

# *Supply Chain Simulator:* *A Partnership for Supply Chain Innovation*

MIT Center for Transportation Studies/  
Ernst & Young

10 December 1998

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Dynamic Strategic Planning

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## *Vision*

- A laboratory based simulation environment where corporations and students alike can experiment with various supply chain configurations.
- Users would be able to model complex interdependencies between suppliers, customers, and other channel partners in a faster, less expensive way.

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## Goals and Objectives



- To expedite supply chain best practice adoption
- To build on the foundation of credibility and expertise enjoyed by MIT and E&Y
- To foster stronger relationships with corporations
- To enhance research tools available to students and faculty
- To generate profits to support other endeavors

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## The Lab Concept



- A room housing simulation computers staffed by technicians and supply chain experts
- Three different lab sizes were defined and costed:
  - Plant A: 4 Computers/8,000 Workstation Hours
  - Plant B: 10 Computers/20,000 Workstation Hours
  - Plant C: 20 Computers/40,000 Workstation Hours
  - $(40 \text{ hrs/wk} \times 50 \text{ weeks/yr} \times \# \text{ of Computers} = \text{WsHrs})$
- Our steering committee felt anything larger would be unrealistic.

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## Recommended Strategy



- **We recommend starting with a small lab (8,000 WsHrs) and building flexibility into the system.**
- The expected NPV for this approach is \$2.7 MM
  - Using discount rate of 20%
- The initial cost will be:
  - \$450,000 investment for start-up and development
  - \$450,000 estimated annual fixed costs
  - \$75 /Workstation-Hour variable costs

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## Strategic Options



- After 3 years, we will re-evaluate market demand and select from the following options:
  - Expand Capacity
  - Maintain Capacity
  - Contract Capacity
  - Cease Operations

*(The lab has been designed to allow flexibility in expansion or contraction with leased equipment, flexible office space and temporary employees)*

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## Lab Plans: Revenue Assumptions

- Student lab time is free
- Corporate client lab time is charged at \$250 per workstation per hour
- Potential Revenue = Workstation Hours x \$250
  - Plant A = \$2 million/year
  - Plant B = \$5 million/year
  - Plant C = \$10 million/year
  - Assumes 100% Corporate use - Management can allocate hours to student use as it sees fit

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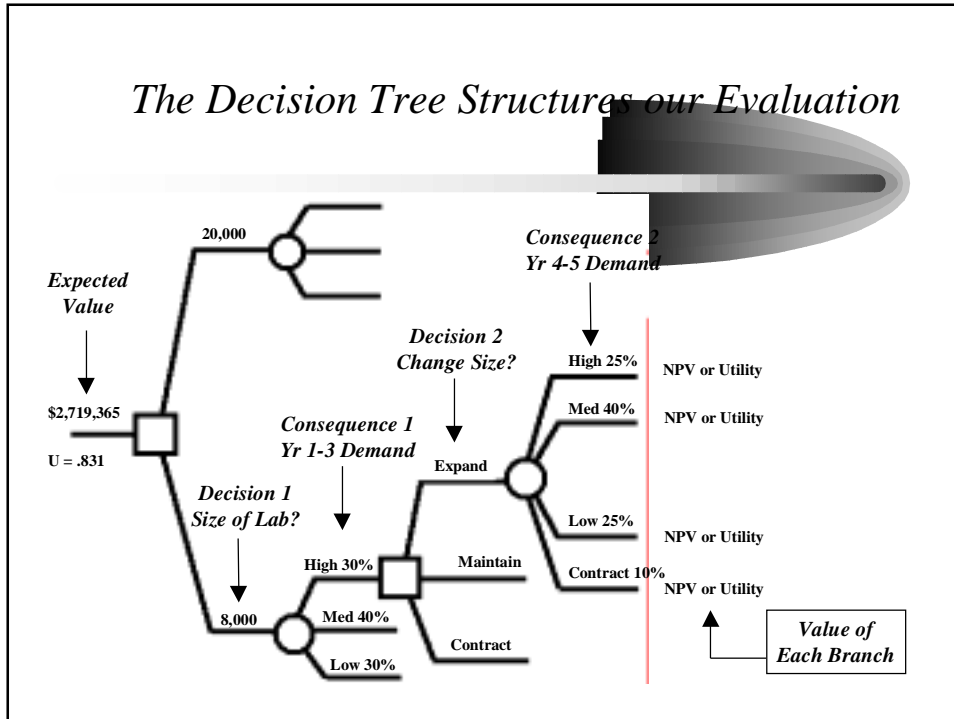
## Laboratory Cost Assumptions

Max possible return/result of effort	Units Workstation Hrs (WsHrs)	Level of Effort (Processing Capacity)				
		Plant A Low 8000	Plant B Medium 20000	Plant C High 40000		
		1	2	3		
<b>Variable Costs (cost per result)</b>						
Operators	\$/WsHr	\$25.00	\$25.00	\$25.00		
Variable Overhead	\$/WsHr	\$12.50	\$12.50	\$12.50		
Property, Plant & Equipment	\$/WsHr	\$12.50	\$12.50	\$12.50		
Subject Matter Experts	\$/WsHr	\$25.00	\$20.00	\$20.00		
Subtotal - Cost per unit result	\$/WsHr	\$75.00	\$70.00	\$70.00		
<b>Annual Costs (Total cost/year)</b>						
Rent and Space	\$/yr	\$50,000	\$150,000	\$250,000		
Salaried Employees	\$/yr	\$150,000	\$350,000	\$500,000		
Equipment and Materials	\$/yr	\$50,000	\$250,000	\$500,000		
Research and Development	\$/yr	\$200,000	\$300,000	\$400,000		
Subtotal - Annual Costs	\$/yr	\$450,000	\$1,050,000	\$1,650,000		
<b>Fixed Costs (investment)</b>						
Initial Planning and Design	\$	\$50,000	\$100,000	\$250,000		
Development and Start Up	\$	\$300,000	\$500,000	\$1,500,000		
Marketing Analysis and Introduction	\$	\$100,000	\$200,000	\$300,000		
Subtotal - Investment Costs	\$	\$450,000	\$800,000	\$2,050,000		
Amortized Investment Cost	0.474725	\$213,626	\$379,780	\$973,187		
Minimum unit variable cost		\$131.25	\$122.50	\$111.25		
					Capacity (max possible output)	8,000
					Annual Production/Sales	8,000
					Actual Unit Variable Cost	\$131.25
					Actual Amortized Investment Cost	\$26.70
					Actual Total Unit Cost	\$157.95
					Costing Assumptions	
					Years to Amortize Investment	3
					Opportunity Cost of Capital	0.2

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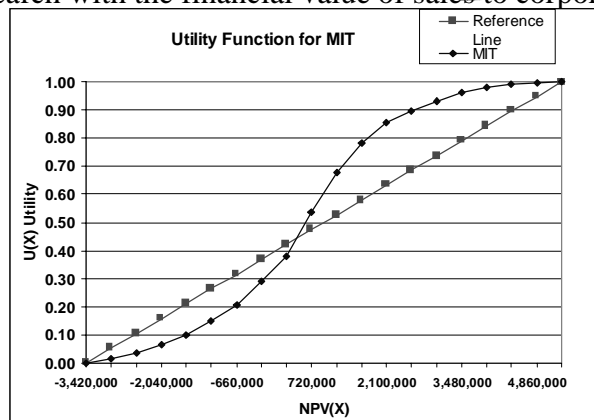
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### The Decision Tree Structures our Evaluation



### Utility: Driven by more than \$

- This utility curve combines the intrinsic values of prestige and research with the financial value of sales to corporations.



### NPV and Utility Decision Tree Results

- NPV Analysis supports:
  - Decision 1 = Plant A - 8,000 WsHrs
  - If Cons 1 = High, Decision 2 = Expand to 40,000
  - If Cons 1 = Med, Decision 2 = Expand to 20,000
  - If Cons 1 = Low, Decision 2 = Maintain at 8,000
- Utility Analysis supports the same thing, although:
  - If Decision 1 = Plant B - 20,000 WsHrs
  - And Cons 1 = Low, Decision 2 Changes from “Reduce to 8,000” to “Stay at 20,000”
    - This is because of the intrinsic prestige and research value captured only in the Utility tree, which assigns positive utility values to negative NPVs

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### Sensitivity of NPV to discount rate and price:

Price above \$150 produces positive net income

	\$ 150	\$ 175	\$ 200	\$ 225	\$ 250	\$ 275
15%	(\$399,864)	\$373,298	\$1,298,038	\$2,228,430	\$3,158,823	\$4,120,892
16%	(\$395,109)	\$357,135	\$1,255,576	\$2,159,456	\$3,063,335	\$3,997,248
17%	(\$390,450)	\$341,710	\$1,214,933	\$2,093,390	\$2,971,846	\$3,878,786
18%	(\$385,885)	\$326,985	\$1,176,014	\$2,030,081	\$2,884,149	\$3,765,236
19%	(\$381,412)	\$312,921	\$1,138,729	\$1,969,389	\$2,800,050	\$3,656,347
20%	(\$377,028)	\$299,485	\$1,102,995	\$1,911,180	\$2,719,365	\$3,551,883
21%	(\$372,730)	\$286,644	\$1,068,734	\$1,855,329	\$2,641,925	\$3,451,620
22%	(\$368,518)	\$274,366	\$1,035,871	\$1,801,719	\$2,567,567	\$3,355,349
23%	(\$364,388)	\$262,623	\$1,004,336	\$1,750,238	\$2,496,139	\$3,262,872
24%	(\$360,339)	\$251,387	\$974,064	\$1,700,782	\$2,427,499	\$3,174,005
25%	(\$356,368)	\$240,633	\$944,993	\$1,653,252	\$2,361,511	\$3,088,572

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*Two options to mitigate risk:*

- SlyCor has offered a Put Option to buy our software
  - Pay \$500,000 today for right to sell for \$3.3 MM in 5 yrs
  - -\$3.3 MM is our worst-case NPV - Put is designed to cover us
  - SlyCor would gain desired ownership of our expected software
  - We would gain the ability to cease operations without loss
  - \$2.7 MM is our current Expected Value NPV
  - Black Scholes analysis values the put option at \$638,436
- We recommend buying the put option

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*The second option is an alternate product design:*

- Option to Incorporate Internet functionality in software
  - Internet functionality would allow an alternate form of expansion to our current capacity assumptions
  - Corporate customers could use the simulator remotely
  - Instead of a fixed 3 year decision point, we would have the ability to expand or contract at any time
  - Increases Net Present Value by expanding capacity
  - Substantial investment would be required to configure the software for Internet access
  - Next step is to quantify this investment

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## Conclusions/Next Steps



- We recommend proceeding with Plant A.
  - \$900,000 for investment and first year fixed costs
- We recommend purchasing the SlyCor put option.
  - \$500,000 for 3rd year strike price of \$3.3 MM
- Subject to corporate objectives, the Internet option could be explored further.

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