

Utilizing Modern Computer Development Tools In Implementing The Resource Consumption Model for Process Design (RCM)

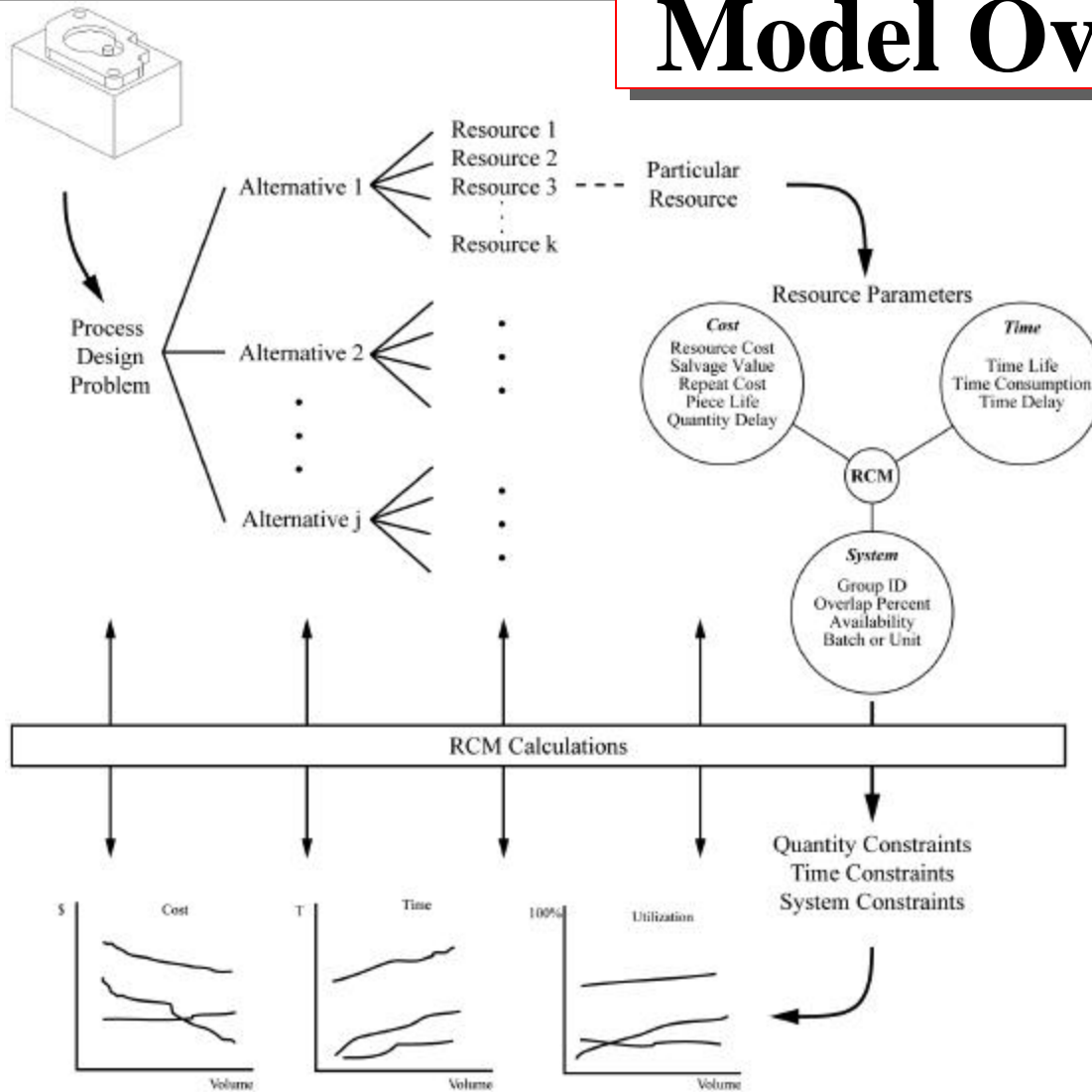
RCM Research Objectives

- **Better Analysis of Process Design Alternatives**
 - **Cost, Time, and Capacity**
 - **Economy of Scale**
 - **Compare alternatives**
 - **Greater detail for better understanding**
 - **Easy sensitivity analysis**

Other Methodologies

- **Engineering Economics**
- **Cost Accounting**
- **Break-even Analysis**
- **Cost Estimating**
- **“Design For” Methodologies**

Model Overview



Modern Computer Tools

- **Object-Based Programming**
- **Object-Oriented Programming**
- **Database Modeling and SQL**
- **Object Linking and Embedding (OLE)**

Object-Based Programming

- **Graphical User Interface (GUI)**
- **Object-Based versus Procedural-Based**
- **Visual Objects**
- **Products**
 - **Visual Basic**
 - **Visual Foxpro**
 - **Many Others**

Data Screen

Resource Cost Model for Process Design

Data Plotting Cost Time Utilization Summary

Projects

P_ID	Projects
P1	Which printer should be purchased?
P2	What process design is best for machining the gasket mold?
P3	Should manual or robotic process design be purchased for manufacturing part

Alternatives

Select?	A_ID	P_ID	Alternatives
<input checked="" type="checkbox"/>	A1	P1	Purchase Cannon
<input checked="" type="checkbox"/>	A3	P1	Purchase HP
<input checked="" type="checkbox"/>	A4	P1	Purchase Epson

Resources

Select?	P_ID	A_ID	R_ID	Resource	Cost	Salva	Pcs.	Time	Prod	Prod
<input checked="" type="checkbox"/>	P1	A1	R1	Printer C	370.00000	0000	0000	0000	.167	1
<input checked="" type="checkbox"/>	P1	A1	R2	Print Head	45.00000	0000	1500	0000	.167	1
<input checked="" type="checkbox"/>	P1	A1	R3	Ink Cartridge Refills	22.00000	0000	40	0000	.167	1
<input checked="" type="checkbox"/>	P1	A1	R4	Setup Labor (20 min	0.25000	0000	60	0170	.083	100
<input checked="" type="checkbox"/>	P1	A1	R5	Labor: Load Paper (0.20000	0000	60	0170	.033	30
<input checked="" type="checkbox"/>	P1	A1	R6	Labor: Replace Prin	0.20000	0000	60	0170	.033	1500
<input checked="" type="checkbox"/>	P1	A1	R7	Labor: Replace Cas	0.20000	0000	60	0170	.033	10

Exit

Plotting Screen

Resource Cost Model for Process Design [- [5 [X]

Data | **Plotting** | Cost | Time | Utilization | Summary

Project: **Which printer should be purchased?**

Alternative: **Purchase Cannon**

Resource: **Printer C**

Analyze data:
 Current selected
 All selected

Plot:
 Resources
 Alternatives

Calculate:
 Average Values
 Total Values

Graph Data Range:

<input type="text" value="0.01"/>	Cost Axis Maximum
<input type="text" value="0"/>	Cost Axis Minimum
<input type="text" value="1000"/>	Time Axis Maximum
<input type="text" value="0"/>	Time Axis Minimum
<input type="text" value="100"/>	Utilization Axis Maximum
<input type="text" value="0"/>	Utilization Axis Minimum
<input type="text" value="1000000"/>	Volume Axis Maximum
<input type="text" value="1"/>	Volume Axis Minimum

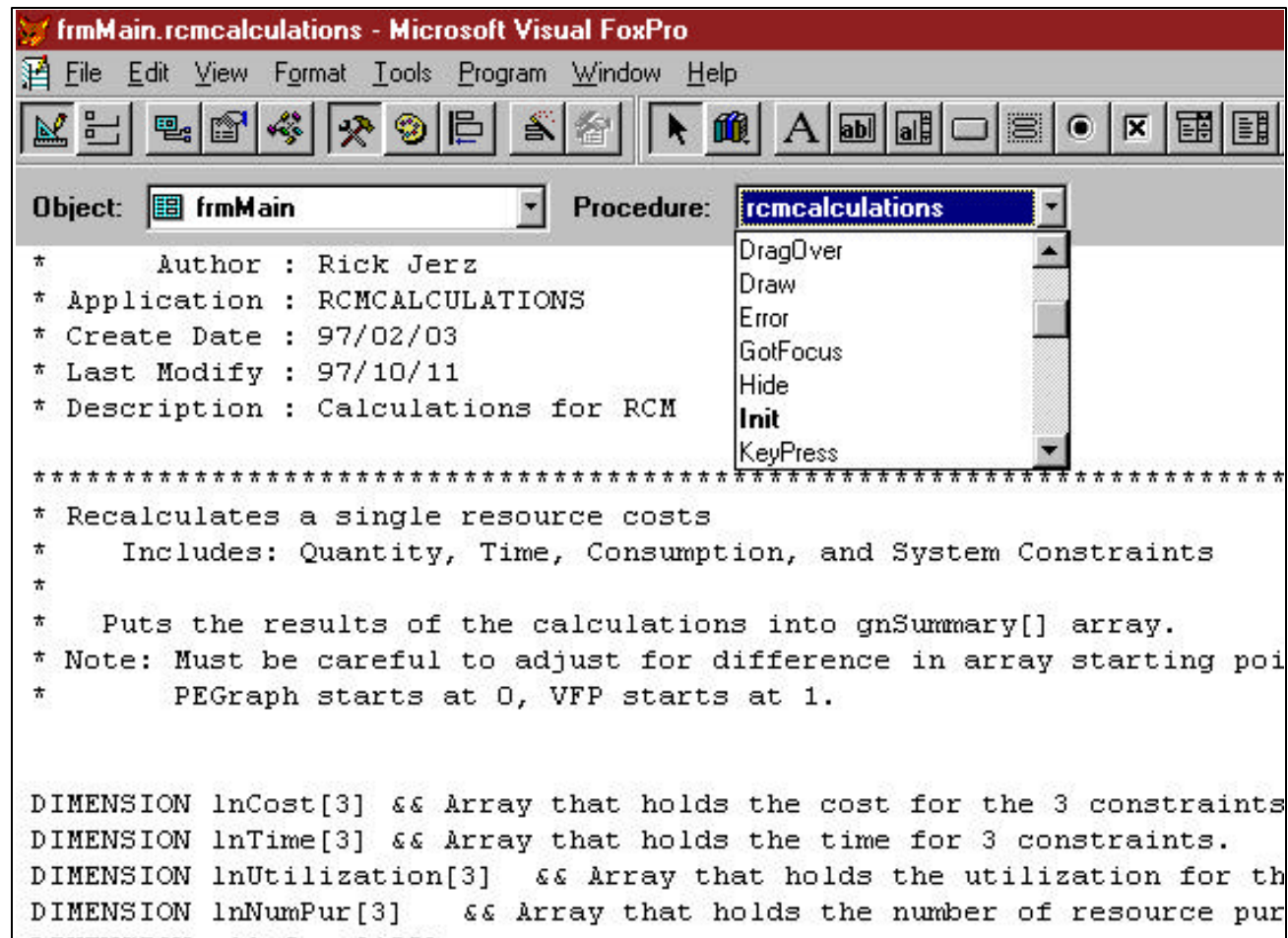
Show Quantity Constraint
 Show Time Constraint
 Show System Constraint

Hours in day:

Object-Oriented Programming

- **Different from Object Based**
- **OOP Components**
 - **Inheritance**
 - **Encapsulation**
 - **Polymorphism**
- **Advantage**
 - **Improved programming efficiency**
 - **Faster development time**
 - **Easier to understand and debug**

rcmcalculations Event



The screenshot shows the Microsoft Visual FoxPro IDE. The title bar reads "frmMain.rcmcalculations - Microsoft Visual FoxPro". The menu bar includes File, Edit, View, Format, Tools, Program, Window, and Help. The toolbar contains various icons for development. The "Object:" dropdown is set to "frmMain" and the "Procedure:" dropdown is set to "rcmcalculations". A list of events is shown in a dropdown menu, with "Init" selected. The main text area contains the following code:

```
* Author : Rick Jerz
* Application : RCMCALCULATIONS
* Create Date : 97/02/03
* Last Modify : 97/10/11
* Description : Calculations for RCM

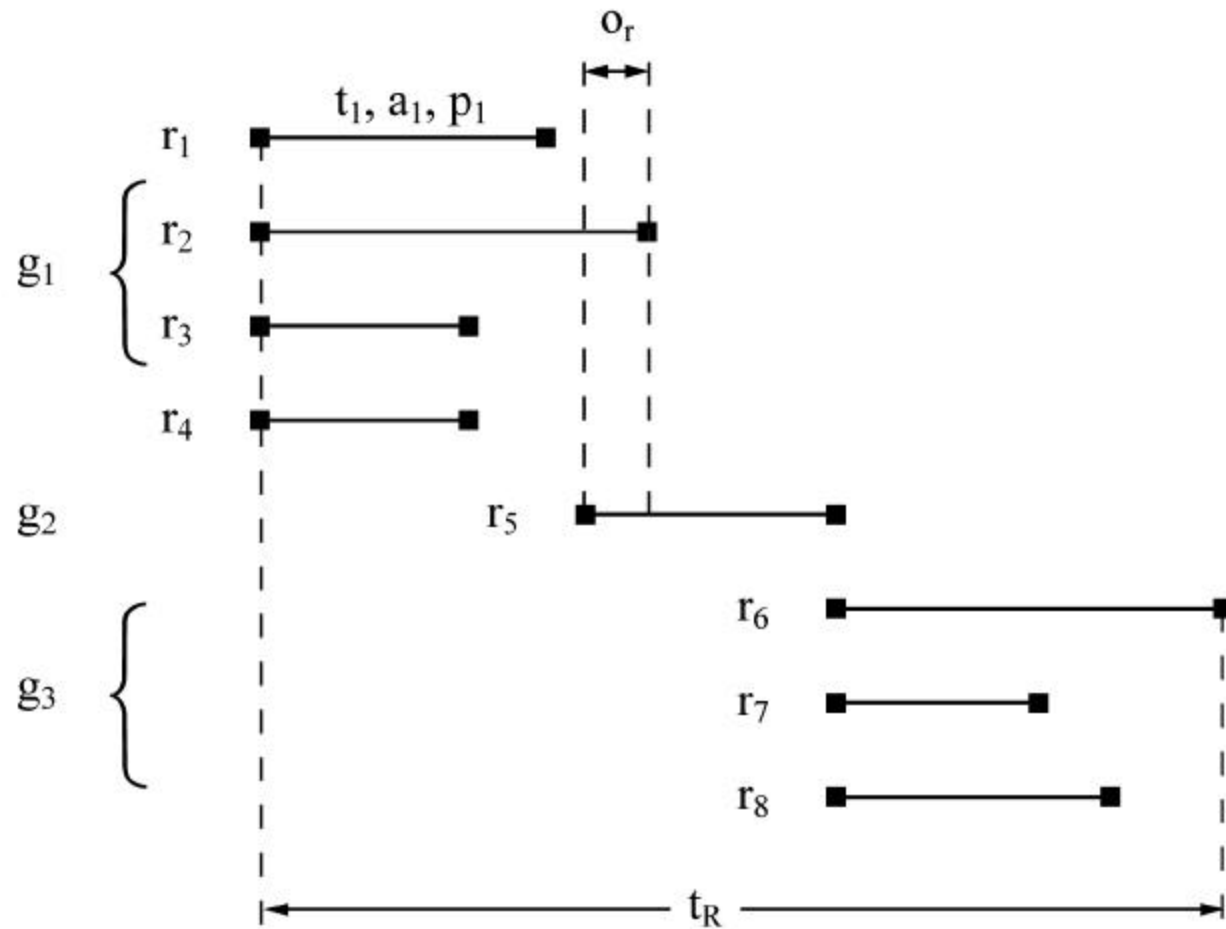
*****
* Recalculates a single resource costs
* Includes: Quantity, Time, Consumption, and System Constraints
*
* Puts the results of the calculations into gnSummary[] array.
* Note: Must be careful to adjust for difference in array starting poi
* PEGraph starts at 0, VFP starts at 1.

DIMENSION lnCost[3]  && Array that holds the cost for the 3 constraints
DIMENSION lnTime[3]  && Array that holds the time for 3 constraints.
DIMENSION lnUtilization[3]  && Array that holds the utilization for th
DIMENSION lnNumPur[3]  && Array that holds the number of resource pur
```

Database Modeling & SQL

- **Databases contain company information**
- **SQL is the standard access method**
- **Data in RCM is contained in a database**

System Time Calculations



SQL Select

```
*****
* Calculate the overall controlling cycle time accounting for all overlaps.
* (to be used for system constraint calculations.

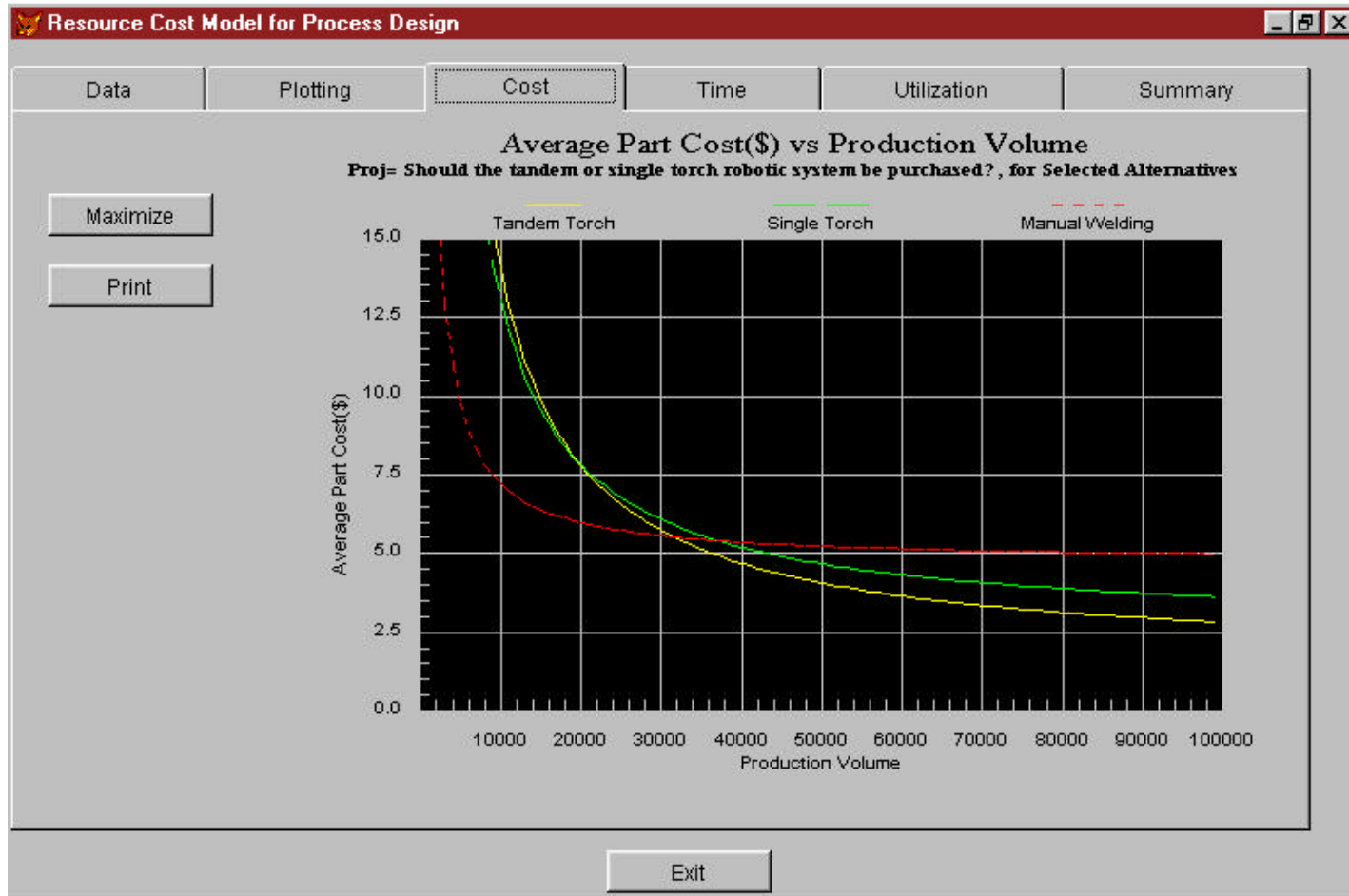
* Fix for when only one setup resource is being considered. (Might need to double check logi
* lnMinAvailability must be defined.
*lnMinAvailability = 1

* First, get the overall time for groups in series without overlap
SELECT MAX(nresprodtime*(1-nrespctover)/nresprodpcs) as ControlTime;
FROM rcm!resources;
WHERE Resources.cprojid = lcCurrentProjectID;
      AND Resources.caltid = lcCurrentAlternativeID;
GROUP BY Resources.ngroup;
into cursor lnControlTime
* Combine the controlling sequence time and the largest individual resource time for an alte
select sum(controlTime);
from lnControlTime;
union;
SELECT MAX(Resources.nresprodtime/nresprodpcs);
FROM rcm!resources;
WHERE Resources.cprojid = lcCurrentProjectID;
      AND Resources.caltid = lcCurrentAlternativeID;
into cursor lnControlTime
```

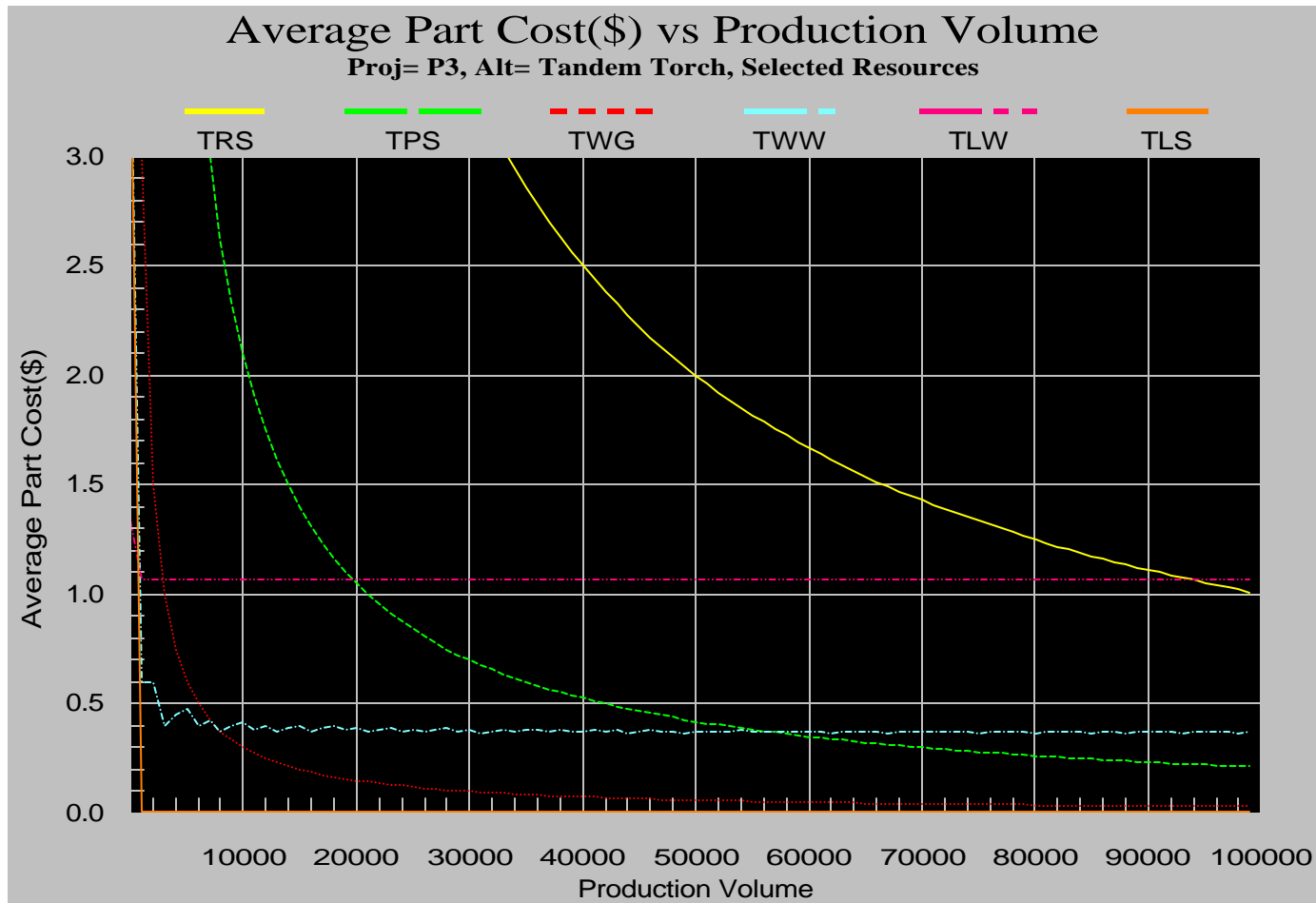
Object Linking & Embedding

- **RCM - Graphing Need**
- **Third-party objects**
- **Advantages**
 - **Faster development**
 - **Better quality**

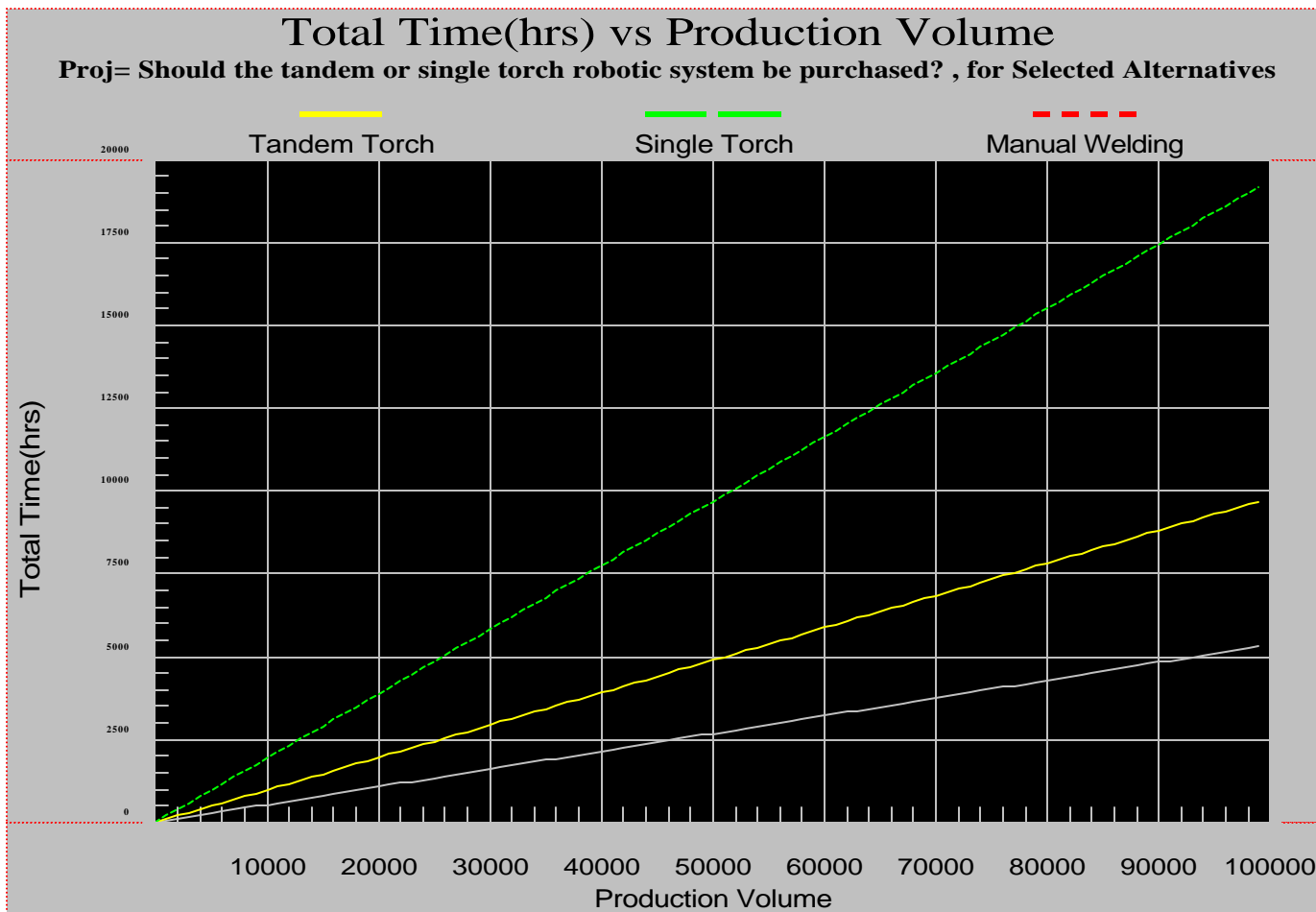
Alternative Comparison



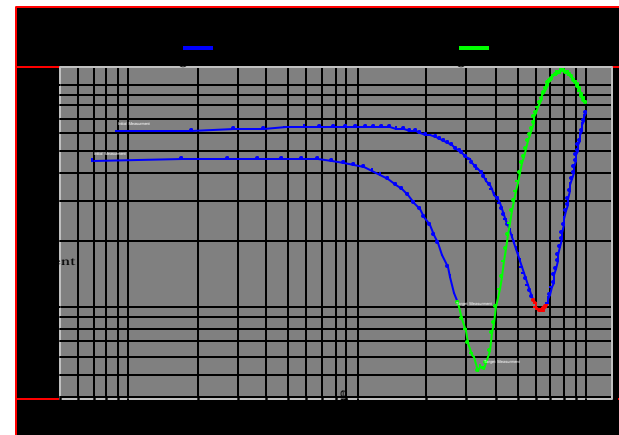
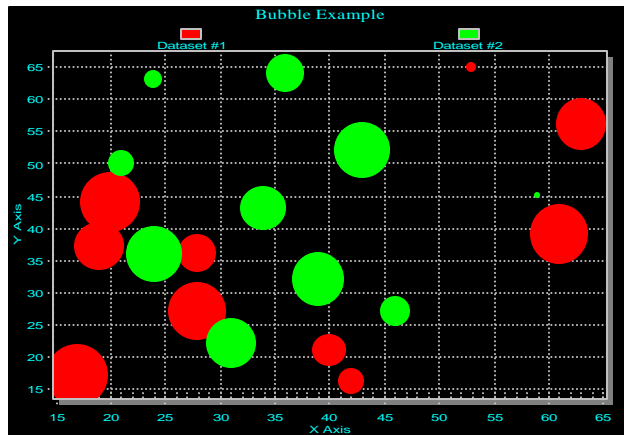
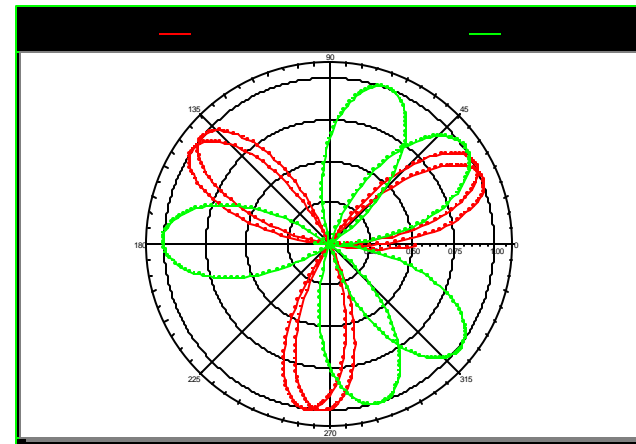
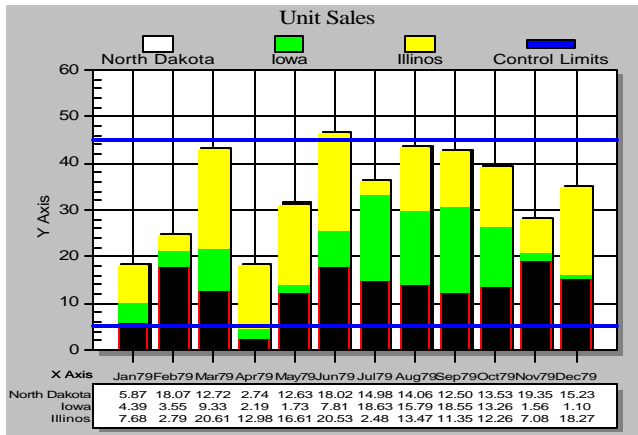
Resources Selected



Alternatives Time Comparison



Gigasoft ProEssentials



Conclusions

- **RCM modeling very difficult w/o tools**
- **Graphic environment standard**
- **OOP improves programming efficiency**
- **Databases understanding is valuable**
- **Third-party controls are important**
- **IE's command of tools provides research advantages**