The Evolution of *3.086: Innovation and Commercialization*:

Developing an Integrated Learning Experience

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HybridEd Workshop

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OFFICE OF DIGITAL LEARNING

The Goals of 3.086

- Introduce students to the fundamental process of innovation
- Have students explore both historical and modern examples of innovation
- Give students the opportunity to practice the innovative process with their own innovative ideas:
  - Student learning shouldn't be passive
  - Give students the opportunity to actually engage in the creative process of innovation
- Provide a collaborative, project-based learning experience for the students

A History of 3.086: *Innovation and Commercialization*

- Fifteen-year history of development
- Has been offered 5 times with online components as either a residential MIT course or as an edX MOOC:

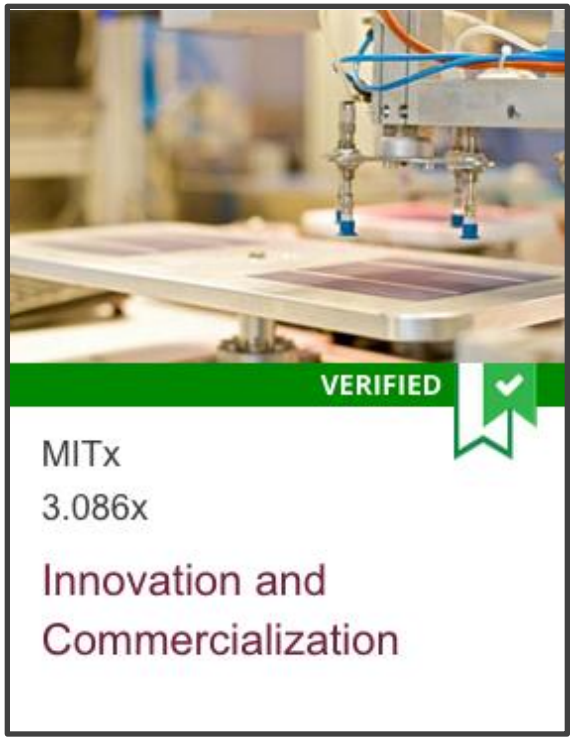
Spring 2013 **Flipped Class**	**Spring 2014** **Online Tools**	**Spring 2015** **Comprehensive Integration**
Lectures online Weekly discussions	Lectures online Weekly discussions Exercises online Basic project app One-on-one mentoring	Lectures online Weekly discussions Exercises online Full project software Group project mentoring Guest lectures to offer new perspectives Two group project presentations

3.086 Online – First Steps

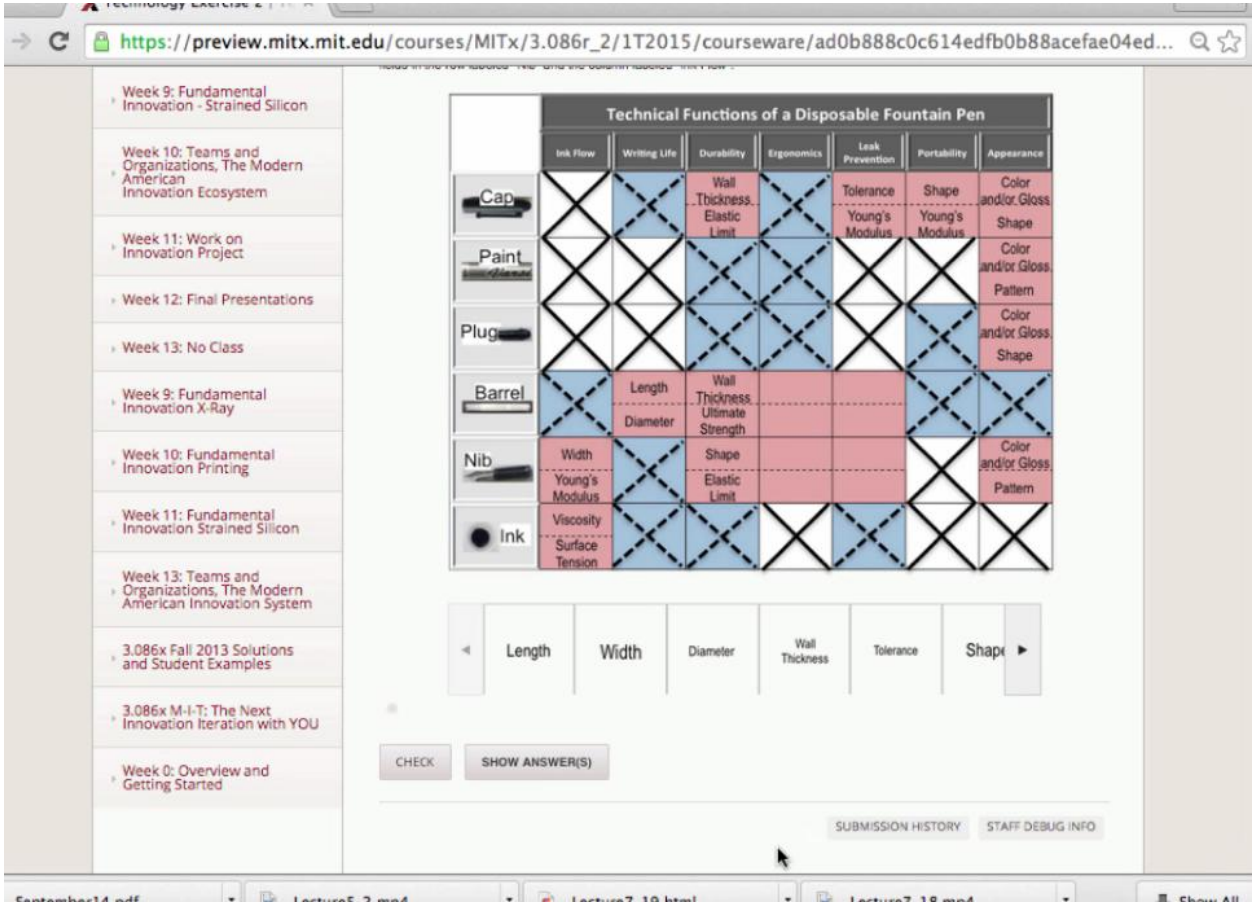
- Begin with a flipped classroom with residential MIT students
- Lectures provided via screencast videos
- Course assignments did not change
  - Short papers analyzing historical innovations and developing students own innovative ideas
- Once-a-week discussion sections with professor
  - Socratic-style inquiry

MOOC Development

- Open-ended nature of course material made MOOC development particularly challenging
- Screencast lecture videos
- In-Lecture Exercises:
  - Goal to make these as open-ended as possible in a computer-graded environment
- Basic Project App:
  - Allows students to organize and present project ideas

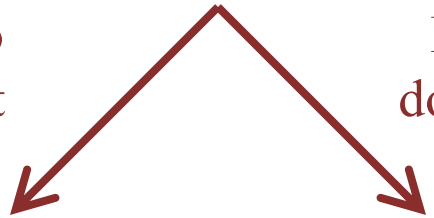


Online Exercise Example



Residential Incorporation

Let computers do what they do best



Free up faculty to do what they do best

- Online Lecture Videos
- Online Exercises
- Project Applications

- Weekly Discussions
- One-on-one Mentoring

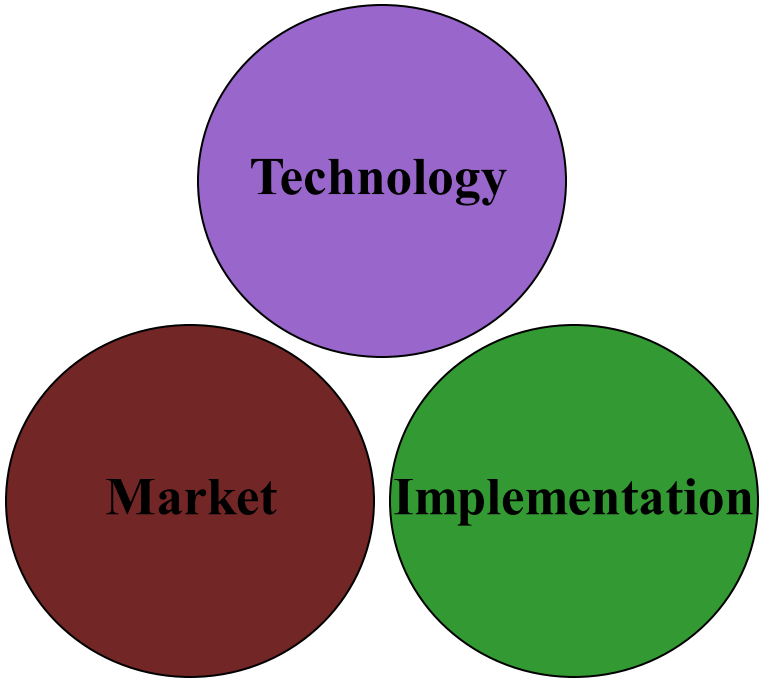
How do we integrate these discrete components into a course design where all of these components work together?

What Did We Learn?

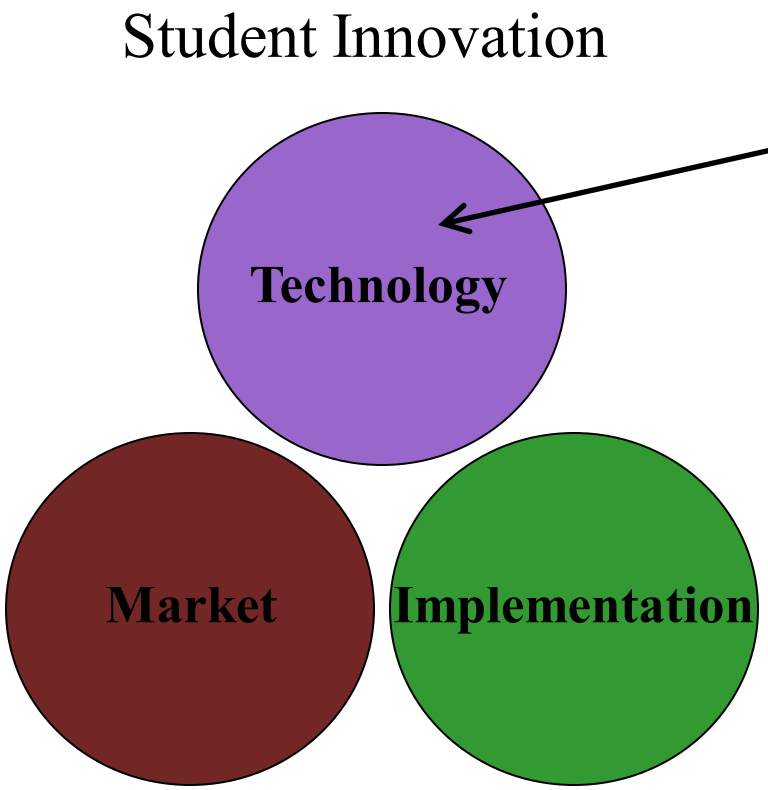
- Further improvements to the course will come from facilitating additional meaningful interaction:
  - Faculty-student interaction
  - Student-student interaction
- We need better online project tools:
  - Allow students to keep detailed records of their research, thoughts, and developments
  - Improve student-student collaboration
  - Give faculty greater insight into students' thought processes and project evolution to facilitate mentoring and feedback

Project Development Structure

Student Innovation



Project Development Structure



Lens Technology

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Coating Technology

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Anti-Reflective Coatings

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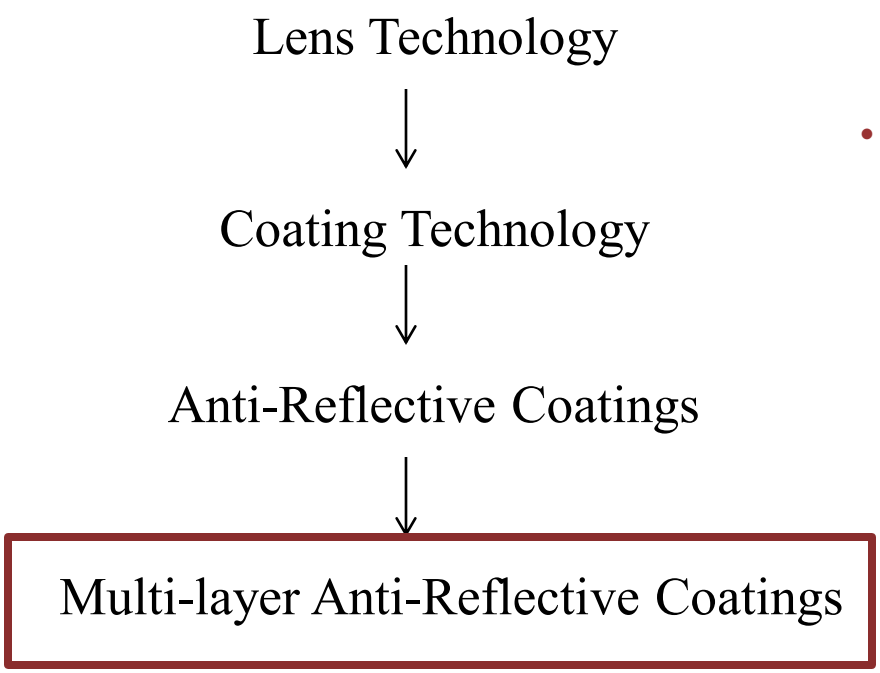
Multi-layer Anti-Reflective Coatings

Project Development Structure



- Students identify all of the individual components that comprise their innovation projects
- For each component, students will:
  - Perform in-depth research on the component
  - Record their research sources and important lessons learned
  - Explain how their research informs their path forward with their innovation projects
  - Communicate what they've learned with their colleagues and professors

Project Metrics

- We evaluate the first two iterations of student projects
- How well-referenced are student projects?
- How many project metrics does each iteration demonstrate?
- Examples of project metrics:
  - Provides intellectual property information relating to the innovation
  - Provides industry structure information that pertains to the innovation
  - Identifies both who might purchase the innovation and why they might purchase it

Project Outcomes

	2014	2015
Mean number of technology references – Assignment 1	1.0	11.2
Mean number of technology references – Assignment 2	2.1	18.8
Mean number of references per student – Assignment 1	1.0	5.8
Mean number of references per student – Assignment 2	2.1	9.8
Mean number of Assignment 1 project metrics demonstrated	2.8	5.2
Mean number of Assignment 2 project metrics demonstrated	4.2	6.3

All 2014 assignments were completed individually; 2015 assignments were done in groups of 1-3

Final Thoughts

- New tools increased the scope, depth and quality of student projects
- Make students active participants in their own learning– students are taking their first steps to becoming practicing innovators
  - Enhance class discussion
  - Improve student collaboration
  - Improve instructor-student collaboration and communication
  - Improved feedback to student project presentations
- Next steps
  - Further enhance student collaboration
  - Improve instructor-student feedback on online platform

Project Metrics – Assignment 2

	2014	2015
Identifies project-specific technology questions	67%	77%
Provided specific info/calcs relating to technology	60%	85%
Identifies next technology questions	33%	77%
Identifies Market “whos” and “whys”	80%	85%
Identifies potential intermediate customers	27%	62%
Identifies potential market influencers	27%	31%
Identifies potential adjacent market customers	27%	31%
Provides specific operating/financial information	27%	69%
Provides specific industry structure information	40%	77%
Provides specific IP information	33%	62%

Project Metrics – Assignment 1

	2014	2015
Identifies Market “whos” and “whys”	73%	85%
Identifies potential intermediate customers	20%	54%
Identifies potential market influencers	20%	7%
Identifies potential adjacent market customers	7%	31%
Provides specific operating/financial information	13%	54%
Provides specific industry structure information	40%	69%
Provides specific IP information	20%	46%
Identifies competing technologies	60%	85%
Identifies related technologies	27%	85%

Project Metrics – Assignment 1

	2014	2015
Identifies Market “whos” and “whys”	73%	85%
Identifies potential intermediate customers	20%	54%
Identifies potential market influencers	20%	7%
Identifies potential adjacent market customers	7%	31%
Provides specific operating/financial information	13%	54%
Provides specific industry structure information	40%	69%
Provides specific IP information	20%	46%
Identifies competing technologies	60%	85%
Identifies related technologies	27%	85%