EDUCATING THE NEXT GENERATION OF INNOVATORS

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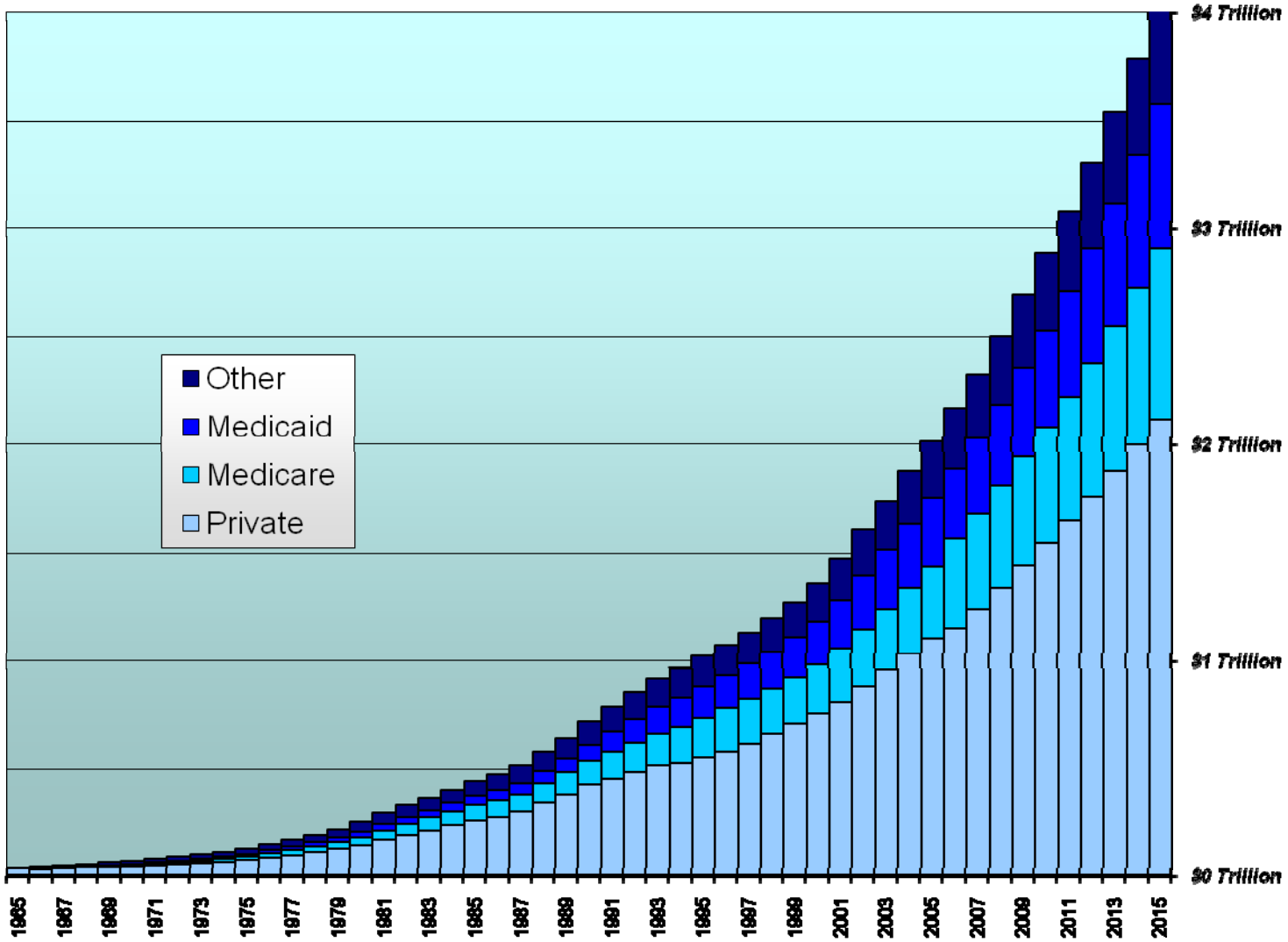
CAN WE AFFORD THIS?

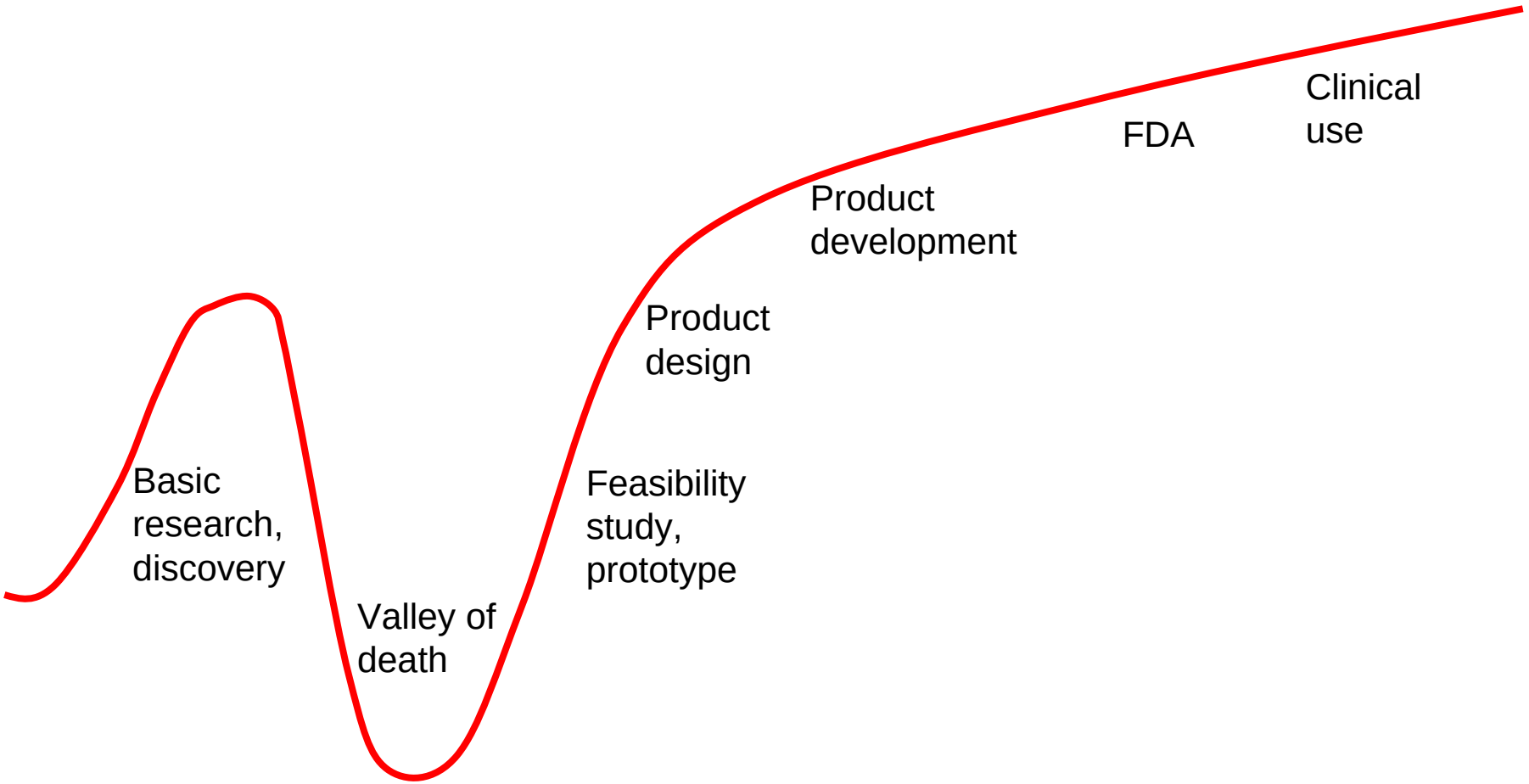


Data from Centers for Medicare and Medicaid Services; Historical from 1965-2004; Projected from 2005-2015; Medicaid Includes Federal, State, & Local

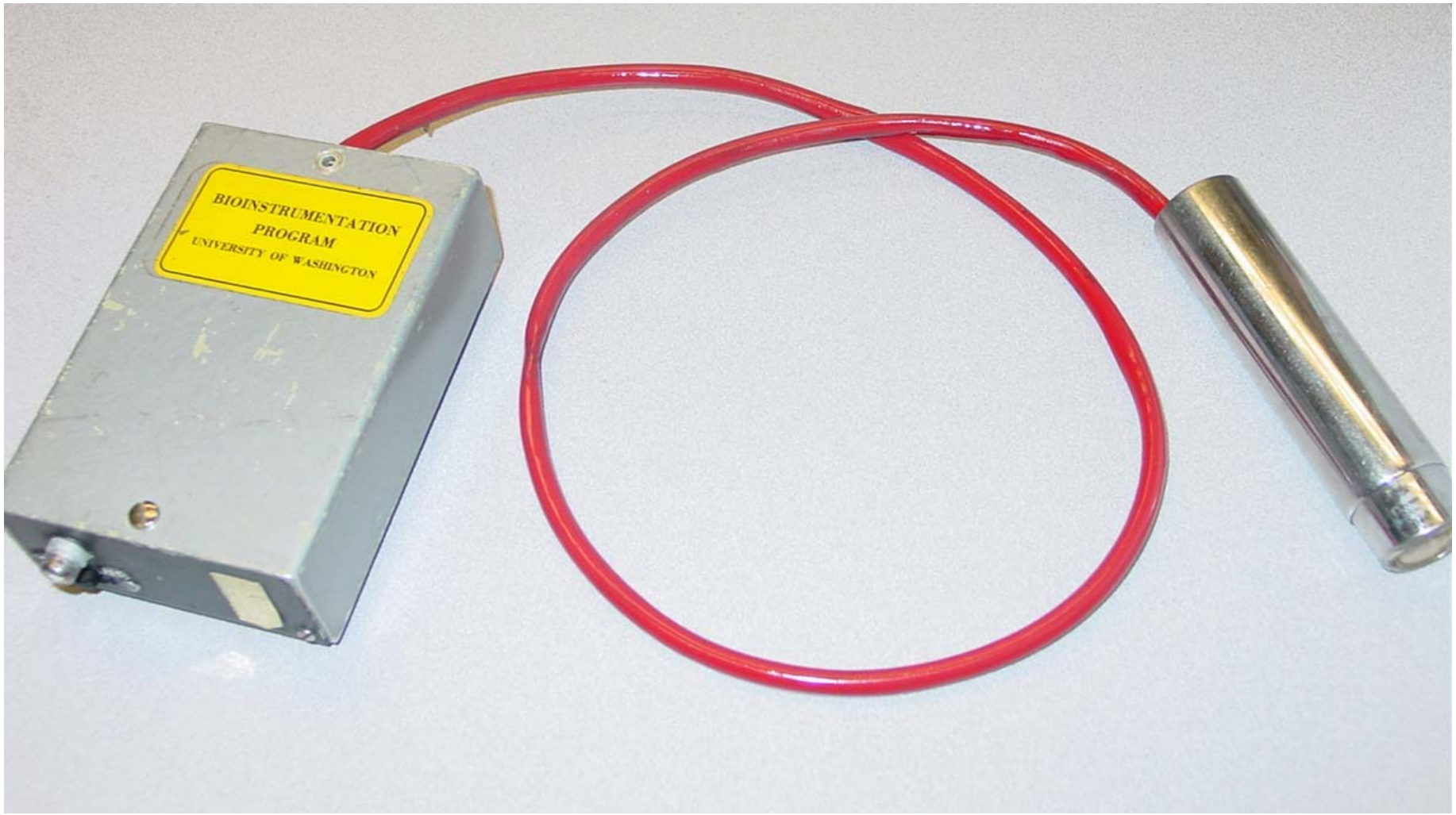
MEDICAL SYSTEMS

- Technologies & Methodologies
  - Biosignal Processing
  - Biomedical Imaging: Molecular, X-rays, CT, MRI, PET, ultrasound and optical imaging
  - Medical Instrumentation & Sensors
  - MEMS and Nanotechnology
  - Neural Engineering
  - Rehabilitation Engineering
  - Biorobotics
  - Biosystems Modeling
  - Computational bioengineering and bioinformatics
- Diagnostic Systems
  - Conventional systems
  - Point-of-care diagnostics
  - Imaging and other tests
- Therapeutic Systems
  - Neuromuscular devices
  - Cardiovascular devices
  - Cancer treatment
  - Drug delivery
  - Artificial tissues & organs:
    Silicon retina, cochlear, tactile sensors, …
- Healthcare and Bioinformation Systems
  - MIS
  - E-medicine & telemedicine
  - D2H2
  - Genomics. Proteomics,and Physiome
  - Tools in drug discoveries

INNOVATION & TECHNOLOGY COMMERCIALIZATION STAGES



THE BEGINNING OF MODERN ULTRASOUND: FIRST PRACTICAL TRANSCUTANEOUS DOPPLER FLOW DETECTOR (SUMMER 1964)



All-in-one PAP Smear Analysis

TRIPATH care technologies

Angioplasty Tool

Boston Scientific

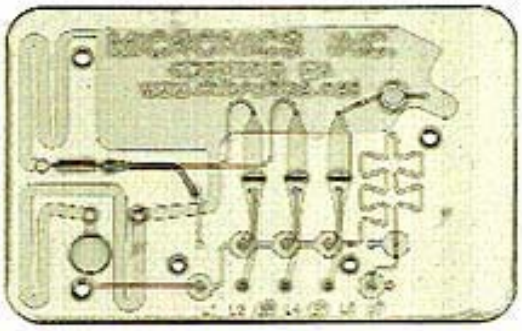
UW BIOENGINEERING

PHILIPS sonicare

The Sonic Toothbrush

micronics

all you need from sample to solution



Lab-on-a-chip Diagnostic Tool

SonoSite

Portable Ultrasound Machines

MY AGING FROM 1971 to 2001

INTRODUCING NEW ULRASOUND MACHINES AT RSNA 2003

UW R&D since FEB. 2000

REAL-TIME 3D US IMAGING (2004)

DESIGN, INNOVATION AND ENTREPRENEURSHIP

- Design: The process of utilizing fundamental principles (engineering, biology, human factors, etc.) to solve a task based on specifications
- Innovation: The creation of something new and useful, solving a need and seeing issues from nontraditional perspectives
- Entrepreneurship: The skill/art of calculated risk-taking in the pursuit of bringing the idea to the marketplace and creating added value

HISTORY

- Many science and engineering graduates struggle in industry as researchers due to lack of training in non-technical fields
- We have courses on entrepreneurship in Industrial Engineering and Business School, but found them not quite effective in training students in science and engineering
- **Spring 2003:** Technical Innovation and Commercialization
- **Summer 2003:** PTC was created. Development of the course sequence
- **Autumn Quarter:** Introduction to Technology Commercialization
- **Winter Quarter**: Studies in Technology Commercialization
- **Spring Quarter**: Applying Technology Commercialization
- **Summer Quarter**: Fellowship

PROGRAM ON TECHNOLOGY COMMERCIALIZATION (PTC)

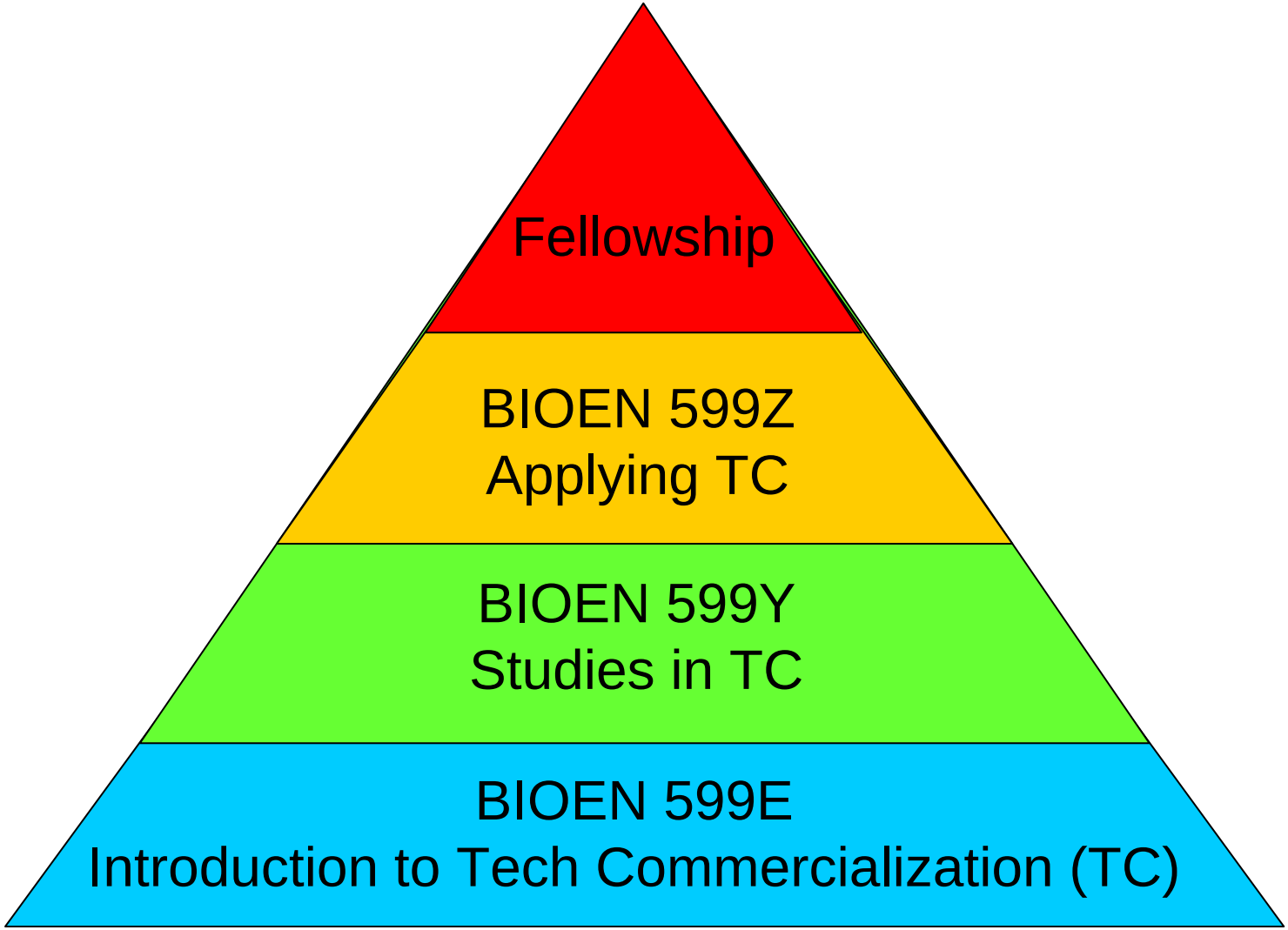
PRIMARY GOAL

Produce the best educated students well trained not only in their disciplines, but also in commercializing technologies and how to move technologies to market

Additional Goals

- Make UW technologies more accessible to investors and licensees
- Help faculty and students in conducting their research and developing realistic expectations
- Create a closer relationship between the local community of experienced practitioners and UW and its faculty

PTC COURSES


Fellowship
BIOEN 599Z
Applying TC
BIOEN 599Y
Studies in TC
BIOEN 599E
Introduction to Tech Commercialization (TC)

BIOEN 599E: INTRODUCTION TO TECHNOLOGY COMMERCIALIZATION

- Covered topics:
  - What is business?
  - Structure, parts/purpose of a company
  - Protecting Intellectual Property
  - Licensing Intellectual Property
  - Contracts and Legal Issues
  - Taxes and Tax Planning
  - Equity Issues
  - Project Management
  - Opportunity Recognition
  - Selling Your Business Idea
  - Market Research and Needs Analysis
  - Product Development & Product Analysis
  - Costs Analysis
  - Marketing, Sales and Distribution
  - Pro Forma Projections
  - Funding and Financing
  - Regulatory Issues
  - Selecting, Hiring & Building Teams
  - Ethics in R&D
  - Working with Professionals

BIOEN 599Y: STUDIES IN TECHNOLOGY COMMERCIALIZATION

- **Topics Covered**
  - Product development and systems engineering
  - Critical market analysis
  - Product marketing
  - Sales
  - IP strategies
  - Negotiations
  - Strategic planning and management
  - Business life cycle
  - Corporate governance
  - Financing
  - Mergers and acquisitions
  - 7 of case studies
- **Contrast to BIOEN 599E**
  - BIOEN 599Y features quite a few case studies and “real-world” examples from the instructors. Student teams also make two 20-minute presentations

BIOEN 599Z: APPLYING TECHNOLOGY COMMERCIALIZATION

- 4-credit advanced course, offered in Spring Quarter
- Requires BIOEN 599Y as a prerequisite
- Student teams use the technologies that have been disclosed to UW TechTransfer or that a team member is currently researching as the basis for studying commercialization
- Each team produces a high-quality market feasibility analysis for their technology
- Feasibility analyses are presented to faculty, inventors, mentors, and UW TechTransfer Invention Licensing
- Teams recommend the most appropriate path to commercialization (if commercialization is appropriate for the technology)

HONOR-LEVEL FELLOWSHIP

- 3-month full-time fellowship in summer
- Awarded when an appropriate technology/product for a new venture is identified by a student team in BIOEN 599Z
- Each student receives fellowship support of $10,000
- Fellows include seniors and graduate (& professional) students from engineering, sciences, law, business schools, and others
- Expectations
  - Fellows work closely with mentors and experienced practitioners
  - Fellows develop a professional business plan
  - Fellows identify and recruit a qualified management team
  - Management team, possibly with Fellows, attempts to start a venture
  - If Fellows join the venture, they understand that they will assume positions appropriate to their level of expertise

OUTCOME MEASUREMENTS

- **It is inherently difficult since it is multi-faceted and multidimensional and it takes a long time to measure its impact**

Qualitative Measures

- Quality and uniqueness of the educational experience gained by students
- Quality of business/concepts
- Process/learning objectives
- Interdisciplinary interaction
- Involvement of local companies and VC/angel community
- Goodwill created with others
- Evaluation by mentors
- Evaluation by inventors
- Evaluation by faculty and outside instructors

Quantitative Measures

- Number of students
- Student evaluation
- Number of technologies analyzed at each stage
- Number of researchers and mentors participating in the process
- Number of business plans generated
- Number of businesses funded for commercialization
- Number of start-ups created directly and indirectly from this program

BIOEN 599E STUDENT EVALUATION

E=Excellent; VG=Very Good; G=Good; F=Fair; P=Poor; VP=Very Poor	No. Resp's	PERCENTAGES [1] E	VG	G	F	P	VP	MEDIAN	Adjusted Median
1. The course as a whole was:	23	35	52	13				4.2	4.0
2. The course content was:	23	43	52		4			4.4	4.2
3. The instructor's contribution to the course was:	23	61	22	9	9			4.7	4.5
4. The instructor's effectiveness in teaching the subj. matter was:	23	43	39	4	13			4.3	4.2
COMBINED ITEMS 1-4	92	46	41	7	7			4.4	4.2
									Relative Rank
5. Course organization was:	23	57	22	13	4	4		4.6	1
6. Clarity of instructor's voice was:	21	57	29	14				4.6	12
7. Explanations by instructor were:	22	45	36	9	9			4.4	15
8. Instr's ability to present alternative explan. when needed was:	20	55	25	15	5			4.6	5
9. Instructor's use of examples and illustrations was:	21	67	19	10	5			4.8	3
10. Quality of questions or problems raised by instructor was:	23	52	35	9	4			4.5	6
11. Student confidence in instructor's knowledge was:	22	64	27	9				4.7	14
12. Instructor's enthusiasm was:	23	61	30	9				4.7	13
13. Encouragement given students to express themselves was:	23	57	26	13	4			4.6	10
14. Answers to student questions were:	23	57	35	4	4			4.6	2
15. Availability of extra help when needed was:	21	52	33	10	5			4.5	7
16. Use of class time was:	22	36	50	9	5			4.2	11
17. Instructor's interest in whether students learned was:	20	45	30	15	5	5		4.3	17
18. Amount you learned in the course was:	20	45	50	5				4.4	9
19. Relevance and usefulness of course content were:	22	59	27	9	5			4.7	4
20. Evaluative and grading techniques (tests, papers, etc.) were:	22	23	27	27	14	9		3.5	18
21. Reasonableness of assigned work was:	22	45	27	23		5		4.3	8
22. Clarity of student responsibilities and requirements was:	22	45	18	18	5	5	9	4.3	16
Relative to other college courses you have taken:		**Much Higher**			**Average**		**Much Lower**		
23. Do you expect your grade in this course to be:	20	5	35	30	25	5		5.2	
24. The intellectual challenge presented was:	20	5	45	10	10	25	5	5.5	
25. The amount of effort you put into this course was:	20		20	35	25	15	5	4.6	
26. The amount of effort to succeed in this course was:	19		26	32	26	11	5	4.8	
27. Your involvement in course (assignments, attendance, etc.) was:	20	15	20	20	40		5	4.8	

BIOEN 599Y STUDENT EVALUATION

E=Excellent; VG=Very Good; G=Good; F=Fair; P=Poor; VP=Very Poor	No. Resp's	PERCENTAGES [1] E	VG	G	F	P	VP	MEDIAN	Adjusted Median
1. The course as a whole was:	11	100						5.0	4.4
2. The course content was:	11	73	27					4.8	4.3
3. The instructor's contribution to the course was:	10	90	10					4.9	4.5
4. The instructor's effectiveness in teaching the subj. matter was:	11	55	45					4.6	4.0
COMBINED ITEMS 1-4	43	79	21					4.9	4.3
									Relative Rank
5. Course organization was:	11	27	64	9				4.1	17
6. Clarity of instructor's voice was:	11	64	36					4.7	16
7. Explanations by instructor were:	11	55	45					4.6	15
8. Instr's ability to present alternative explan. when needed was:	11	64	27	9				4.7	8
9. Instructor's use of examples and illustrations was:	11	82	18					4.9	3
10. Quality of questions or problems raised by instructor was:	11	55	45					4.6	12
11. Student confidence in instructor's knowledge was:	11	82	18					4.9	14
12. Instructor's enthusiasm was:	11	82	18					4.9	13
13. Encouragement given students to express themselves was:	11	82	18					4.9	5
14. Answers to student questions were:	11	55	36	9				4.6	11
15. Availability of extra help when needed was:	10	60	30	10				4.7	10
16. Use of class time was:	11	55	45					4.6	6
17. Instructor's interest in whether students learned was:	11	73	27					4.8	7
18. Amount you learned in the course was:	11	73	27					4.8	1
19. Relevance and usefulness of course content were:	11	82	18					4.9	2
20. Evaluative and grading techniques (tests, papers, etc.) were:	11	36	36	27				4.1	18
21. Reasonableness of assigned work was:	11	55	45					4.6	4
22. Clarity of student responsibilities and requirements was:	11	55	45					4.6	9

Relative to other college courses you have taken:		Much Higher		Average		Much Lower			
23. Do you expect your grade in this course to be:	10	20	50	20	10			5.9	
24. The intellectual challenge presented was:	10	20	50	20	10			5.9	
25. The amount of effort you put into this course was:	10	20	60	10		10		6.0	
26. The amount of effort to succeed in this course was:	10	10	60	20		10		5.8	
27. Your involvement in course (assignments, attendance, etc.) was:	10	20	60	10	10			6.0	

BENEFITS TO STUDENTS

- Students loved the program! It attests to a real need among our students.
- The student evaluation results place the courses in the top 5% at the University of Washington
- Complete education, learning not only in their major areas but in commercialization to be able to bring their ideas and inventions to market
- Valuable experience in interacting with the commercial world and a better understanding of it
- Prepare them to be better innovators and collaborators not only for future entrepreneurship opportunities but also working in an established company (intrapreneurship)
- Better contacts increasing employment opportunities and extra education giving them an edge in this competitive global economy

BENEFITS TO THE UNIVERSITY

- Creation of a program that is consistent with UW objectives to provide our students with quality education, promote collaboration, integrate education and research, and transfer results of UW research for the public good
- Students' analysis of real technologies may
  - Assist OIPTT (Office of Intellectual Property and Technology Transfer) to better analyze potential products, licensees, and, where appropriate, new venture opportunities
  - Expose more technologies to the entrepreneurial community, leading to increased technology transfer and economic development
  - Help faculty and students understand the value of translational research so that they can do better in conducting research and transferring technologies
  - Demonstrate a path to commercialization that spurs additional research funding from government agencies, foundations, and industry

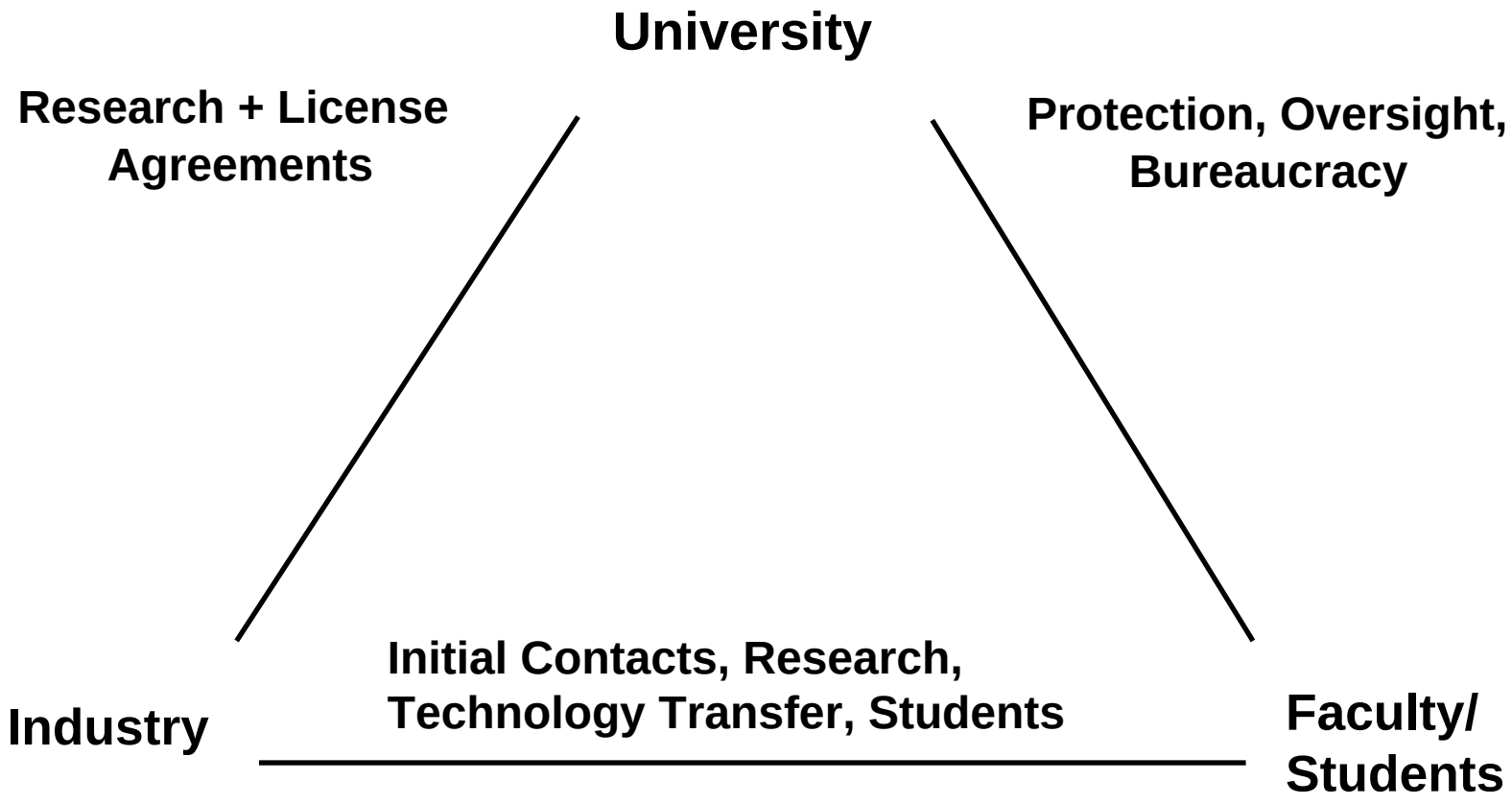
BENEFITS TO LOCAL COMMUNITY

- An opportunity to engage some of the brightest and motivated students
- Chance to educate and influence future engineers, scientists, entrepreneurs, and leaders
- Learn more about UW technologies, faculty and inventors
- Exposure to new business opportunities
- Opportunity to serve the University of Washington
- The guest lecturers were enthusiastic about the program and unanimous in that PTC would have been a valuable addition to their own training
- One said “this course could have led to the avoidance of over $100M in mistakes.”

TRANSLATIONAL RESEARCH IN ACADEMIA

- Faculty time
- Lack of $ support beyond discovery phase
- Working with industry and intellectual properties
- Issues are getting complex in public institutions
- Lack of market analysis
- University research services (GCS, TechTransfer, …) are underfunded
- Risk avoidance and bureaucratic approach (and legalistic) rather than customer-oriented
- Lack of faculty members and administrators with real experience and good understanding in technology commercialization and entrepreneurship

UNIVERSITY/INDUSTRY INTERACTIONS



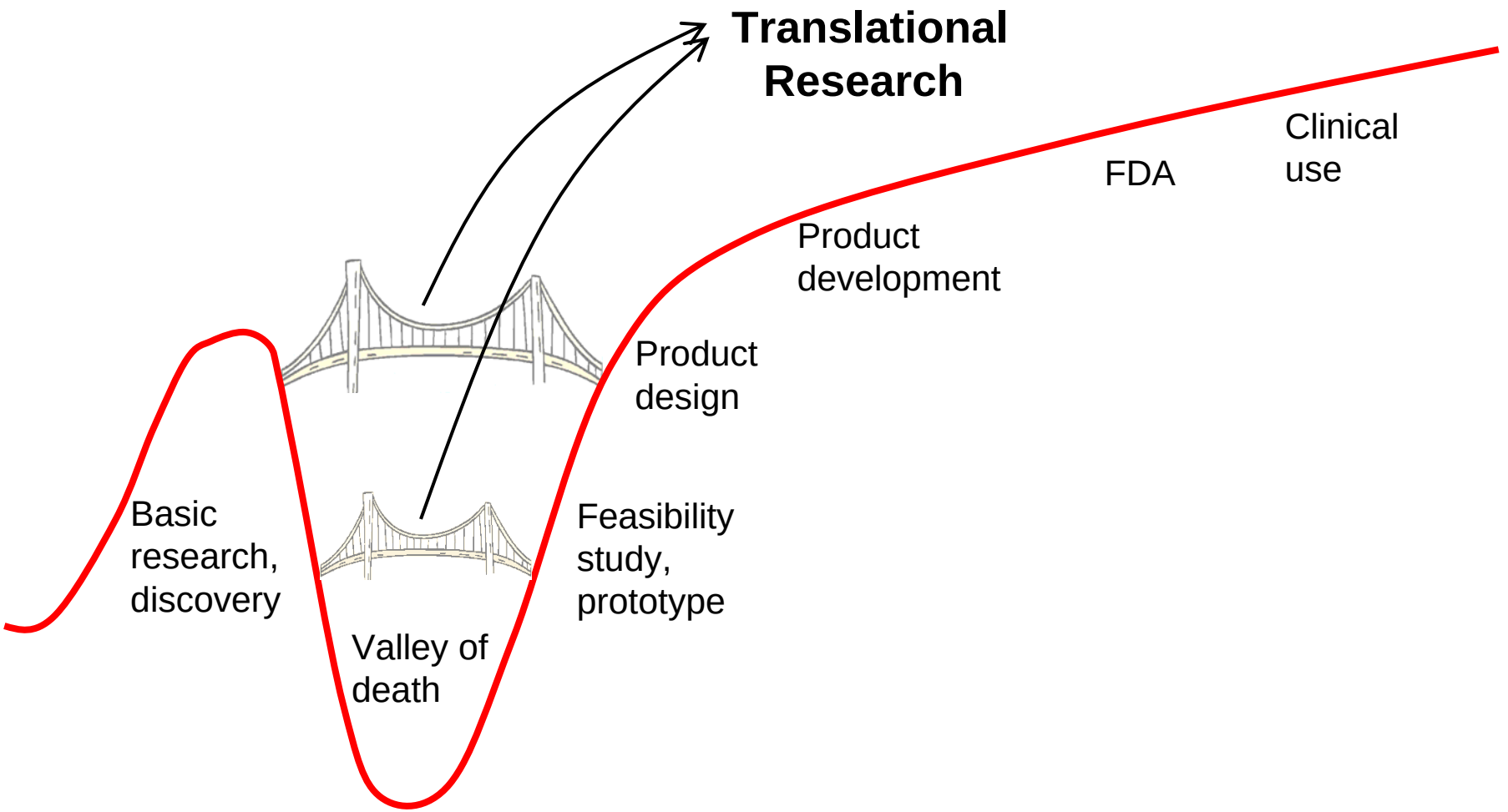
MUTUAL BENEFIT vs. GREED

- **Industry**
  - Access and interaction with faculty and students.
  - Have the promising ideas explored and tackled with the minimum risk.
  - Treat faculty and students as subcontractors and cheap labor.
  - Lack of understanding in academia.
- **University/Hospital**
  - Reputation, $, Infrastructure, seed for more significant research.
  - Good relationship with industry. Direct impact on the economy.
  - More practical training for students.
  - Competitive with other institutions and flexible.
  - Each research agreement needs individual attention.
  - Too much interest in the license and royalty income.
- **Faculty/Students**
  - Opportunity to narrow the gap between academic research and practical applications, and better understand industry.
  - Satisfying and rewarding.
  - There are many time-consuming tasks other than conducting research.
  - Disregard for institutional interests.
  - Frustration with industry and university.

WHAT DOES IT TAKE TO SUCCEED?

- Excellence and innovation in research
- Understand the needs (marketing) and competition
- Vision, risk-taking, entrepreneurial culture, and (realistic) optimism
- Leverage the existing strengths and experience
- IP
- Passion, perseverance and patience
- Team building and planning
- Integrity, trust and fairness
- Good peoples and communications skills
- Entrepreneurial ecosystem
- Entrepreneurial and collaborative spirit
- Close ties with industry, win-win-win
- External research funding and external/internal translational funding

BRIDGING THE VALLEY OF DEATH



CONCLUSION

- We have developed a very successful educational program on technology commercialization (PTC) at the University of Washington
- It consists of 3 courses and 3-month full-time fellowship
- We leveraged our strength in research and track records in translational research and commercialization to reach out to the local community and get their support and participation
- Its success is attributable to external experienced practitioners (many of them have engineering/science background) sharing their real-world experience in a structured course setting
- PTC benefits our students first and foremost, but we have found that it benefits the University of Washington and the local community, making it a key component of the vibrant local innovation and commercialization ecosystem

UNIVERSITY OF WASHINGTON