System Dynamics '96

Using System Dynamics to Determine the Return on Investment in Engineering Information Technology

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The CEO Questions

- **How much should we be spending on IS?**
- **What ROI should we accept for IT projects?**
- **How do we measure the value of IS?**
- **Are we getting value from our investment in IS?**

Questions about the Questions

- Is there such a thing as an IT project?
  - A: no, except for infrastructure
- Who should answer the questions?
  - A: **not** the CIO
- Are firms in the business of securing an ROI in IT?
  - A: no; firms use IT to enable the processes which are the manifestation of their strategies
- Why use capital investment techniques, when capital is often the smallest part of the costs?
  - A: because ROI is what CFO's know
- When will the ROI questions stop?
  - A: when there's something better

The ROI Question

"What is our ROI in IT?", asks the CEO of the CIO

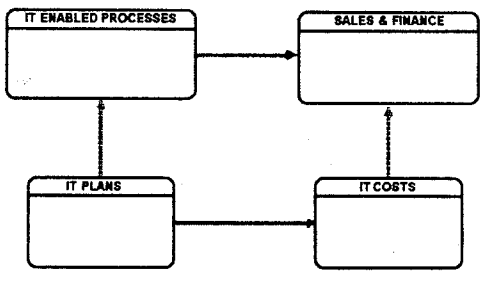
The CIO options include:

- **Lying - "It's 12%"**
- **Diverting - "good question, let's get the guy who did the ROI for the corporate jet in on this"**
- **Technobabbling - "Well, we measure function points per fortnight"**
- **Last resort - reason, but it's probably too late for that.**

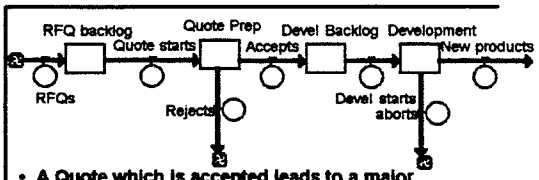
System Dynamics-Based Simulation vs. ROI

- **Major electronics company.**
- **Central IS undertook major project to install CAD, CAM, KBE etc.. in the engineering departments of their many lines of business.**
- **Encountered resistance on roll out.**
- **Sponsored authors to "develop a general method of demonstrating the value of the engineering ITs (the EITs)".**
- **Based on attitudes expressed in prior slides, a System Dynamics approach was proposed to demonstrate:**
  - **specific effect of EITs on the engineering operations.**
  - **effect of the changes in operations on sales and income.**
  - **effect of changed operations on the business in general.**

A Project to Introduce IT to Engineering Development



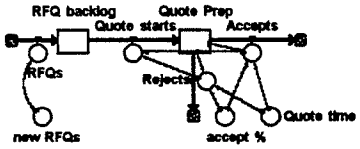
Main Process



- A Quote which is accepted leads to a major development project.
- Development Phase is followed by long Introduction Phase.
- Whole process duplicated for modifications to existing product.

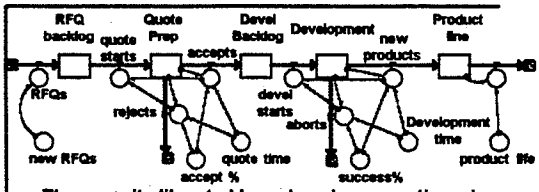
The model presented here is abstracted from a much more detailed "full" model, but contains all the significant elements and when run with actual data produces output of the same form and magnitude.

Dynamics of the Quote Preparation Phase



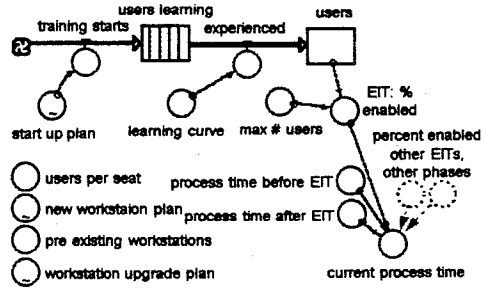
- Another quote starts when one is completed.
- Quote Preparation and the other major phases have ~10 subprocesses affected by one or more EITs.
- The main effect of the EITs is to reduce the duration of the subprocesses that aggregate to Quote Time.
- Quote Time is calculated in the IT Plans sector.
- 'Reservoir' form of levels (stocks) allows for analytical setting of initial values (= no equilibration period).

Two Phases



- The capacity liberated by reduced process times is used to generate more quotes and undertake more development projects - more realistic than assuming headcount will be reduced.
- Model assumes the firm will respond to RFQ's that it now ignores.
- At this point, *accept%*, *success%* and *new RFQs* are independent variables.

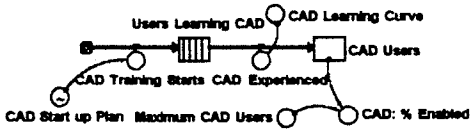
An IT Plan (schedule) - 1 of 4 phases*, 1 of 6 ITs**



* Concept, Development, Introduction and Modification

** CAD, CAM, KBE etc.

Scheduling the Introduction of One Technology

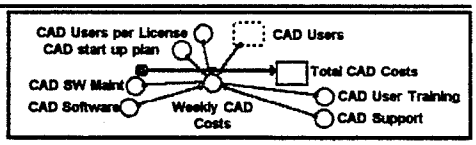


- Key input is the CAD Start up Plan - eg. users per week for weeks 26 to 78.
- Use of Maximum CAD Users provides a measure of the progress of the project. - CAD:% Enabled. This in turn leads to demonstrating the benefits of the project as it progresses

Scenarios

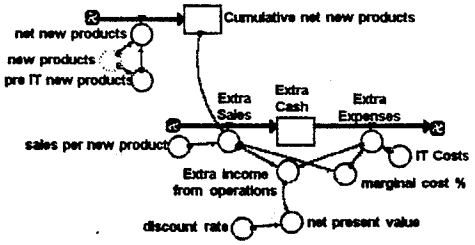
- In the full model, the schedule for each of 6 EITs in each of 4 phases (Quoting, Development, Introduction and Modification) can be independently varied
  - i.e.. *CAD(Quote) % Enabled* and *CAD(Development) % Enabled* are independent
- For realistic combinations of schedules the impact on the durations of the 4 phases was calculated (off-line) and the resultant scenarios evaluated
- This allowed examination of the questions:
  - "where should we start?"
  - "how much better is half-a-loaf than no bread?"

The IT Plan and its Cost



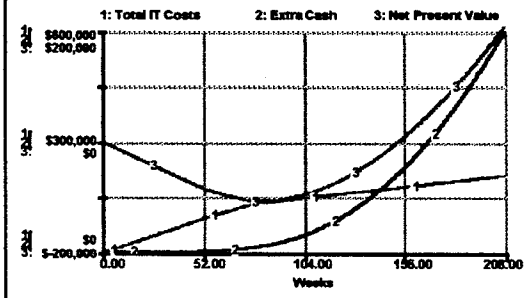
- **Above structure replicated for each technology, and all the Weekly Costs are summed to give IT (weekly) Costs.**
- **In the full model, the shown costs are supplemented with one-time site hardware costs, new and upgraded workstation costs and maintenance costs, all according to explict schedules.**
- **The users per seat and users per license connect proposed working arrangements with the IT costs.**

Sales and Finance

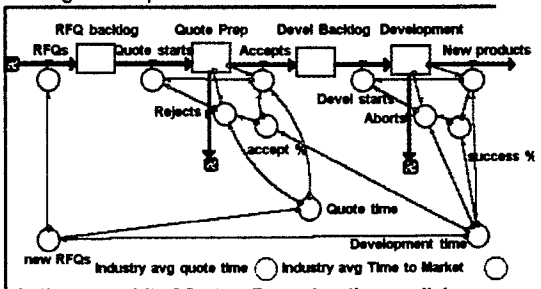


- **Initial value of *new product* flow stored for pre IT rate.**
- **Cash used as the Balance Sheet entity**

Financial Outcome



Adding the Dependencies



In the true spirit of System Dynamics, the new linkages would be through a level of Customer Expectation, determined by the current performance parameters, suitably delayed and relative to the competition.

Looking Back

- **This project was sponsored even though at least 2 major ROI studies had shown favorable return for the project. They lacked credibility, and in them:**
  - **Savings came from reduction in labor hours, but headcount was not really expected to be reduced.**
  - **The Gantt charts used to derive new Time to Market were neither correlated with specific EITs, nor able to show benefits as the project progressed**
- **System Dynamics approach forced explicit attention on business/market assumptions.**
- **Approach well received by firm. Being deployed within firm.**
- **As the firm embraces simulation, it is willing to incorporate more systems thinking into the model.**

Biographies

- **Vera J. Cole** is a National Science Foundation Scholar and a Ph.D. student in Engineering Management in the College of Engineering, Drexel University, Philadelphia, PA. She holds an MS in Industrial Engineering from Arizona State University and a BS in Mechanical Engineering from New York Institute of Technology. In addition to current consulting, she has held positions in computer-integrated manufacturing and operations management with Unisys Corp. and Motorola. She can be reached at (610)346-7223 and sg93nk2m@dunx1.ocs.drexel.edu
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