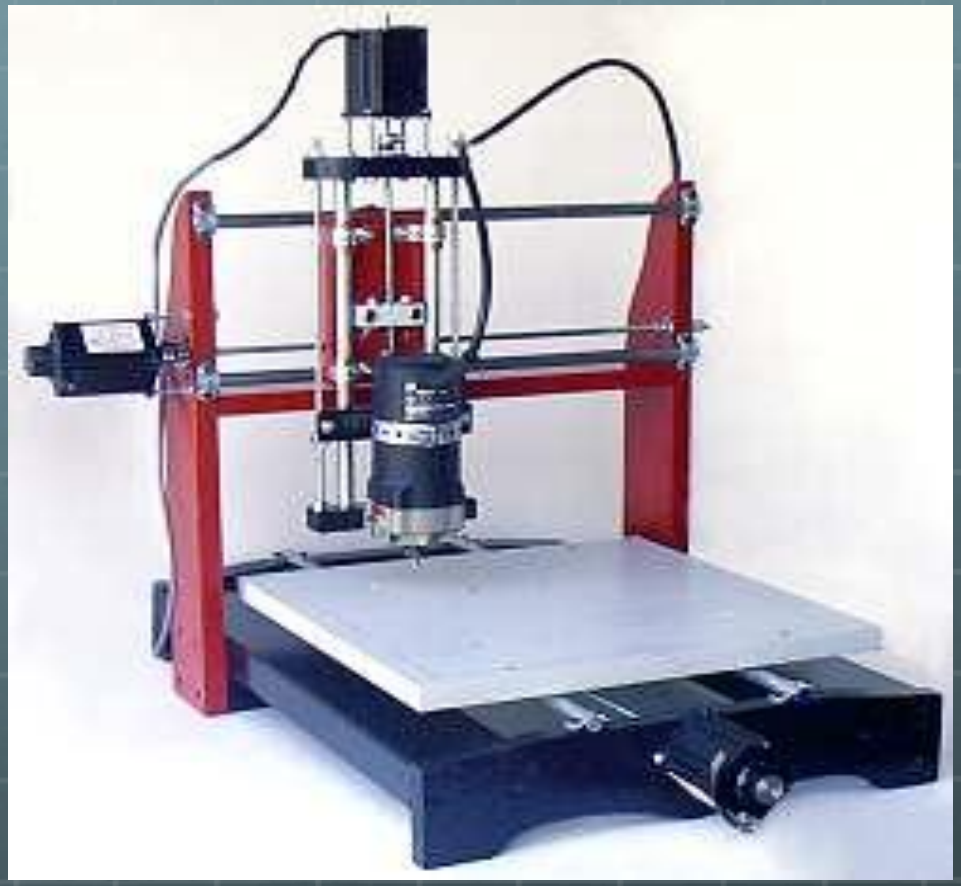


Desktop Manufacturing

Educational Products & Services

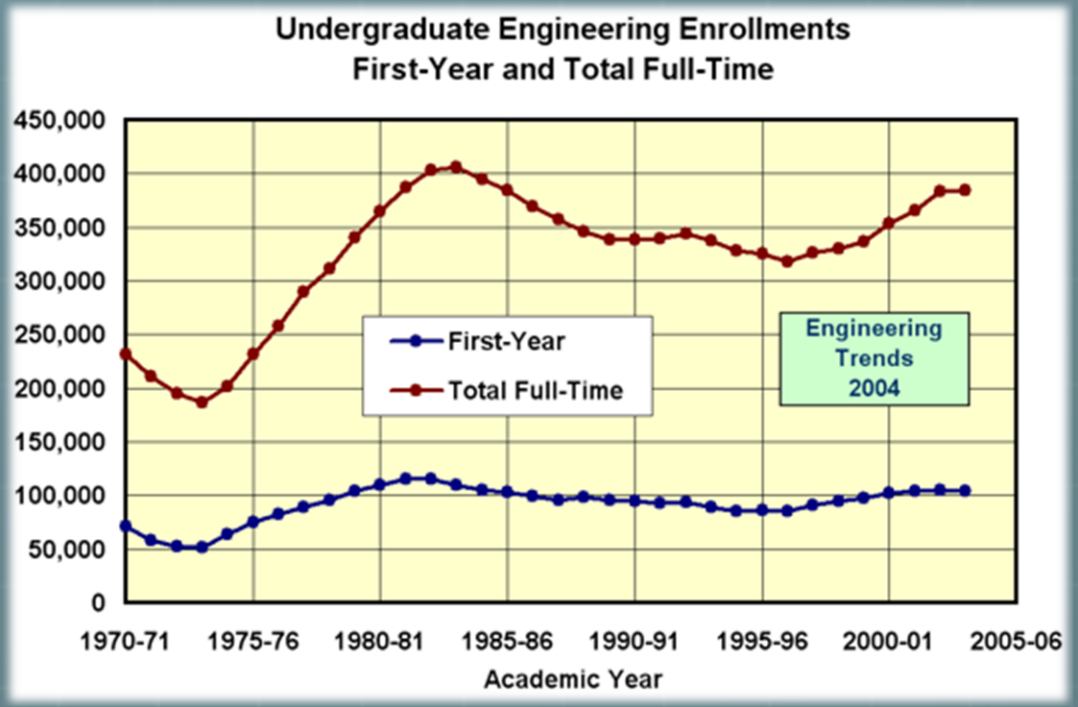
Entrepreneurship and New Ventures- Prof. Santinelli

Fall 2009

Ross Gale
Jayesh Gorasia
Ryan Harris

Engineering Education is in Trouble

- Declining Enrollment[1]
- Low Retention – 56%[2]
- Decreasing practicality of in-class lecture learning[3]

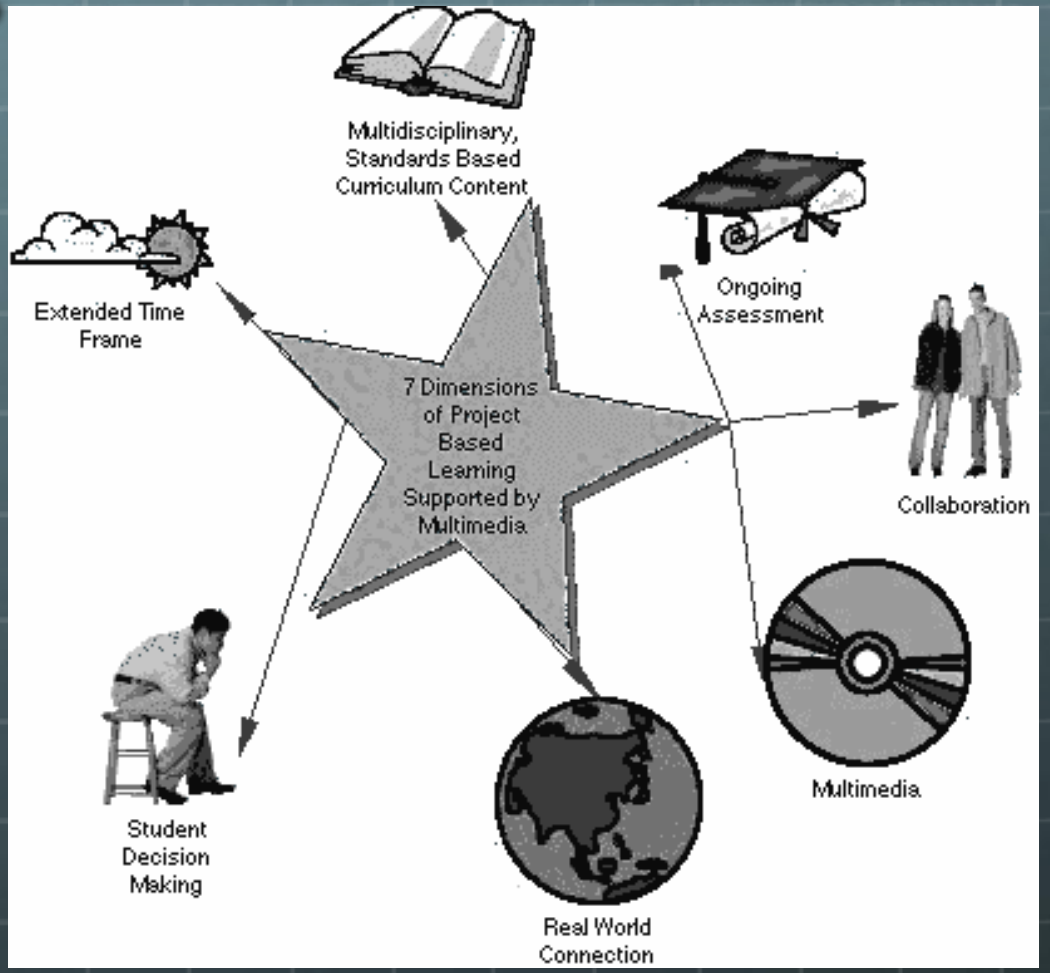


http://www.engtrends.com/IEE/1004B.php

[1] Statistic from Engineering Trends http://www.engtrends.com/IEE/1004B.php
[2] Statistic from IEEE Spectrum http://spectrum.ieee.org/blog/semiconductors/devices/techtalk/engineering_schools_that_tie_t
[3] Zastavker, Y., Ong, M., & Page, L. (2006). Women in engineering: Exploring the effects of project-based learning in a first-year undergraduate engineering program. *36th ASEE/IEEE Frontiers in Education Conference, San Diego, Ca.*

Problem Statement

- Educational Foundations (ASEE, NSF, PLTW, ASME, IEEE, NAE, NAS, ABET, NCSSSMST) have been pushing for changes in engineering education for years.[1][2]
- One of the ideas proposed to is to incorporate project based learning (PjBL)[3][4][5]



[1] WA Wulf "The urgency of engineering education reform" the New Paradigm for Engineering Education, 1998

[2] Lr Lattuca, Pt Terenzini, Jf Volkwein Engineering Change A Study Of The Impact Of Ec2000, Baltimore, Md: Abet Inc, 2006

[3] LP Maletsky, RD Hale " **The Practical Integration of Rapid Prototyping Technology into Engineering Curricula**

[4] J. S. Lamancusa, J. E. Jorgensen, and J. L. ZayasCastro, The learning factory - a new approach to integrating design and manufacturing into the engineering curriculum, J Eng Educ 86(2) (1997), 103-112

[5] Wingspread Group on Higher Education, An american imperative: higher expectations for high education, Racine, 1993

Solution: PjBL

- Provides Perspective on lecture
- Ownership of project engages students
- Better prepares students for careers
- Allows students to share hands-on learning experiences

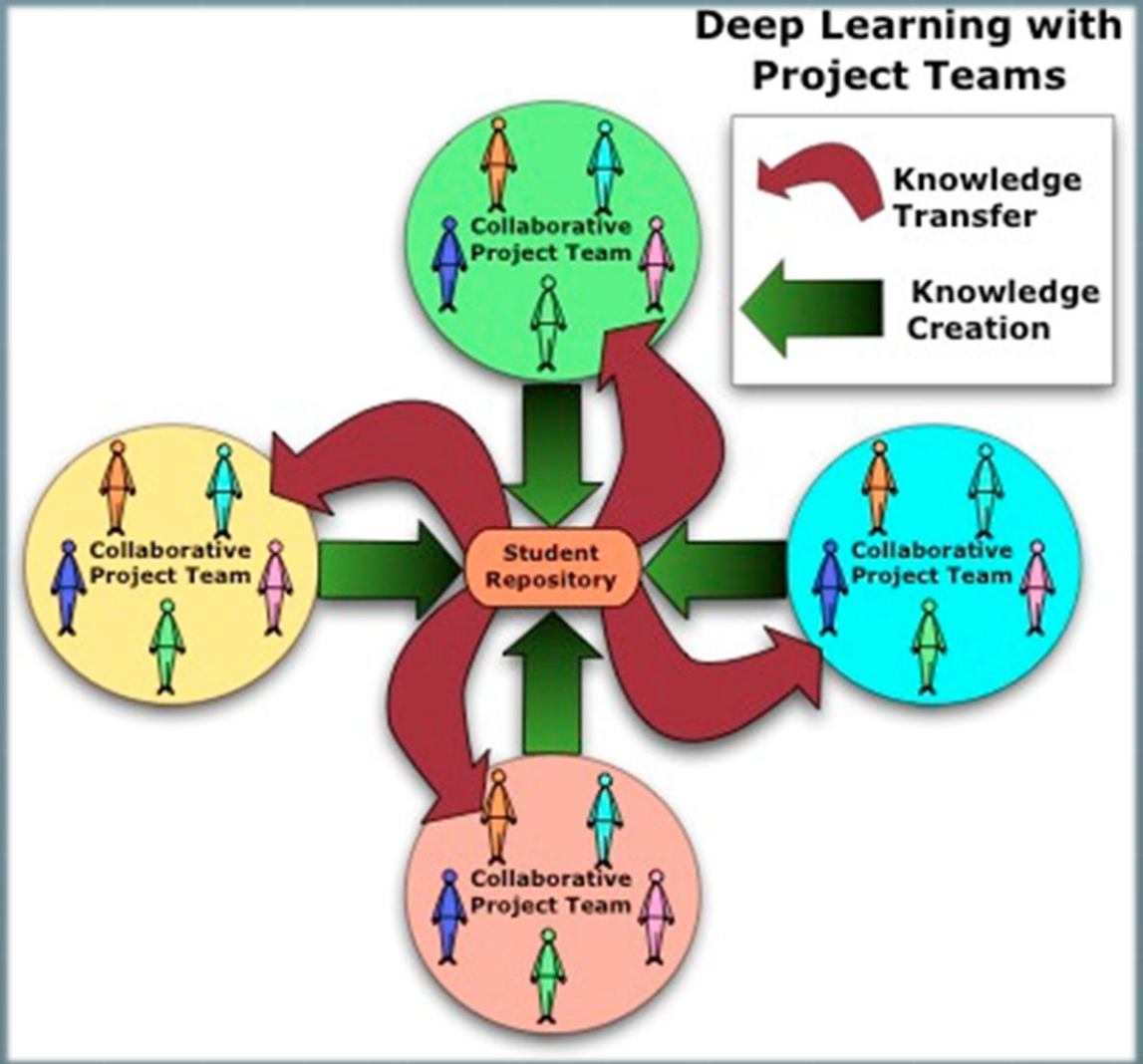
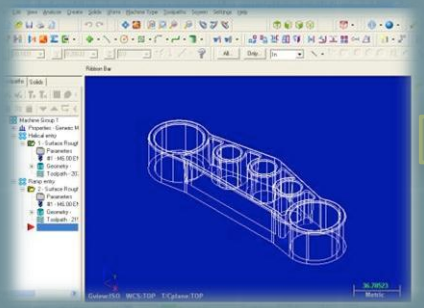


Chart Source: http://www.profoundlearning.com/Content/EducationSolutions/projectBasedLearning.jpg

Business Concept



Influence Design & Purchase of user-friendly computer-aided manufacturing (CAM) software

Desktop Manufacturing
(Us)

$$$$$$$

Sell/Lease our CNC machines with accompanying software and curriculum to high schools and universities worldwide

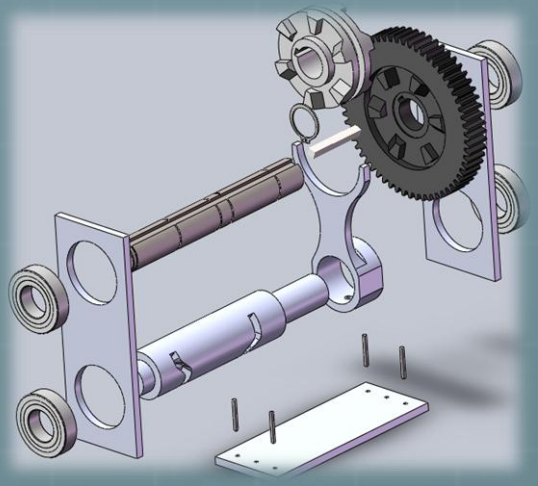
Develop low-cost CNC machines

made abroad

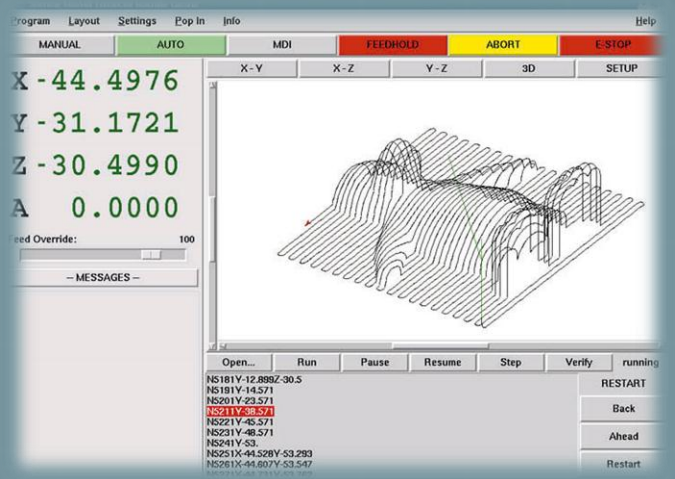
NSF

Work with Engineering & Science Educational foundations/organizations, as well as schools to promote Project-Based Learning

CNC Manufacturing Process



Model Generation



Toolpath Generation

Machining Process

Finished Part

Low Cost Desktop CNC

- Cheaper: $800 compared to ~$3000[1][2]
- Lower precision and accuracy: .005” instead of .0005”

[1] http://www.harborfreight.com/cpi/ctaf/displayitem.taf?Itemnumber=66052
[2} http://www.probotix.com/FireBall_v90_cnc_router_kit

Curriculum

- We will offer curriculum supplements and guides with our products
  - Lab guides, testing procedures, handouts, administration suggestions
  - This will assist educators in implementing the software and CNC mills
- Why?
  - Engineering professors are incentivized to research not to teach.

Market Study

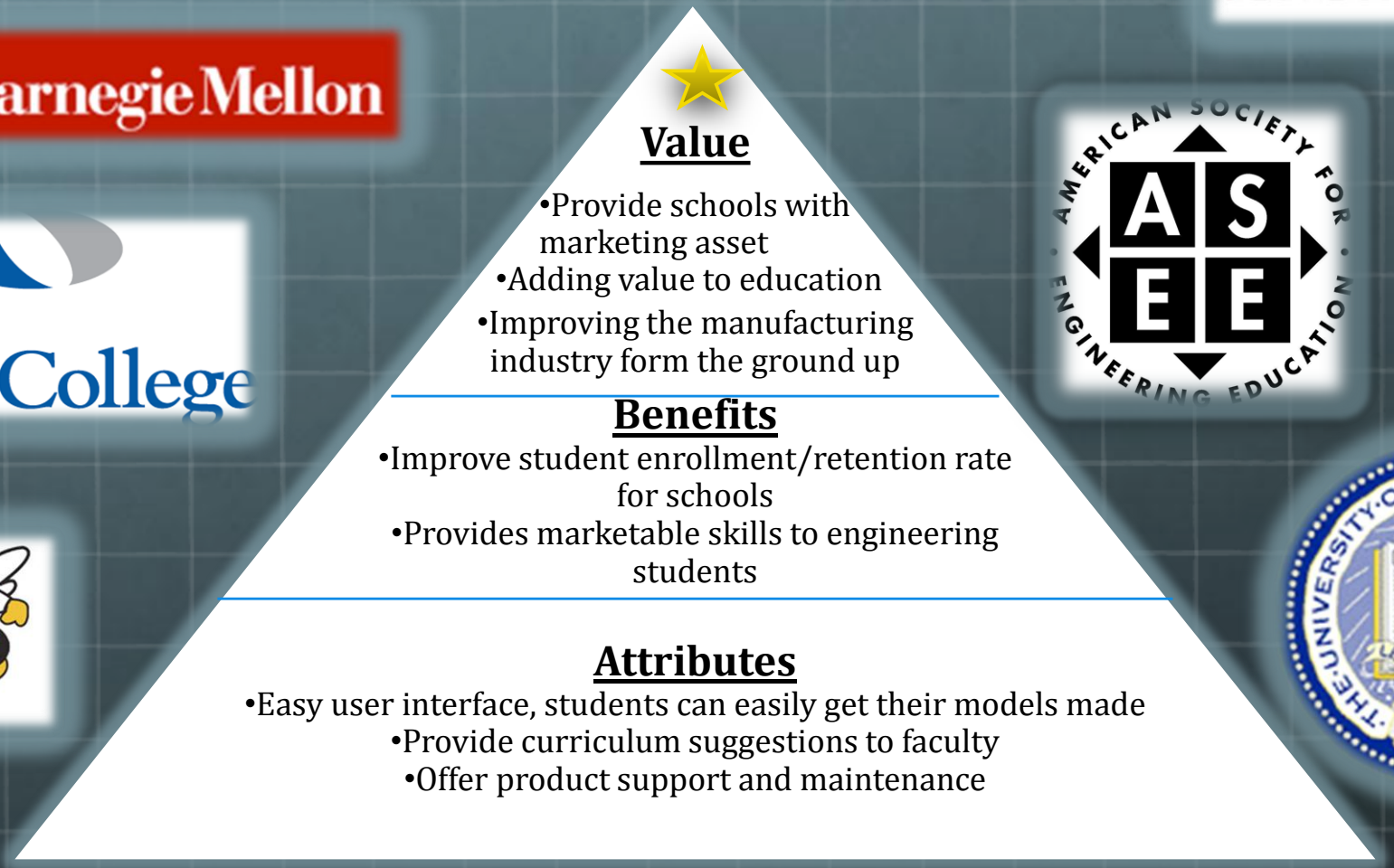
Educational Institutions: High Inertia

Students: Low Budget, Space Concerns

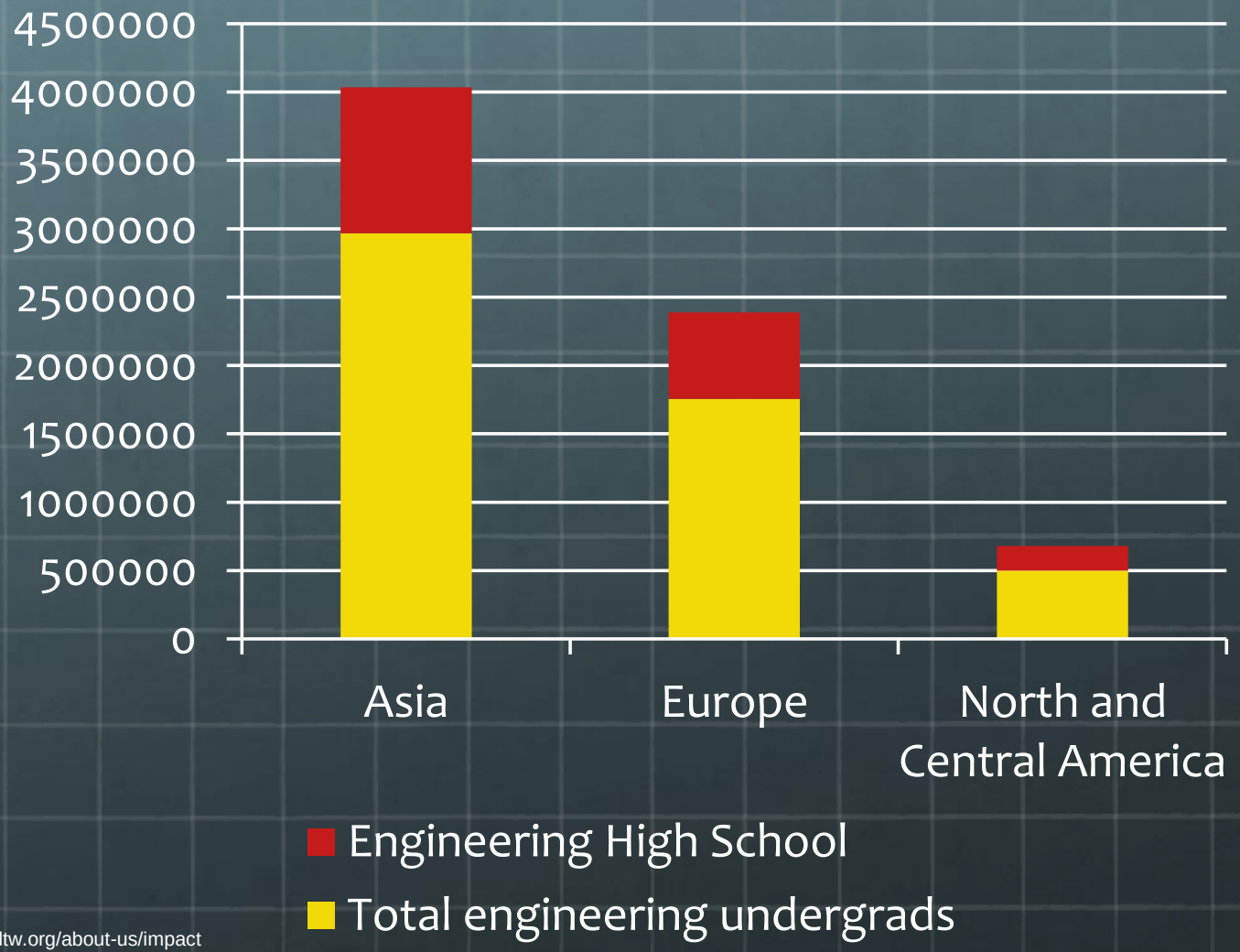
Hobbyists: Small market, Low Budget

Design firms: High Budget, Low time

Customer Value Proposition



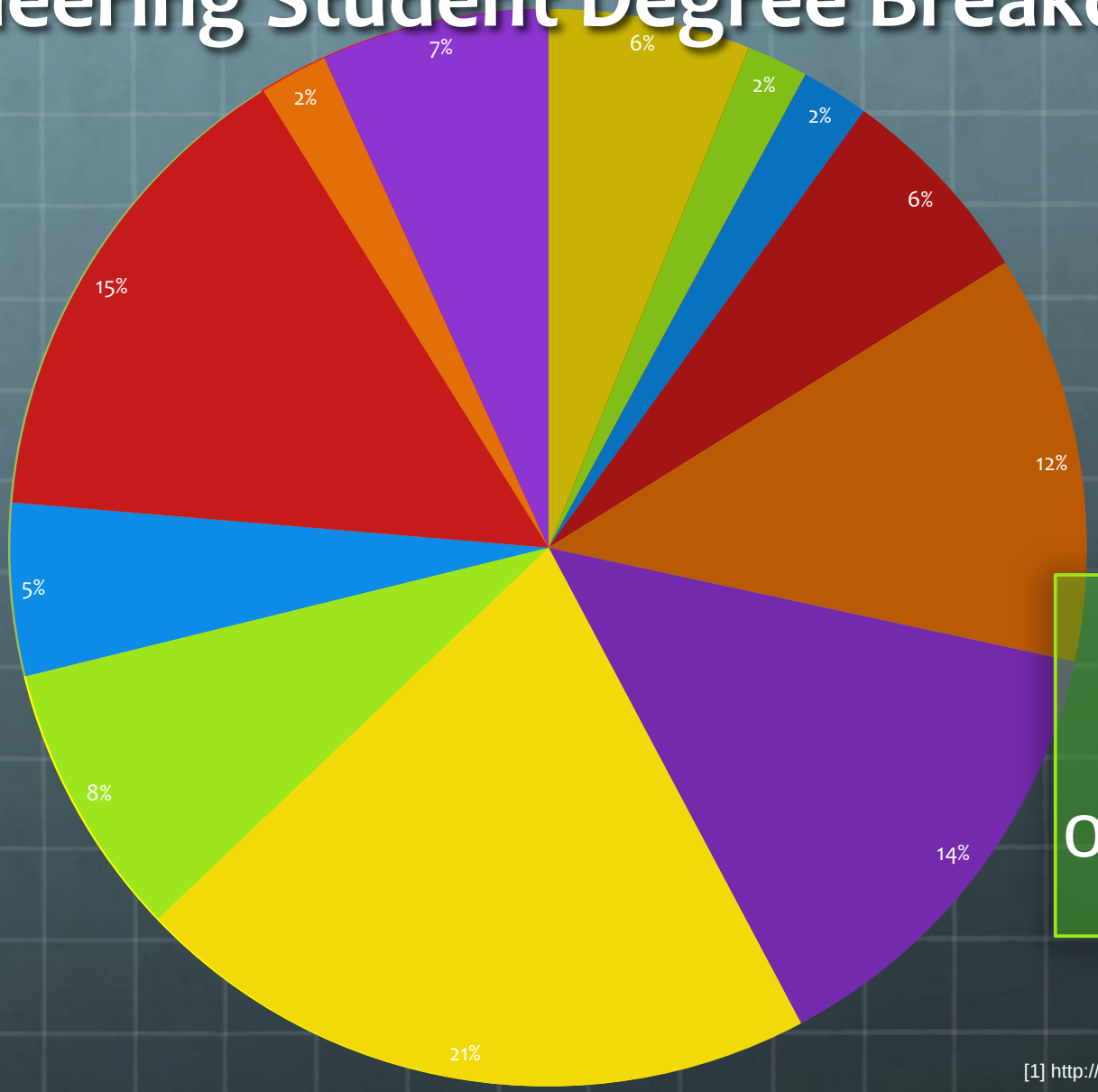
Number of Engineering Undergrads and High School Students



Project Lead the Way - http://beta.pltw.org/about-us/impact

National Science Foundation – Figure 2-34 [http://www.nsf.gov/statistics/seind08/c2/c2s5.htm]

Engineering Student Degree Breakdown

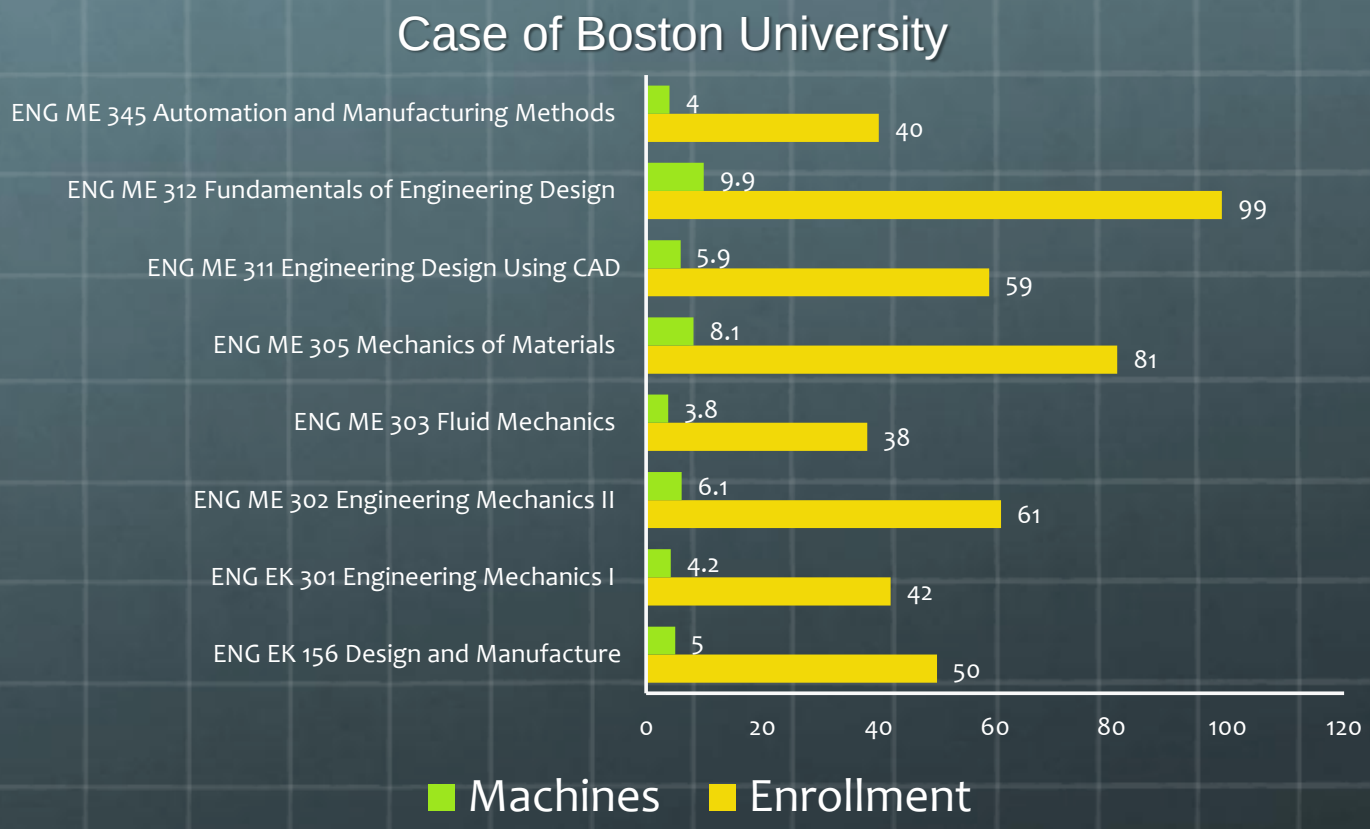


38%
Could use
our services

[1] http://www.engr.utexas.edu/about/factsheet/
[2] http://engineering.illinois.edu/about-us/facts-figures
[3] http://coe.berkeley.edu/about/college-facts.html

- Aerospace
- Agricultural and Biological Engineering
- Bioengineering
- Chemical and Biomolecular Engineering
- Civil and Environmental
- Computer Science
- ECE
- Industrial and Enterprise Systems
- MatSci
- Mechanical Science and Engineering
- Nuclear, Plasma, Radiological
- Physics

Course Machine Requirement

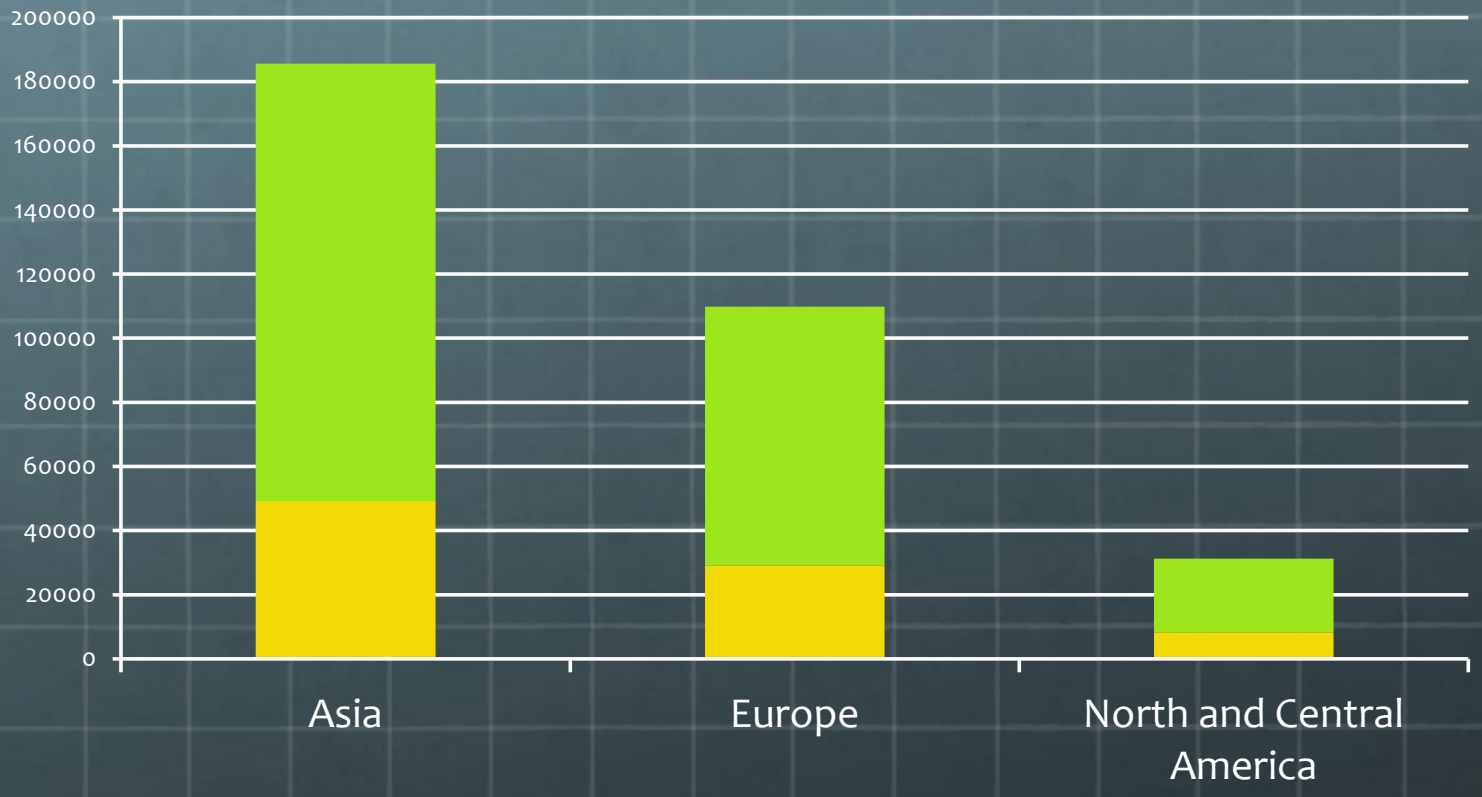


Range of 5-20 students per machine

depending on school analyzed

Source: http://www.bu.edu/eng/facts/

Available Market for Machines



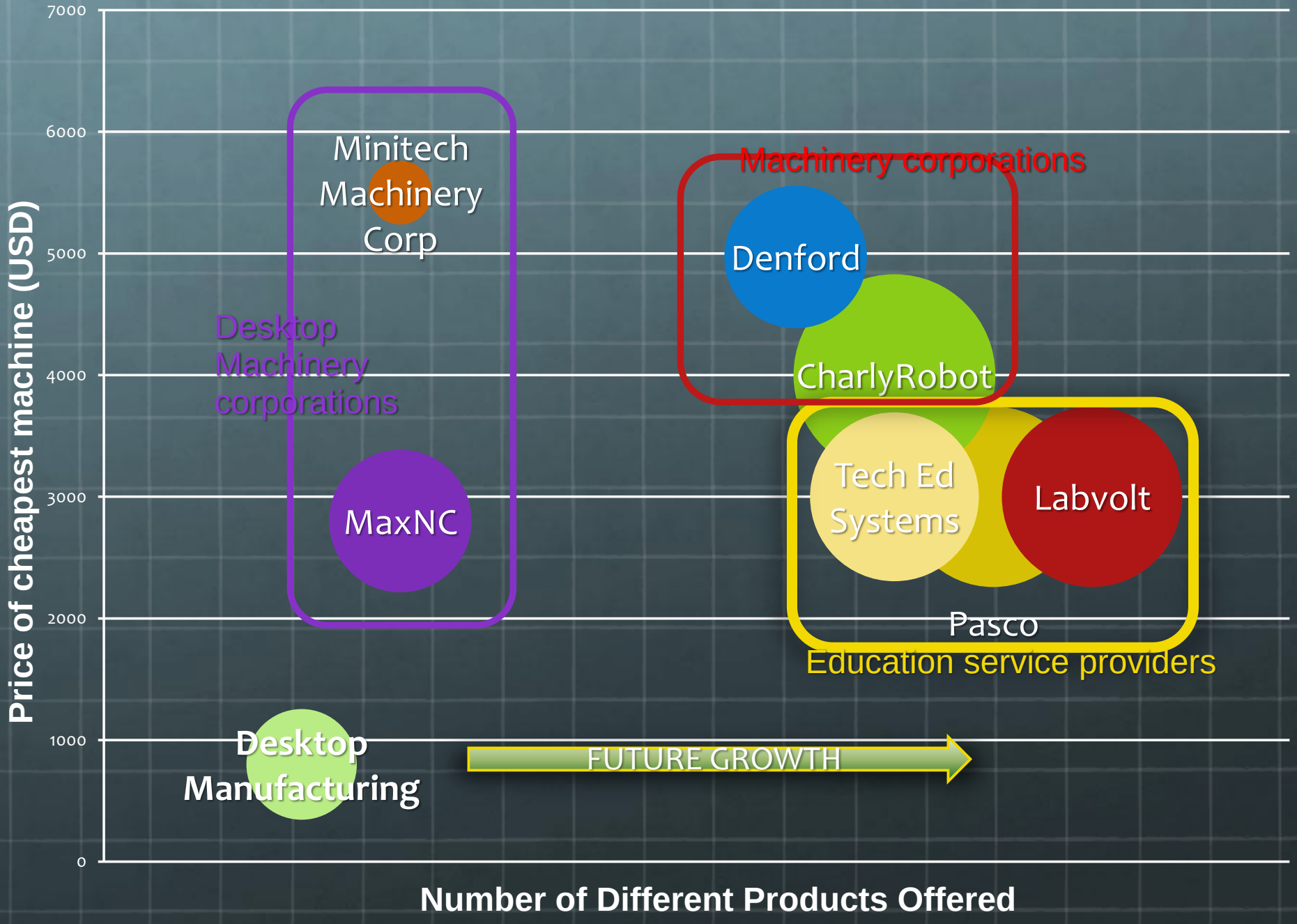
Available market = 327000 × $800 = $261 million

Market Share Growth

- Aiming for 20% market share in 5 years, assuming 5-year product life cycle.

Year	Annual Sales	Revenue (million)
1	8,788	$7.0
2	10,546	$8.4
3	12,655	$10.1
4	15,186	$12.1
5	18,223	$14.6
Total 20% Market Share	**65,398**	**$52.3**

Competition



About the Industry

- The desktop CNC belongs to the low volume manufacturing industry
  - $2 billion annual revenue
  - 20% annual growth rate

Desktop CNC Milling

Additive Printing

Stereolithography

Laser Sintering

Statistics from: David R. Butcher "Rapid Prototyping Shows Few Signs of Slowing" <http://news.thomasnet.com/IMT/archives/2006/09/rapid_prototyping_shows_few_signs_of_slowing_materials_properties_growing_fast.html>

Porter's 5 Forces

	Favorable	Moderate	Unfavorable
Threat of new entrants		X	
Bargaining power of buyers			X
Threat of substitutes			X
Bargaining power of suppliers		X	
Intensity of rivalry			X

- **NONE of Porter's 5 forces are considered favorable, indicating the sustainability of this venture is limited.**

Critical Risk Factors

- Slow adoption of idea that engineering reform is needed.
- Schools not having enough funds available to invest in new programming
- User misuse/abuse would affect products' reputation & require high support

Critical Success Factors

- Partnering with a PjBL Organization such as Project Lead The Way
- Establishing an early partnership with one or more universities, educational foundations, engineering firms, and large institutional donors.
- Offering curriculum guidance that encourages use of the products
- Getting a suitable manufacturing partner to make the CNC machine at a competitive cost
- Low cost encouraging high product redundancy

Potentials for Growth

- Adding additional products
  - Different types of machines and accompanying software (Routers, Lathes, Presses, RP Machines)
- Complete K-12/HS/University curriculum development
- Building low-price high-quality CNC machines for sale to the general market (Dental, Hobby, Personal, Designers…)

Our Decision

Can we do it – YES

Is it worth doing – YES

Should we do it – NO

NO…GO