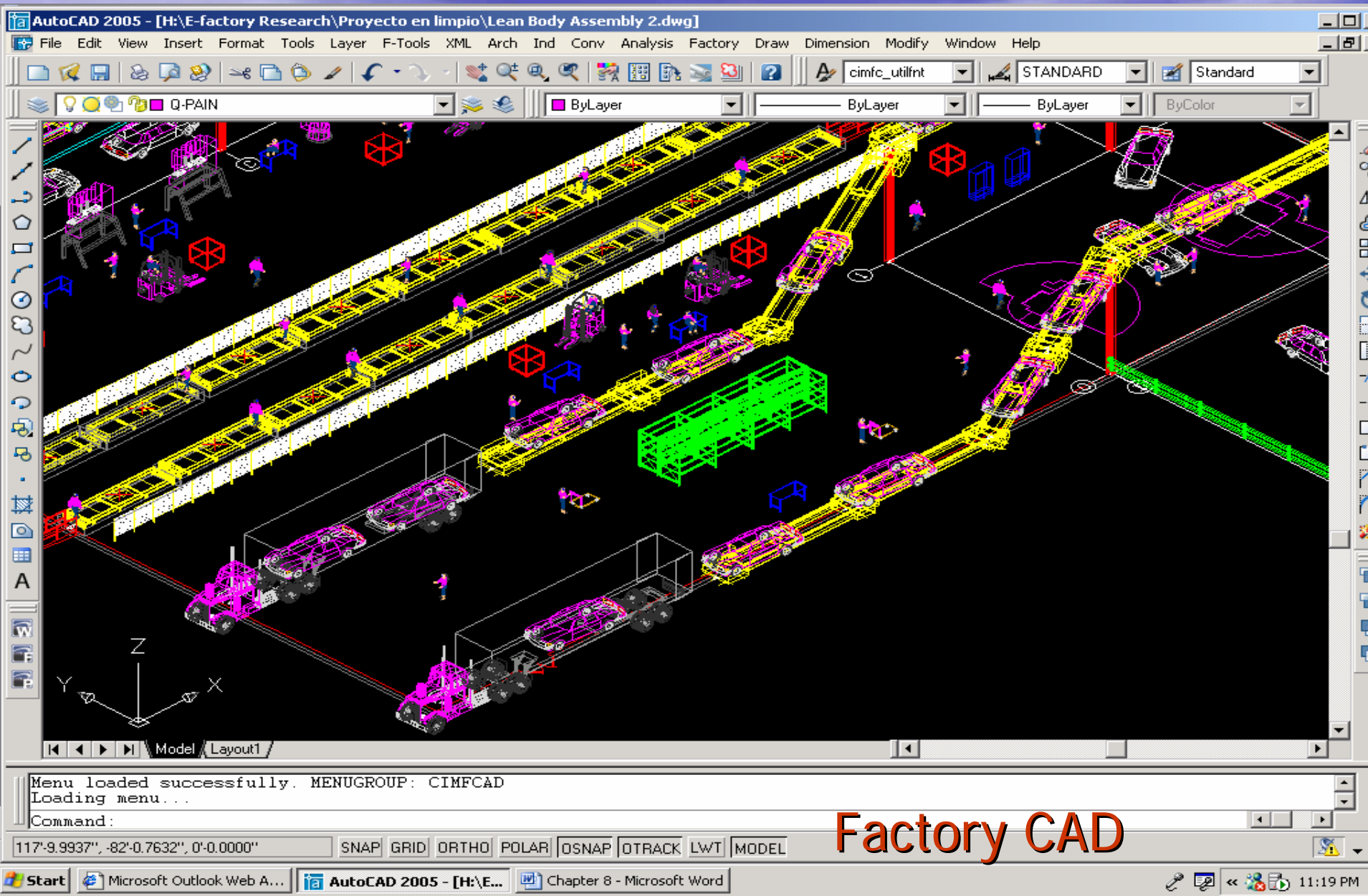
Creating "Lean" Designs



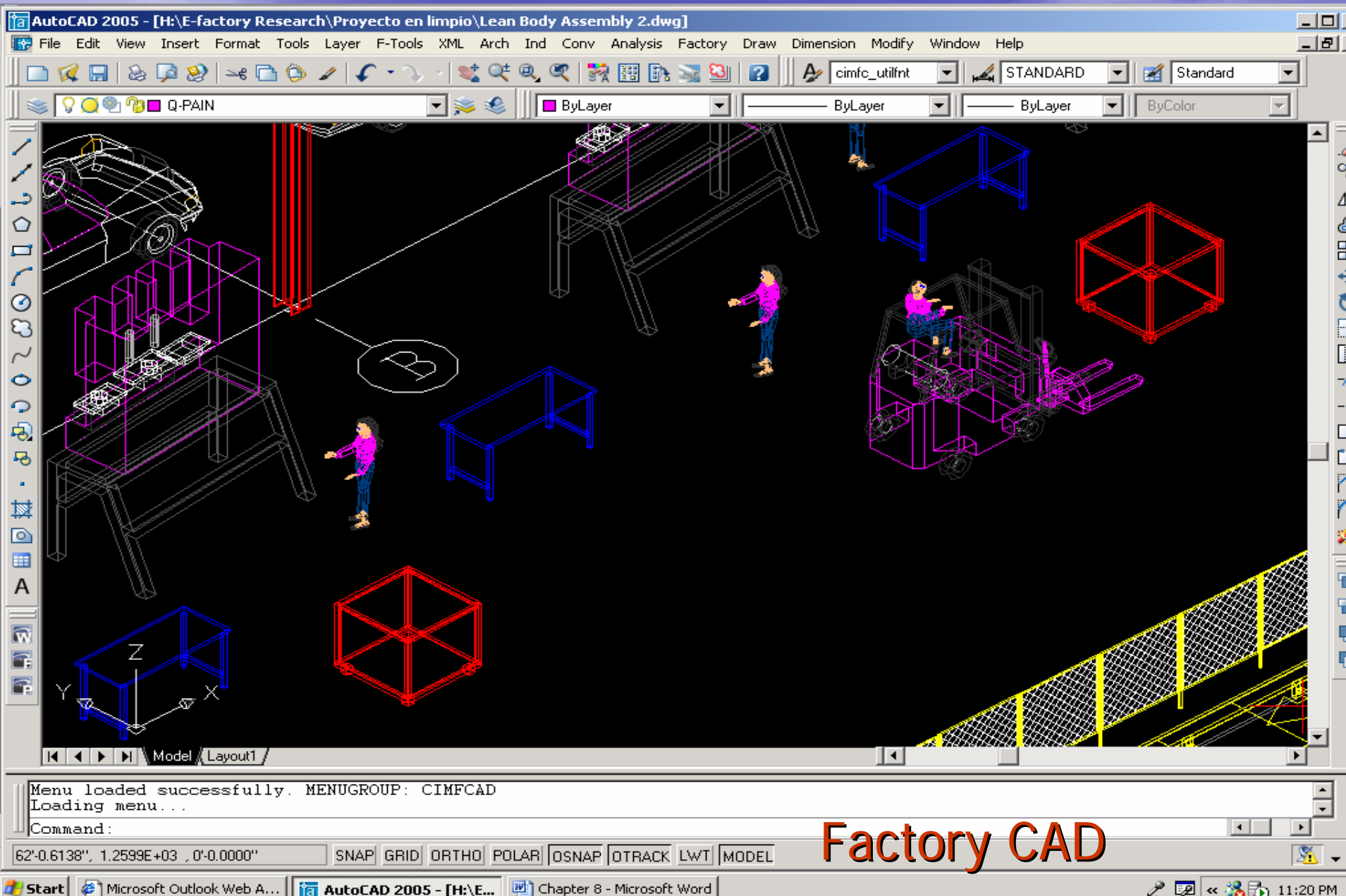
Creating "Lean" Designs



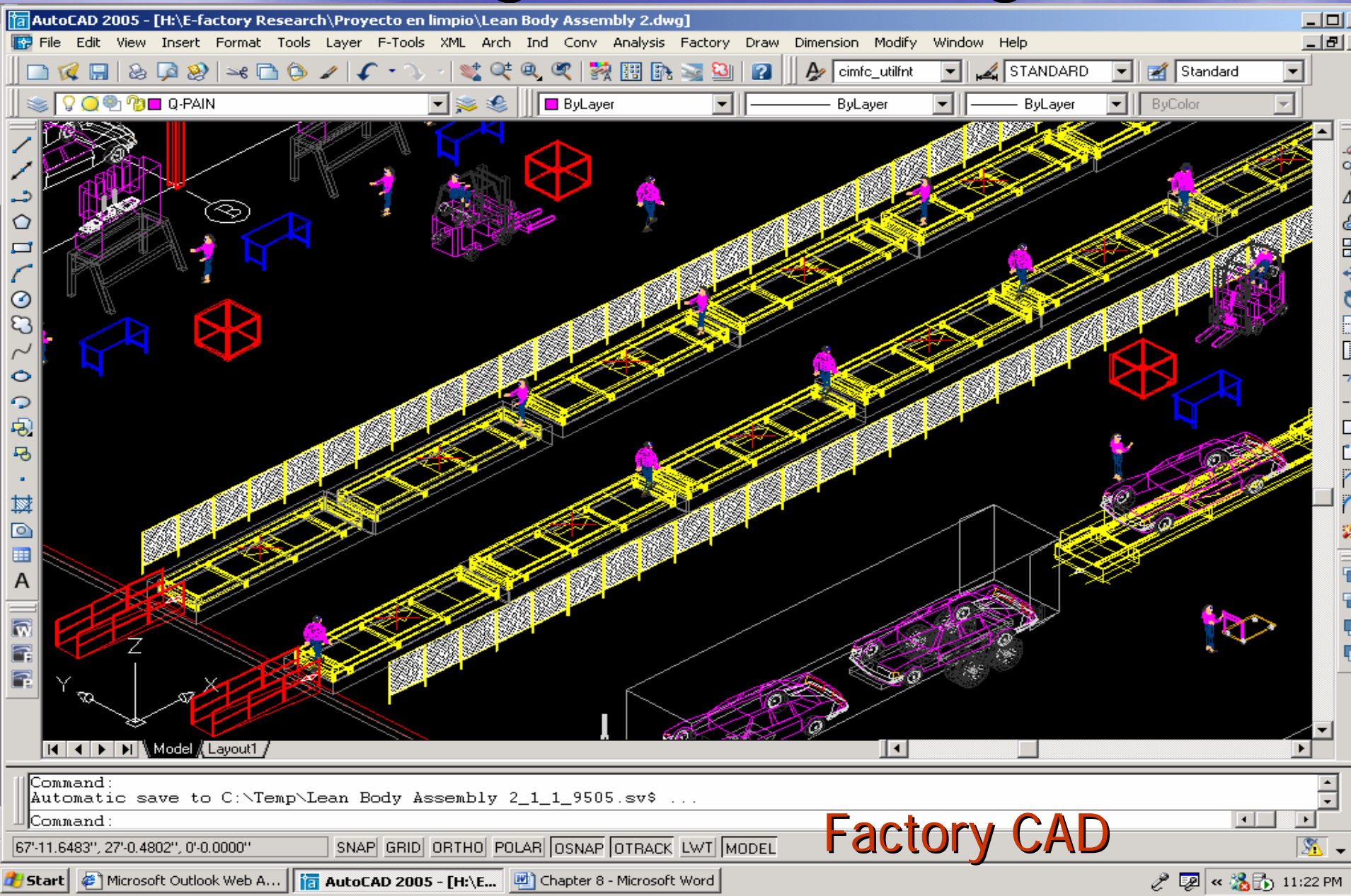
Creating "Lean" Designs



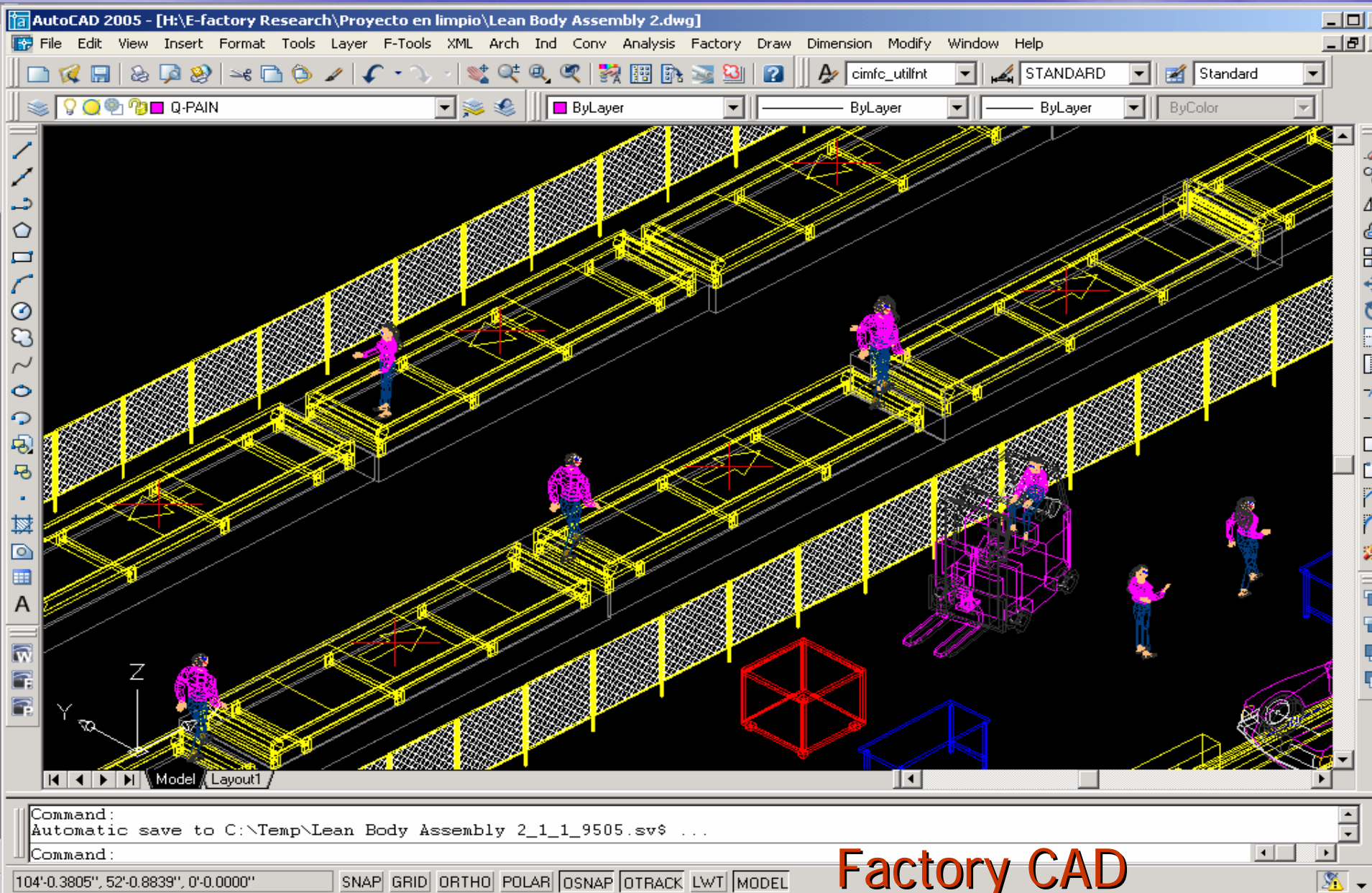
Creating "Lean" Designs



Creating "Lean" Designs



Creating "Lean" Designs



Summary of Conclusions

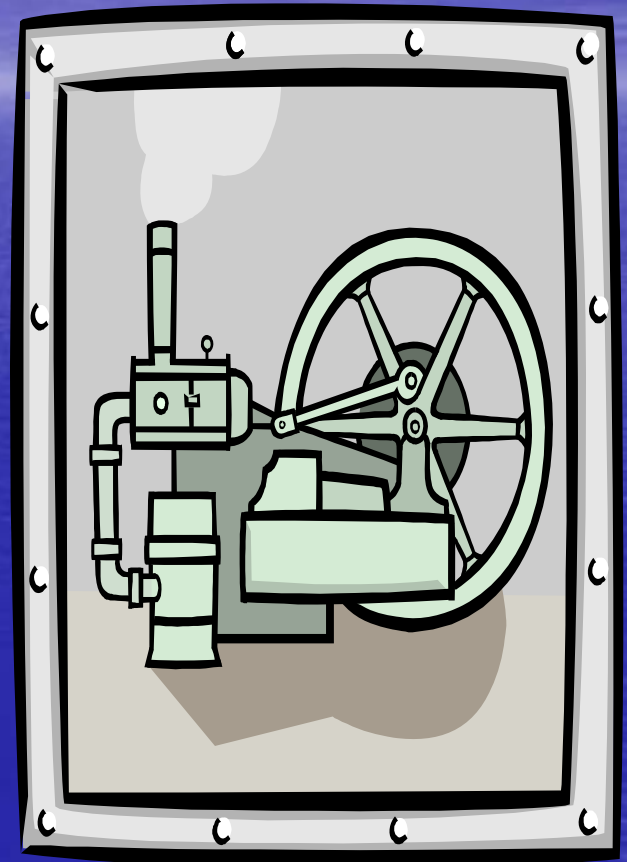
	Factory Plan	Factory CAD	Factory Flow	Factory OPT	Pro-Planner	Work-Place Planner
Goals and objectives of manufacturing						
facilities design and material handling		X				
Data sources for facilities design					X	
Path networks & activity graphs			X		X	
Time studies			X			X
Flow analysis			X			X
Activity relationship analysis	X			X		
Facility design & layouts		X				

Software Features – Factory CAD

- Sketching a Floor
- Sketching Grids
- Inserting Columns
- Creation of Objects
- Drawing Electrical Lines, labels and disconnect switches
- Drawing Pits
- Including a guard rail
- Sketching a container
- Drawing a rack
- Including generic tools
- Safety fences
- Sketching a mezzanine
- Robots
- Workstation Design
- Lean Designs
- Activity Relationships
- Flow Relationship Diagrams

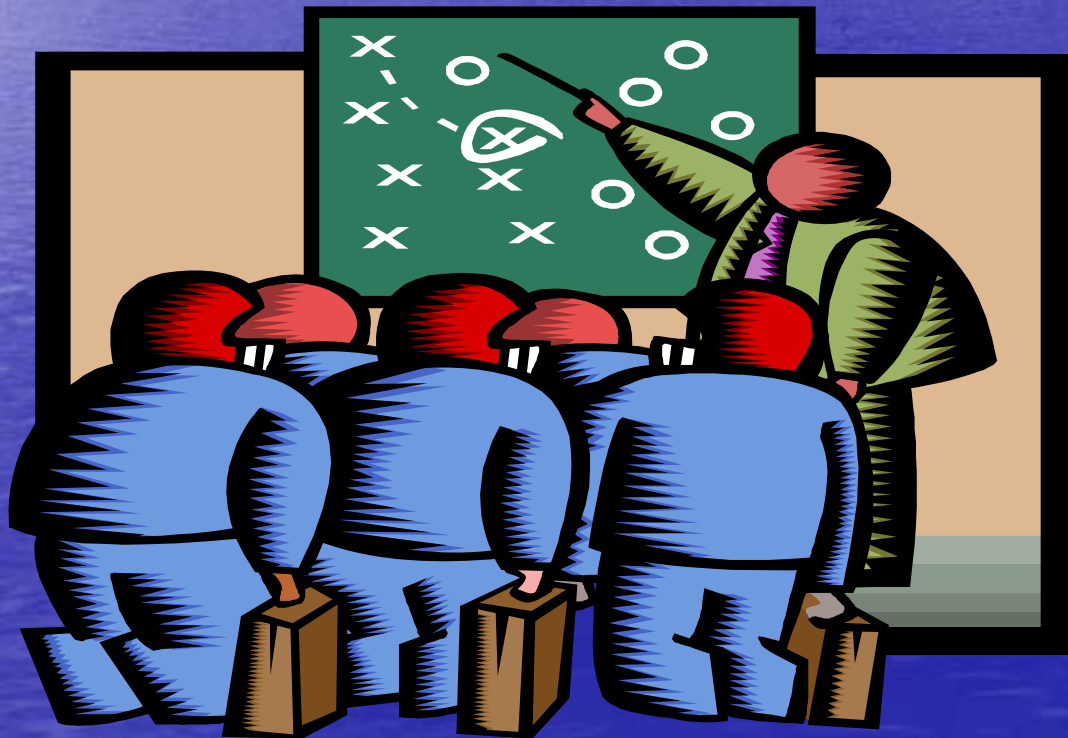
Software Features – Factory Flow

- Workstation Data
- Display of path networks
- Euclidean calculations
- Sketching Aisles
- Routing calculations
- Aisle congestion drawing



Software Features – Factory OPT

- Layouts
- Activity Relationships



Software Features – Pro-Planner

- Tree Structures
- Diagrams & Graphs
- Indented Bill of Materials
- Gantt-chart
- Pert-CPM chart
- Cycle times, bottleneck times and takt times
- Production rates calculations
- Resources display
- Work instructions display

Software Features – Work-Place Planner

- Distance and displacement calculations
- Time calculations
- Operator's speed
- Simulations
- Flow path calculations
- Congestion calculations
- Lean percentages display



Software Features – Flow Path Calculator

- Congestion calculations



Thank you

