



## ***The Dynamics of an SDM Thesis***



**December 4, 2003**

**Steve Gilbert**

**Sam Weinstein**

Courtesy of Steve Gilbert and Sam Weinstein. Used with permission.

Chickens and eggs (or are they “nuggets?”) are representative of our introduction to system dynamics

Center picture is the title page of Nate Clark’s thesis, which is a rare example of one that was finished early



## Presentation Overview



- Objectives and Motivation
- Hard Data
- Approach
- The Entire Framework
- Model Core
- Early Advisor Involvement
- Goal Erosion
- Nuggets



## Objectives and Motivation



- **Discover important factors and effects that contribute to completing an SDM master's thesis "on schedule"**
- **Neither of us had the time to take a System Dynamics course**
- **As self-sponsored students, the most relevant and complex "project" that we have managed over the last year has been our lives, balancing**
  - Coursework
  - Thesis
  - Family
  - Finances
  - Logistics
  - leisure (theoretically)

Hopefully these factors will lend insight previously unknown to SDM students and administrators. The intent is to positively influence the thesis process for future SDM students, although it may be too late to benefit our own efforts.

Due to time conflicts imposed by the courses we must take, the electives we want to take, the required thesis, and our personal deadlines for completing the program and returning to the workforce; we have not been able to take the System Dynamics course. This term project presented an excellent opportunity to satisfy a required course and learn more about a topic of interest.

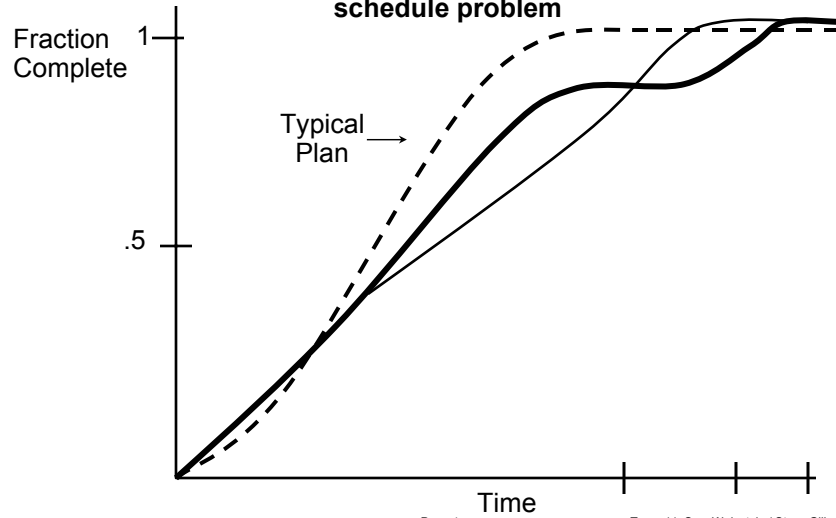
The thesis is the part of the equation that is rapidly consuming its slack time and seems destined for the critical path. We hope that by using a project management perspective we can identify some of the causes and propose remedies for "thesis slip".



## Objectives and Motivation



Thesis is a “project”: Analogous to project dynamics on-schedule problem




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From ESD.36 Lecture #7: The Dynamics of Project Performance II



## More Motivation: Data from Ted



- **List of Thesis Proposal Submission, Anticipated Degree Date on Proposal, and Actual Thesis Completion Date**
- **78 sample size**
- **Only 1 finished early**
- **Of those late (19%), the average late time is 5 months!**
- **These numbers only increase if we used the unavailable Anticipated Degree Date at the start of SDM**




This represents a tuition cost of \$6,000 to \$13,000 extra, based on SDM04 tuition rates

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Ted Hoppe is the Administrative Assistant to Director of the SDM Fellows Program

Explanation of “the unavailable Anticipated Degree Date at the start of SDM”: this is the answer one would receive if asking the question, “when do you plan to finish your thesis?” of a new SDM student (Spring of first year), however, this data is unavailable. The “Anticipated Degree Date” used is given on the proposal form, which is submitted much closer to the end of the thesis process. Thus, percentage of people late and average late time only reflects the proposal Anticipated Degree Date, so the actual numbers will be greater. (i.e. these numbers are “best case”)

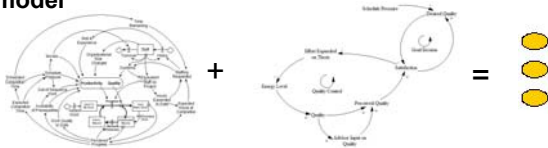
The tuition costs are estimated from SDM 04-05 numbers. A student that is forced to extend their thesis for one term registered as “Thesis Only” would pay \$6,000. The worst case scenario would be for a 24-month student that must extend their stay for the additional 5 months while registered for courses (assuming a self-sponsored student would not do this), which would cost approximately \$13,000. (This number is a reasonable estimate, but has not been confirmed by Jeff Shao of SDM Finance),



## Approach



- **Started with the Lyneis project model and the Sterman student burnout model**



- **Outlined what we thought were the key variables and drew concepts of how those variables change over time**
- **Interviewed:**
  - Students done with thesis
    - Successful in completing on time
    - Not successful in completing on time
  - Students currently working on thesis
  - SDM Administrators
  - Thesis Advisors
- **Drew our causal loop diagram and “synthesized nuggets”**

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Since both group members were new to System Dynamics, Professor Lyneis emphasized that the project should frame the context of the problem and gain insight through application of the tools of system dynamics. The end product may not have a full executable model. With this advice in mind we chose the Project Model covered in SDM and Sterman’s Student Burnout Model.

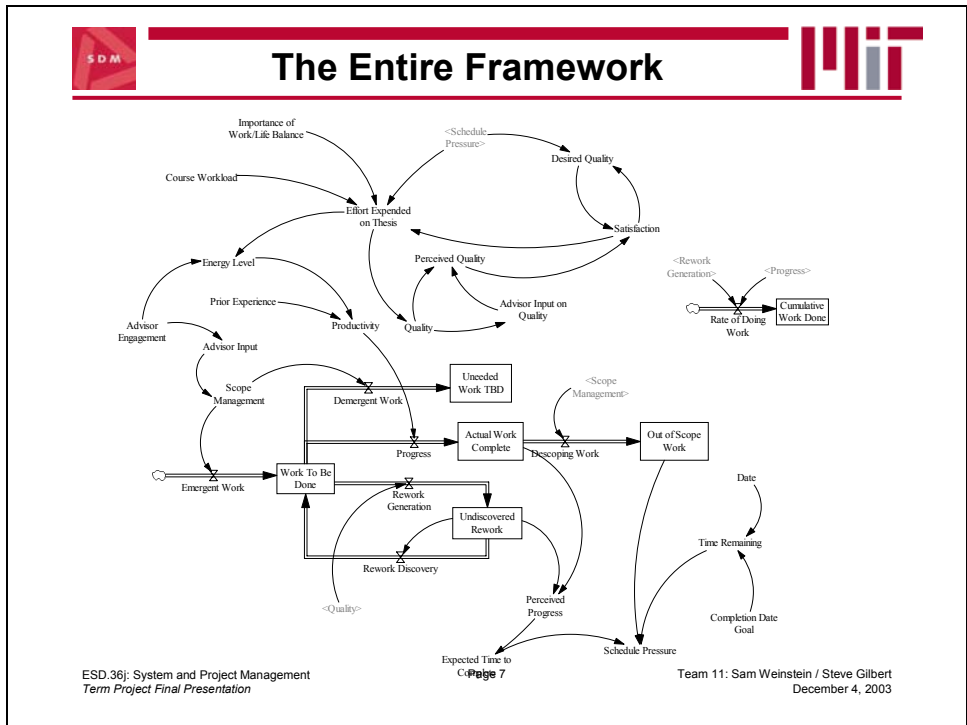
Student Burnout Model is from pp 159-69 of “Business Dynamics: Systems Thinking and modeling for a Complex World” by John D. Sterman

The Lyneis project model is from ESD.36 Lecture #7: The Dynamics of Project Performance II

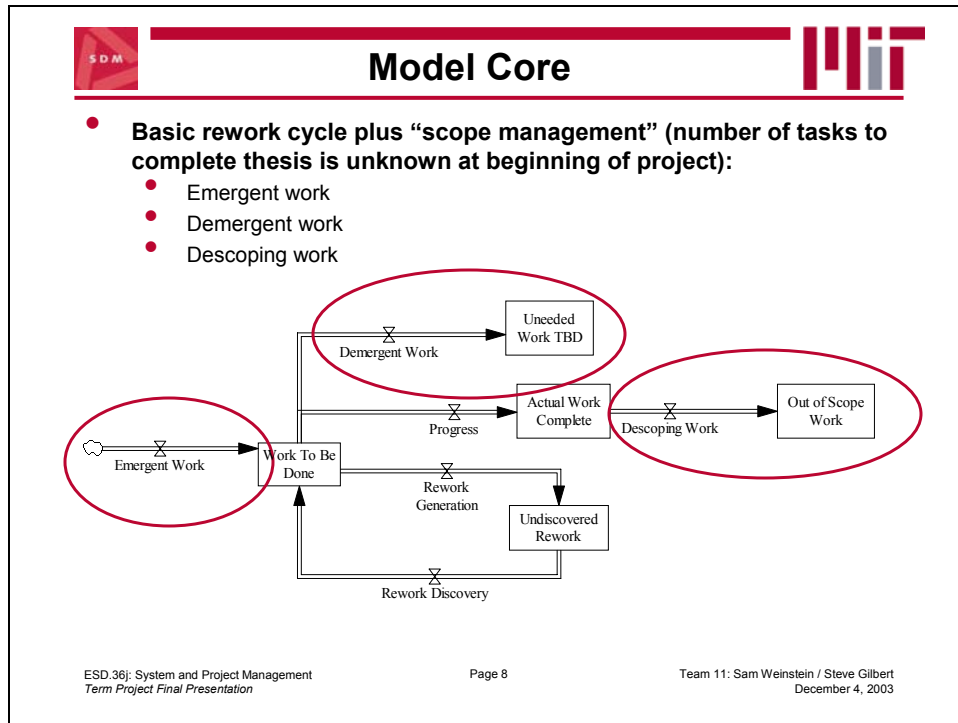
The Sterman approach outlined in his text for the student burnout model proved useful in a number of ways:

- The feedback loops for balancing student workload are all outlined
- The approach of drawing guesses of how the variables change over time
- The method of visualizing the two extreme cases to help draw important loops

Given the scope of the project, the interviews were key to drawing out information on the process. The number of interviews was small, but they cut across the different groups (students, administrators, and advisors) and captured input from students in different stages of thesis completion. Prior to the interviews we developed our initial opinions of key variables to completing a thesis on time and sketched what they looked like over time. This data was tested and revised during our conversations with interviewees. The last step was to synthesize key points from the interviews and construct a framework of the system.



The model shown above is the first cut at describing the dynamics of an SDM thesis. Fundamental pieces of the Rework Model and Student Burnout Model have been incorporated. However, there are some new elements that we will cover in the following slides. While not complete, we feel this model is an excellent starting point for testing and calibration.



Additions to the basic rework cycle presented in class:


**Emergent work** is the additional tasks added to Work TBD from scope changes (i.e. adding ideas or changing the direction of your thesis)

**Demergent work** is the subtraction of tasks from Work TBD from scope changes


**Descoping work** is discarding completed tasks from scope changes

These three flows can be referred to as “Scope Management”. The higher the flow in any of the three areas, the more the scope of the thesis is fluctuating.

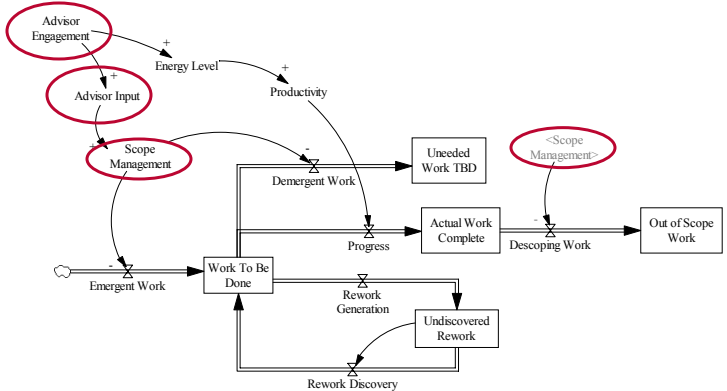
Note: Dilution of quality from adding inexperienced staff is irrelevant in this case because a thesis is an individual assignment.



## Early Advisor Involvement



- “I threw out 30% of what I did before I talked to my advisor, but the rework has been <10% since then.”
- **Advisor Involvement limits scope creep flows**



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The quote is from an SDM '02 that is in the draft review phase of his thesis.

There were some consistent messages from our interviews:

Students consistently have set overly ambitious goals.

One of the typical first actions of the thesis advisor is to reduce the scope and/or focus the student on a core of work that could be built upon.

The thesis advisor is ultimately the person that determines when the thesis project is complete. They are analogous to the customer for the project. It is critical for the expectations of the student and the advisor need to be resolved as early as possible. All work that is done before that point is effectively “at risk”. In other words, the longer you wait for advisor input, the greater the amount of “scope creep”, that is to say, more emergent work, and/or the greater the chance that what would have been demergent work will be descoped (discarded). Discarding completed work, especially late in the process, can be very deflating to the student.

**(Early) (Advisor Involvement)**

Why don't Students Start Early?	Why aren't advisors engaged?
<ul style="list-style-type: none"> <li>• “Your lack of progress is unprecedented”</li> <li>• The “Superman Effect”</li> <li>• Typical Spring Courseload</li> <li>• Multiple learning curves</li> <li>• No deliverables until thesis proposal</li> <li>• “Don't I need a good idea first?”</li> </ul>	<ul style="list-style-type: none"> <li>• Student wants to work with a particular “star” professor</li> <li>• Student shopping around an overdeveloped idea</li> <li>• Professor won't tell student that it's a bad fit</li> <li>• The “Prom Date Effect”</li> </ul>

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The Quote is what an advisor told an SDM '99 about 3 months before his thesis was due. He spoke to our cohort in January. It was supposed to be a hellish story of how NOT to do a thesis, but in the end he got it in on time.

The Superman Effect – This is the typical reaction to a horror story as described above. “Wow, that sounded terrible...but if he can get it done, then I can do it too.” Basically it diminishes the impact of good advice because the receiver feels that they are immune to the risks.

Students (especially 13 month students) load up on courses in the spring. Some students have taken as many as 8 courses, but usually no fewer than 4. In both cases this is a lot of work.


Multiple Learning Curves: Students are new to the program and most have been out of school for a while. Others are new to MIT and Boston. It is estimated that an individual can only manage 2.5 learning curves at a time before productivity drops off dramatically. All of the new experiences combined with course load means that students put off work on the thesis.

No Deliverables: The reason students delay is because there is no immediate consequence of doing so.


Students have the impression that they need to have a great idea before they get started. However, experience says that the best ideas emerge from work in progress.

Student wants to work with a particular “star” professor – Some professors have more star power than others. They may be great people, but there is no guarantee that they will be a good advisor with you.

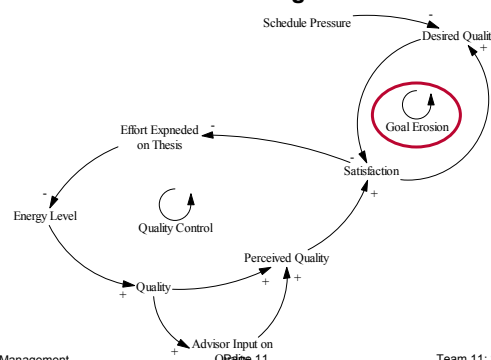
The “Prom Date Effect” – After a student has little success finding an advisor, they quickly work with the first person that shows any interest.



## Goal Erosion



- “This guy’s thesis is an embarrassment.”
- Goal erosion: “Save the world” becomes “Just Do It”™
- Vicious cycle when schedule pressure is applied
- Early advisor involvement reduces goal erosion



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Quote is from a thesis advisor regarding the only SDM thesis that received a “C”

A great example of how early advisor involvement helps resolve cognitive dissonance is in this term project: we initially had grandiose plans to build a full working system dynamics model of an SDMer’s life; this quickly turned into an SDMer’s thesis and then just taking the model built in class and only adding a few factors; this, in turn, became drawing a causal loop diagram based on the model presented in class to gain insights into the driving forces of the dynamics of an SDM thesis. Without Professor Lyneis reigning us in, we would have been prime candidates for dissatisfaction and the resulting goal erosion “death spiral” that follows as the deadline approaches.

Schedule Pressure unbalances the loops to the point where adding additional effort no longer helps. To resolve the cognitive dissonance, standards must be dropped.

Comments that reflect goal erosion:

- When I started, I really wanted to make an impact at work. Now all I care about is getting my advisor to sign.
- I’m sick of it.
- I used to write 5 pages an hour, now its all I can do to churn out a ¼ page in that time.



## Nuggets or Fool's Gold... You Decide

- **Need an early deadline (recommendation for deliverable for Spring 04 thesis class)**
- **Students should interview a large sample of advisors to maximize probability of matching:**
  - Interests
  - Personality
  - Schedule
- **Crashing schedule for advisor meetings will result in more scope creep flows**
- **If your prom date is ugly, ditch him/her as soon as something better comes along**



## Backup – New Terms Introduced



- **Demergent Work** – as the prefix implies, the opposite of e-mergent work. This is the flow of work from ‘Work TBD’ to ‘Unneeded Work TBD’. As with the other ‘scope creep flows’ (Emergent Work and Descoped Work), it is best to minimize these flows, or at least take care of them early in the thesis project. Otherwise, what could have been simply moved to ‘Unneeded Work TBD’ can become Descoped or discarded work later on, resulting in more Cumulative Work Done (and, thus, higher cost) for the same end product
- **“Superman Effect”** – the belief that one can accomplish anything that someone else said they did
- **“Prom Date Effect”** – as much as we hate to use the dating or marriage analogy, it keeps coming up when talking about advisors and students. It really is a long term relationship, and neither party can be shy about ending the relationship if it is not going to work out, for the happiness of all involved.