Introduction

Abstract

In recent years there has been renewed interest in reforming undergraduate education for professions. Theoretical and research-centeredness of the 1980's has given way to project and case-study-centeredness of the 1990's to the interdisciplinary projects encouraging communication and team-building skills emphasized in the new millennium. While this thrust has made the classroom experience more closely resemble the workplace, all pedagogical approaches that do not incorporate the potential for students to generate real income from their work fall short of reproducing the private industry environment.

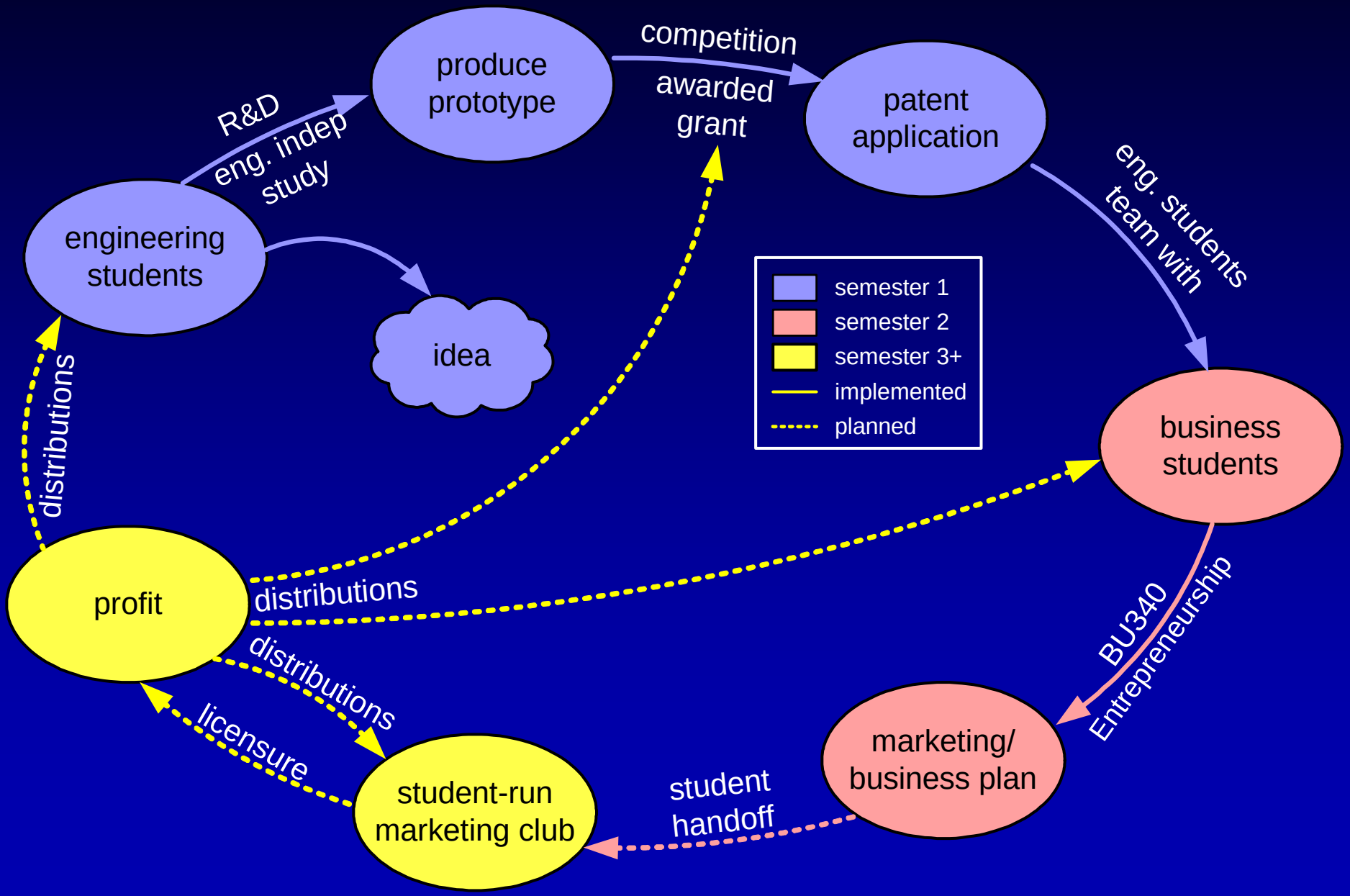
At the Virginia Military Institute we have experimented with permitting engineering and business students to compete as teams to invent a marketable product. The student team with the most novel and potentially profitable invention was awarded a grant to obtain a patent. The engineering teams were then invited to work with business students to create a plan to market and/or license the technology, with the understanding that all students involved (engineering and business) would share with VMI any profits generated.

Abstract (continued)

Surveys revealed students who participated in the entrepreneurship course that worked on the real-world projects thought the course was 5.0±0 effective, as compared to a class average of 4.5±0.71 on a 0-5 scale. Post-course surveys showed there was no correlation of a "winning" engineering/business design team's overall GPA or SAT scores to VMI as a whole, indicating that this process rewards a different aspect of student development than is evaluated in most university or SAT exams.

In conclusion, we have found that both engineers and business majors find the opportunity to work together as they develop, market, and license a product both real-world and motivational, although it remains to be seen whether long-term shared-income profit from patent licensure amortizes the cost of prosecuting student patents.

Concept

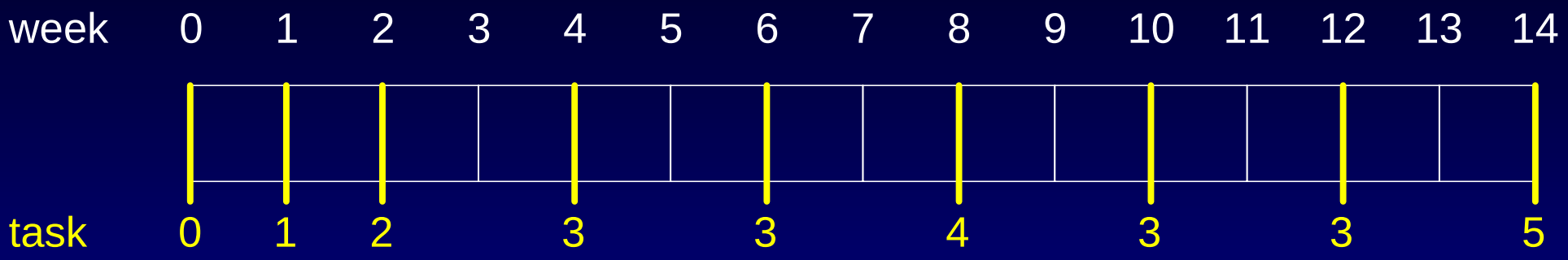

produce prototype
competition awarded grant
patent application
R&D eng. indep study
engineering students
idea
eng. students team with
distributions
semester 1
semester 2
semester 3+
implemented
planned
business students
profit
distributions
distributions
licensure
BU340 Entrepreneurship
marketing/ business plan
student-run marketing club
student handoff

Implementation

Players

Students	Faculty	Administration	External
Engineering/science (independent study)	Eng./sci advisors	Undergraduate Research Initiative (funds patent development)	Patent law firm
Business (entrepreneurship)	Business advisors	Intellectual Property Committee	University Technology Transfer Office (VMIRL)
Marketing club students	Marketing club advisor	Grants Office (e.g. NCIAA grant)	Technology patent licensee

Engineering (Independent Study)



0. Initial Meeting
1. First cut: project goals, timeline
2. Project goals, timeline agreed upon, initial parts order
3. Semiweekly progress demonstration and status report
4. Semiweekly progress demo, status rpt, and midterm peer evals
5. Final presentation, report, peer evals, competition

Grading

90% 6 semiweekly progress demonstrations & reports

10% peer evaluations

See examples at www.jamessquire.net/research/student_projects.html

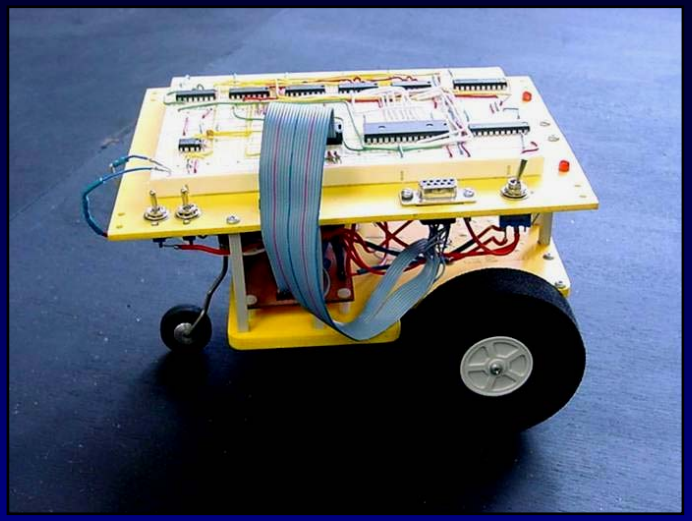
Business (Entrepreneurship)

The course is intended to provide students with an introduction to the entrepreneurial process. Approximately one-fourth of the course is devoted to providing information about entrepreneurs and their opportunities/problems/concerns (including spending time on the personal characteristics of successful entrepreneurs). About one-half of the course is devoted to preparation of a Business Plan and the remaining fourth to financing the firm and on-going management issues. Students select, after consultation with the Instructor, a small, entrepreneurial business as their prototype and write an extensive Business Plan for their business. The Business Plan includes separate sections on organizational issues, marketing, production, and finance. The business selected can be an existing business, a *de novo* operation, or a franchise.

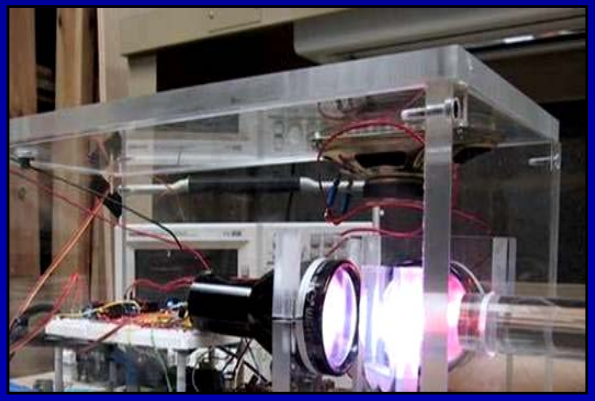
Results

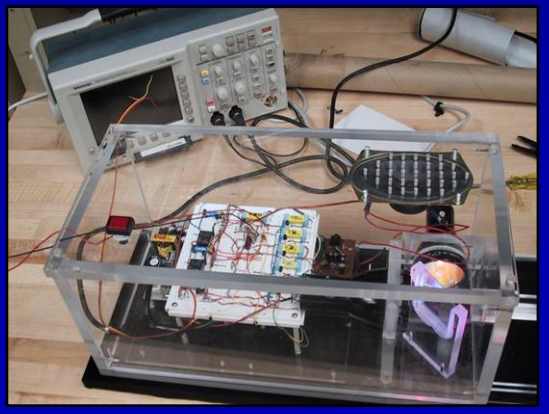
Example Engineering Products

2003 Winner: Internet-aware commercial garage parking system



Runner-up: Embedded navigation system for robotic exploration

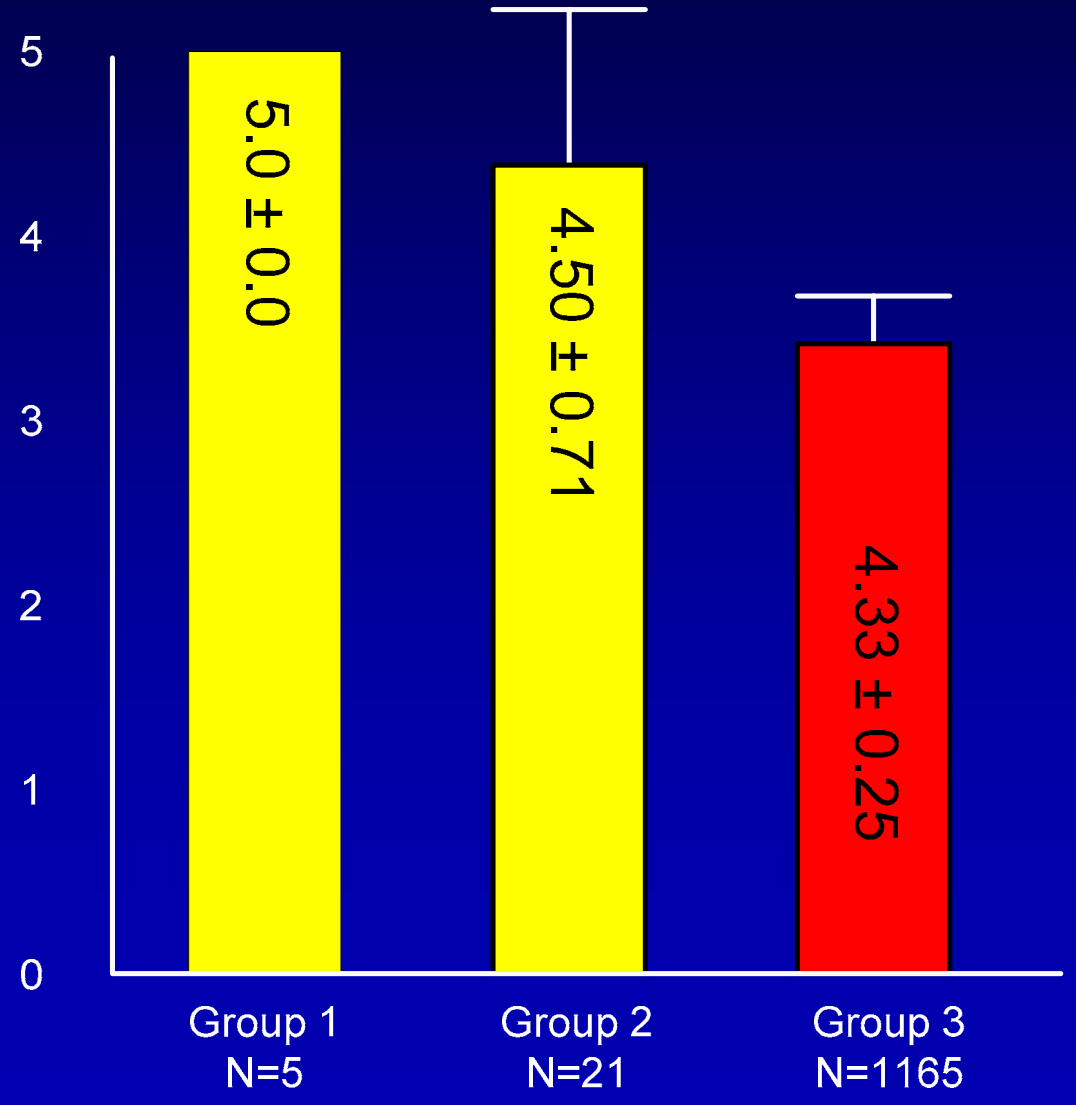




Laser-free optical communication system

Student Surveys

Course Effectiveness Statistics

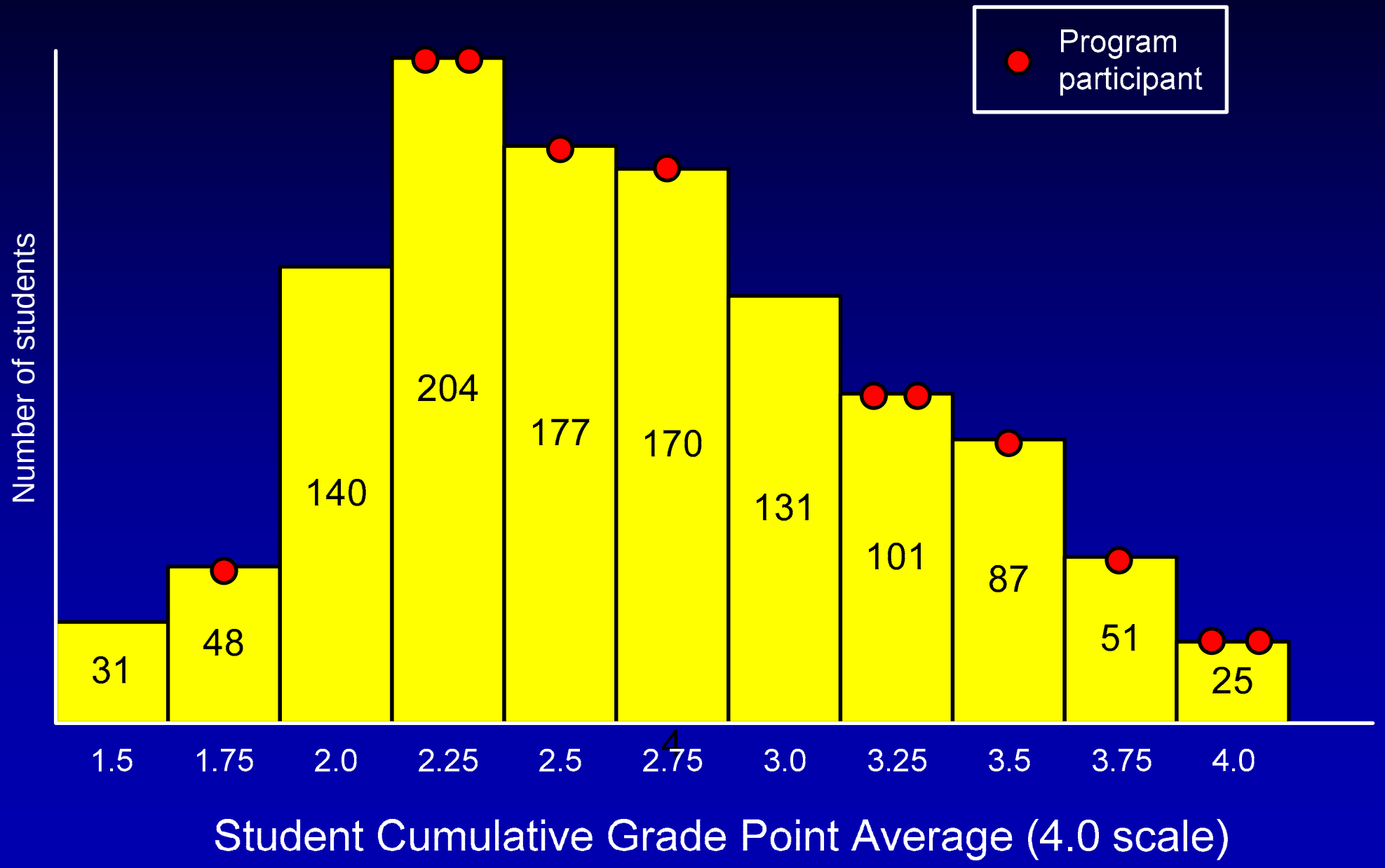


Group 1: Engineering indep. study
Group 2: Business entrepreneurship
Group 3: VMI school average

Unpaired t-test that the group mean of students rating the efficacy of the "Real-World Engineering & Entrepreneurship" program combind is higher than the efficacy rating of the average course at VMI:

Significant to p = 0.006

Student GPA Statistics



Discussion

Benefits

- **Potential institutional profit**
  - Intellectual property licensure
  - Grants opportunities related to entrepreneurship (e.g. NCIAA)
- **Pedagogically sound**
  - Strong student motivation
  - Addresses multiple intelligence learning styles
  - Engages broad student mix, not just traditional top GPA students
- **Program accreditation**
  - Engineering – ABET requirements
  - Business/economics - AACSB requirements
- **Intellectual property issues**
  - Opportunity to modernize institutional IP policies
  - Regular program means can negotiate lower patent prosecution costs
- **Other student benefits**
  - Patent development or licensure work on resume stands out
  - Encourages student participation at regional/national conferences

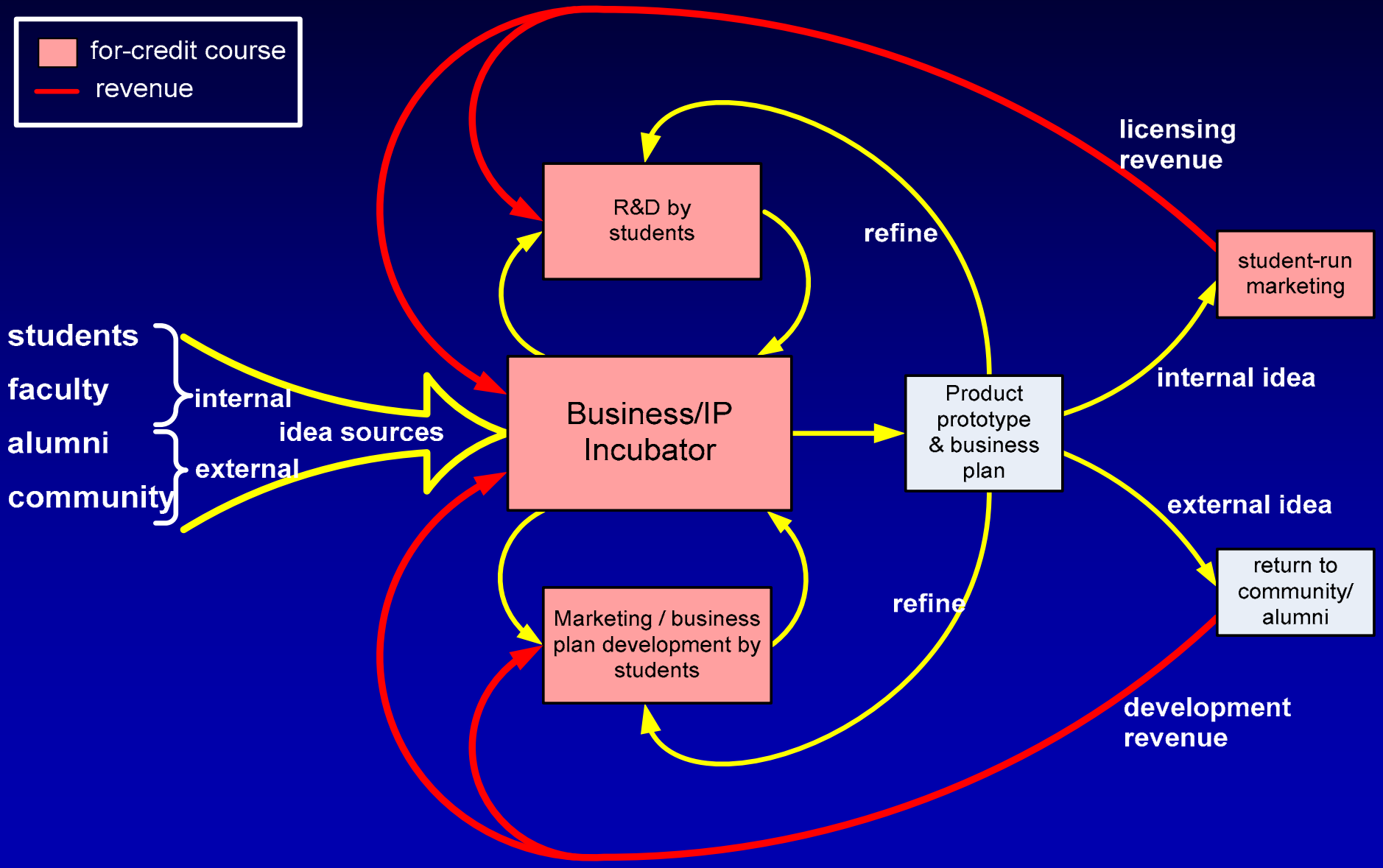
Costs

- Fiscal costs
  - Mean of $6500 / patent, including responses to USPTO replies
  - Equivalent of $185 / student involved; about twice that of a typical engineering lab
- Faculty time
  - Engineering – about 25% more than usual because of patent filing work
  - Business – about 25% more than usual since not a standard case study
  - Club manager – expected 4 hours/week

Issues to be Resolved

- Time to patent – about 2 years
  - original inventors will have graduated
  - loss of further development potential
  - difficult contacting for response to USPTO questions
- Technology Licensing Office (TLO)
  - potential competition between TLO and student-run IP Club
  - potential disagreement by TLO with a client found by the students
- Cost / benefit ratio unclear
  - expected revenue/semester = (mean revenue/semester if licensed) x (probability of licensure) – (cost of patent prosecution
  - probability of licensure low

Future Plans



Conclusion

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- Program provides the real-world experience of an internship within the structure of a college course
- Potential to make money and prestige of doing “real world” work a huge student motivator
- High student motivation makes it a pleasure for faculty to administer, although additional time burden
- Engages students on a different level than traditional courses; some “underperformers” shine
- Long term revenue unclear