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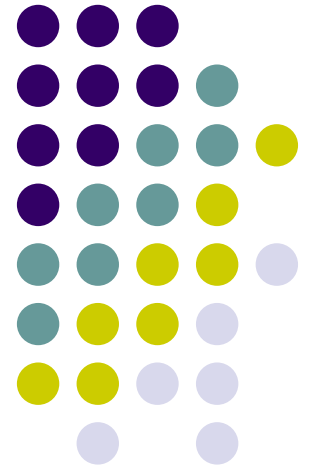
15.351 Managing Innovation and Entrepreneurship
Spring 2008

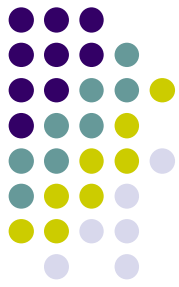
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15. 351 Managing Innovation & Entrepreneurship

Fiona Murray
MIT Sloan School of Management
Spring 2008

Class Fifteen – SpudSpy

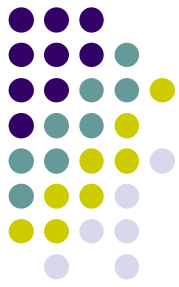




Traditional Perspective

Researchers organized into distinctive worlds & generated distinctive types of knowledge

		Consideration of Use?	
		NO	YES
Quest for Fundamental Understanding?	YES	“Science” Academic World (Bohr – WHY?)	
	NO		“Technology” Commercial World (Edison – HOW?)



Traditional Perspective

Two quite distinctive worlds in which research is taking place

Science = “Open Science”

Contributions to basic knowledge undertaken in academia & published & made available for scrutiny

Technology = “Private Property”

Contributions to useful knowledge generated in industry & patented or maintained as secret

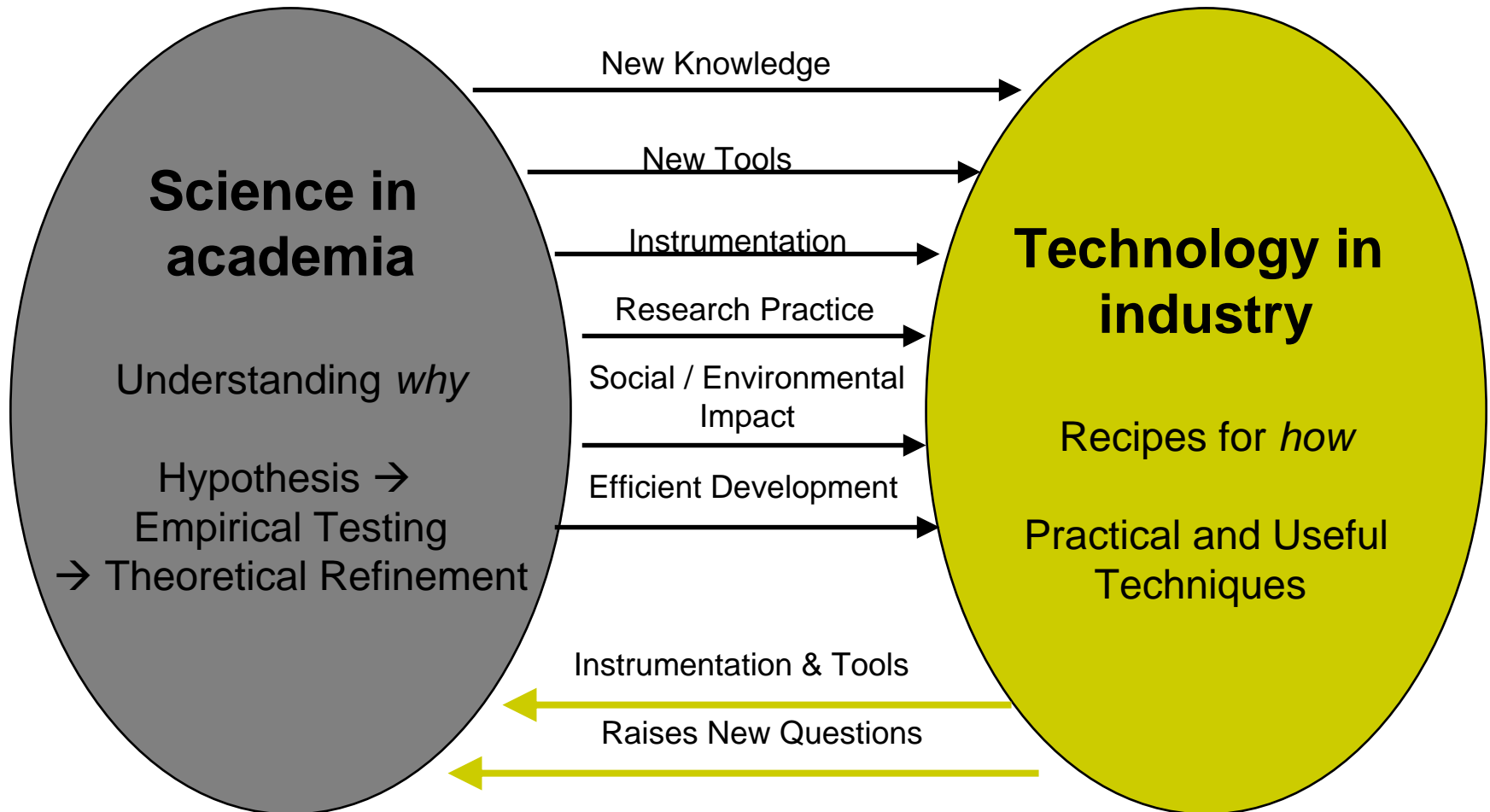
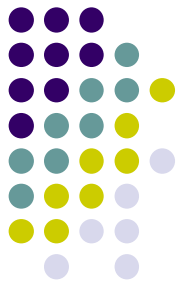
Priority-based system of exchange

- Researchers adopt *norms* that require disclosure in papers
- *Quid pro Quo*: Disclosure of findings via publication allows for “standing on shoulders of giants” in return for priority (citations), prestige & job security

Private-property based system of exchange

- The patent system designed to minimize duplication & facilitate cumulativeness (overcome incentives for secrecy)
- *Quid pro quo*, exchanging limited monopoly rights for disclosure in patents which provide a base for follow-on researchers/investors

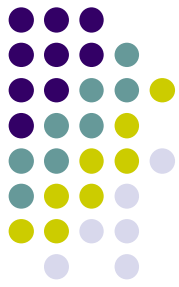
The Relationship between Academia & Industry... flow via literature, trained students, consulting



New Perspective –Pasteur’s Quadrant

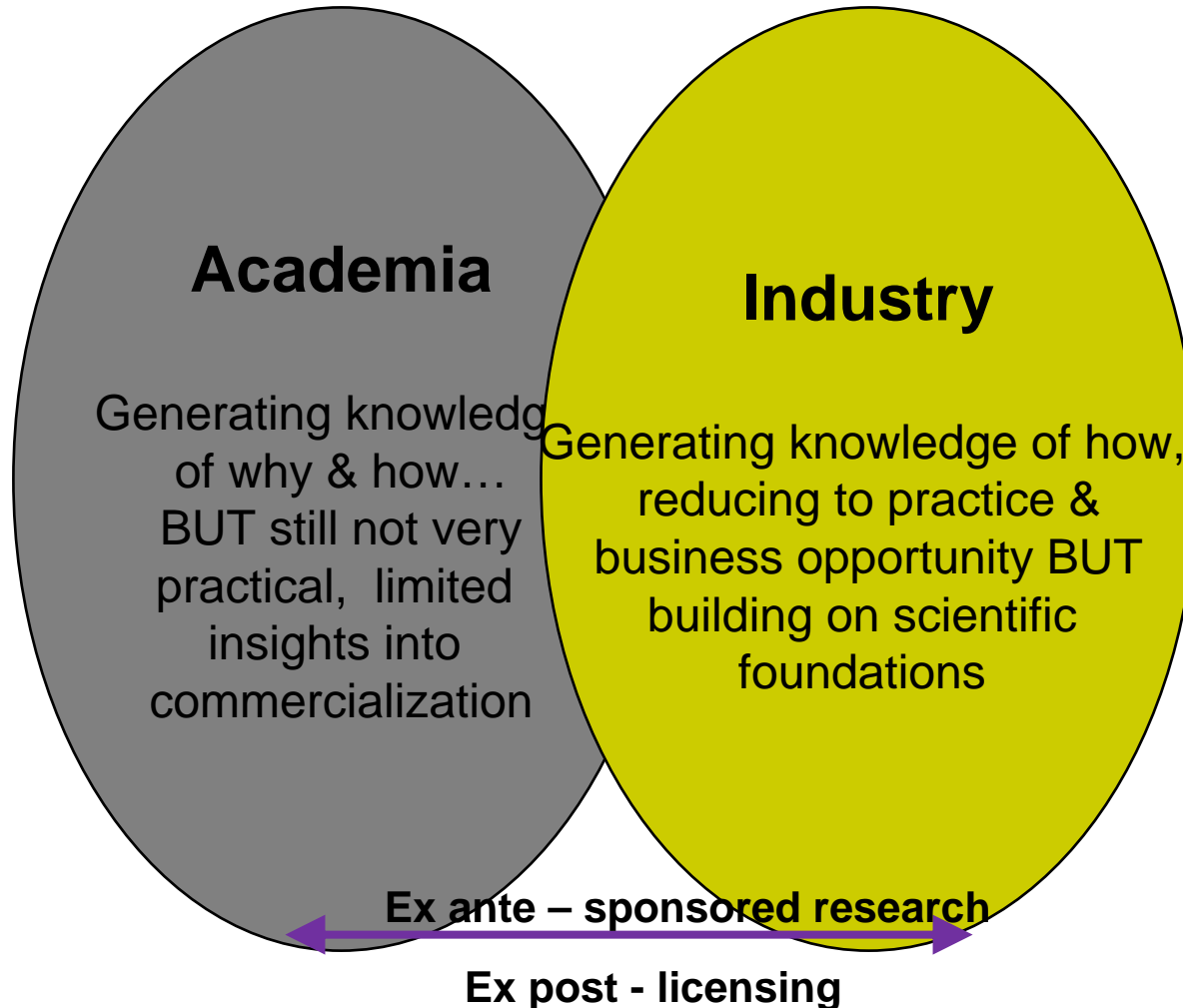
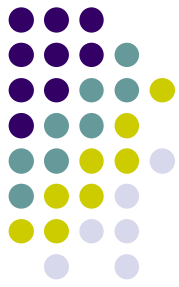
Knowledge that is both fundamental & of practical use...

“sweet spot” but how do we organize this?

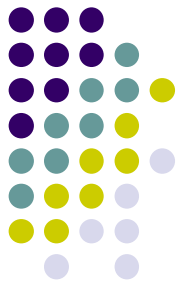


		Consideration of Use?	
		NO	YES
Quest for Fundamental Understanding?	YES	“Science” Academic World (Bohr)	PASTEUR’S QUADRANT
	NO		“Technology” Commercial World (Edison)

Requires new ways to push academia & industry together



Key distinctions



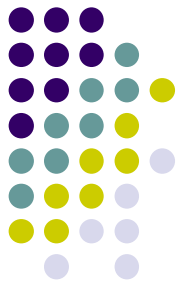
- Ex ante - BUY EXPERTISE – develop ideas for you (sponsored research)
- Ex post - BUY IDEAS – after they are developed (tech licensing)
- Sponsored research arrangements
- Structured around research agenda
- More interaction with labs & PIs needed
- Pay-off hard to predict
- Licensing agreements
- Typically structured around IPR (but not always)
- Exclusive or non-exclusive
- Deal terms
- Start-ups & established firms

Ex ante – working with academia before an “idea” is completed to develop an idea



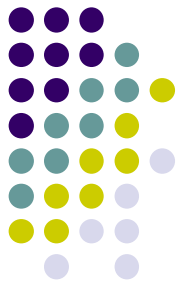
	Ex ante – sponsored research
General issues	Rights to follow-on IP -Rights to negotiate a license - Rights to non-exclusive research use Publication review Work program specification Alignment of research interests
New Firm	Show how start-up can benefit the faculty – getting faculty tools into widespread circulation, standard setting etc. If research comes AFTER start-up: -Potential for participation in firm -Faculty can't do sponsored research if you hold EQUITY
Established Firm	Money for lab! Show that the firm can benefit the faculty – hard to access equipment, materials etc. Real world applications experience Best company to take to later commercialization

Ex post – working with academia after an “idea” is completed to get rights to idea

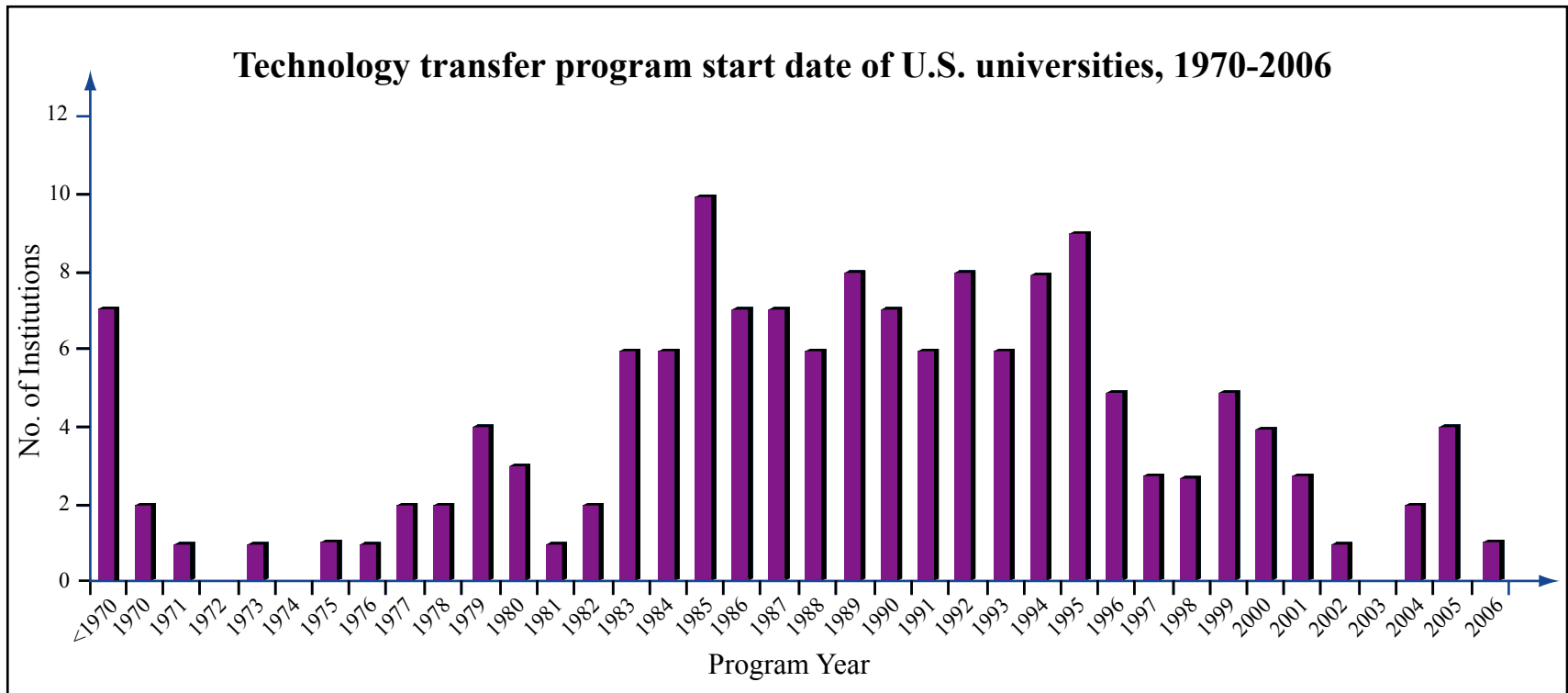


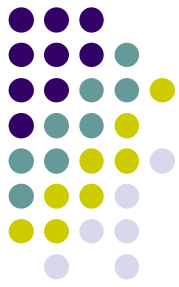
- Traditional mechanism – technology licensing
- Governed by a complex set of rules:
 - Bayh-Dole Act 1980
 - Employee “Participation agreements” – sign over title of most IP generated (often includes students)
- Characterized by mis-aligned incentives & no clear structure:
 - Faculty don’t have to commercialize
 - Unlikely to be very financially rewarding (EV~\$100,000)
 - No accepted process for initiating commercialization

Bayh-Dole Act 1980



- Ownership of patents generated in a university using Federal funding => universities
- Burden on universities to ensure the commercialization of these patents (of all ideas) – structured via licensing arrangements
- Requirement to favor small, entrepreneurial firms

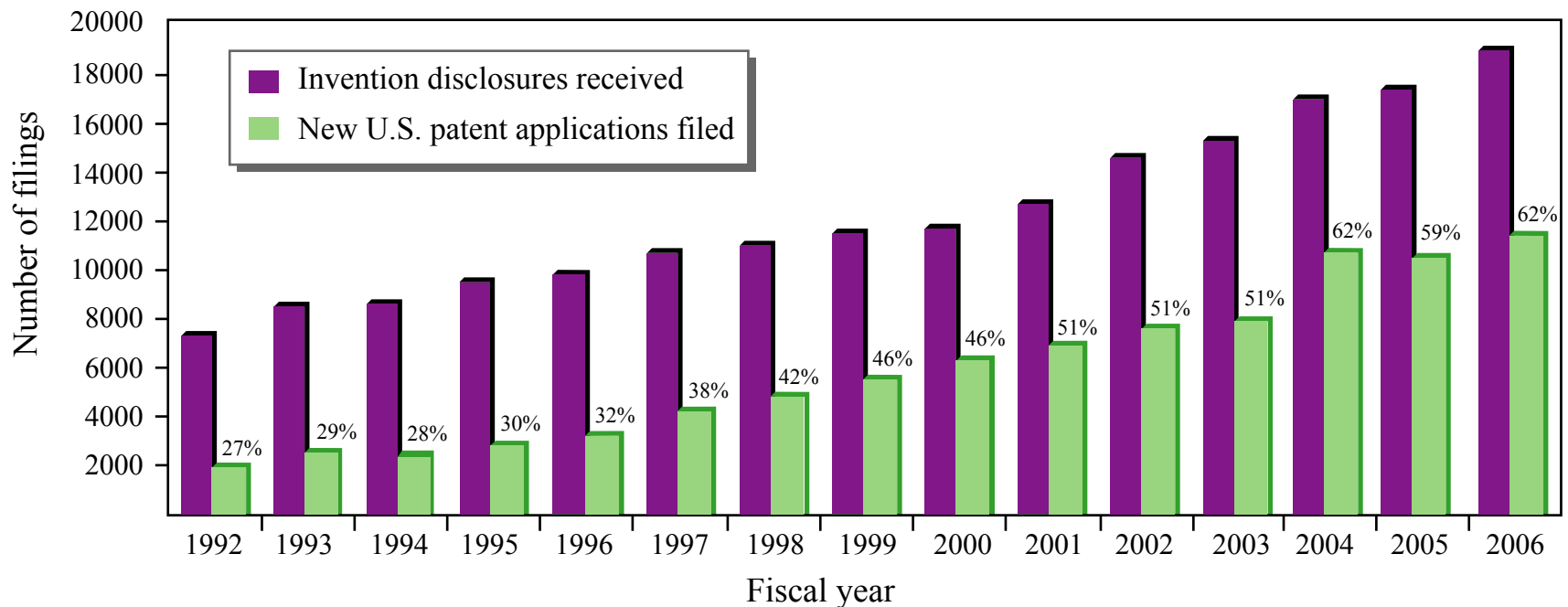




Response to the Bayh-Dole Act

About 3000 patents granted per year to US universities on about US\$30billion per year research funding – 100 patents/billion!

New patent filings and invention disclosures received, 1992-2006



Positive Outcomes

Considerable progress in drug discovery

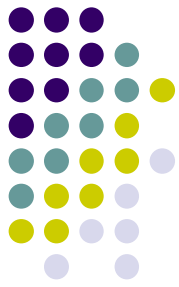


Number of successfully developed drugs patented & licensed from US academic institutions (1980-2006)

<u>By the Numbers</u>	
Total number of institutions	64
Total number of drugs	112
Number of NCEs	58
Number of Biologics	26
Number of Vaccines	14
Number OTC	3
Other	11
Number of drugs jointly discovered by two or more public institutions	18

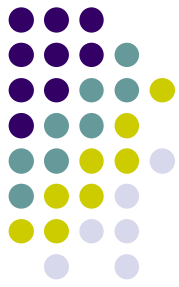
Given low success rates probably means that more than 1,000 drugs from academia went into the clinic

Ex post– working with academia after an “idea” is completed to get rights to idea



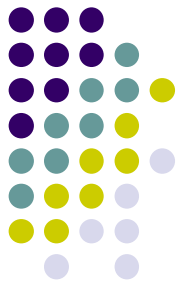
	Ex post – Technology licensing
General issues	Licensing terms -Upfront & milestone payments -Royalty rates Rights to follow-on IP -Rights to negotiate a license - Rights to non-exclusive research use
New Firm	Equity relationship With university – negotiate with TLO – typically ~ 1% at IPO With faculty – negotiate for founders equity ~ 5% at IPO or may be willing to simply “bless” the deal
Established Firm	Coordination of licensing with either sponsored research OR hiring of key graduate students OR consulting with faculty Transfer rarely happens effectively in isolation

Multiple participants in all negotiations with divergent interests



- Faculty
 - Wants to continue research line & have an impact
 - Wants opportunities to see work “make a difference”
 - If there is money, wants his “fair share”
- Graduate students (in lab)
 - Potential employment opportunity with firm
 - Start-up opportunity – CTO, CEO – is business that hard?
- TTO
 - Safeguard interests of university
 - Get the best deal for technology
 - Listen to desires of (some) faculty
- Spin-out “agent” – students, experienced VCs, managers, Centers (e.g. Deshpande)

University Commercialization Projects – potential for mis-alignment



Spin-out Team

- Needs to agree to the commercialization activity – more powerful partner
- Rewarded by intrinsic interest in seeing ideas in practice but wants deal to be fair
- Project is secondary to scientific projects & scientific work, teaching, students etc.
- Not always versed in business issues
- Sometimes tainted by prior failures – trust?
- Wants to start a new business
- Financial goals (& experience) are key
- If MBA, then project could be the source of employment opportunity but some problems of hierarchy (MBA to professor)
- If outsider – needs to have “credibility” – build trust via introductions etc.
- No clear operating procedures

Ambiguities – grad student role, TTO role, (business) faculty advisor role

Anatomy of a License



+ equity issues

- **Upfront licensing fee**
- **Milestone payments**
- **Royalties on final product**



Licensing rights to develop IP

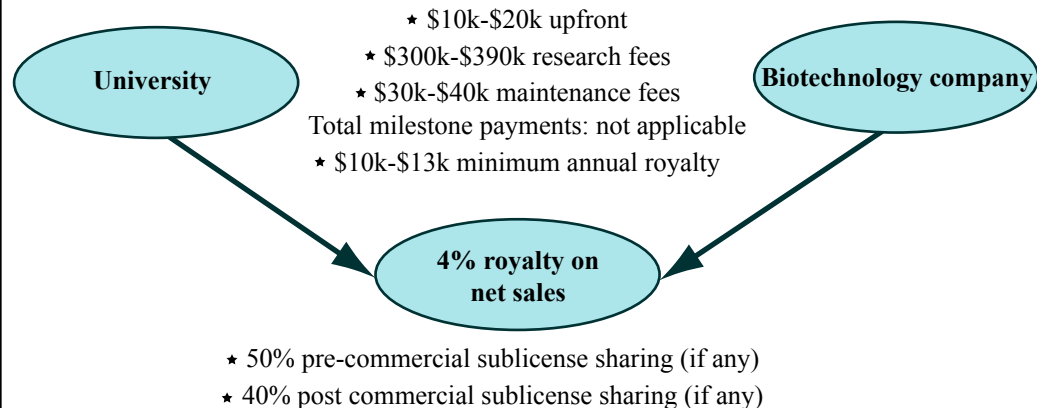
- **exclusive or non-exclusive**
- **limited by specific applications or not**
- **geographic scope may be bounded**

Distributed to the faculty & department according to a formula – 1/3:1/3:1/3



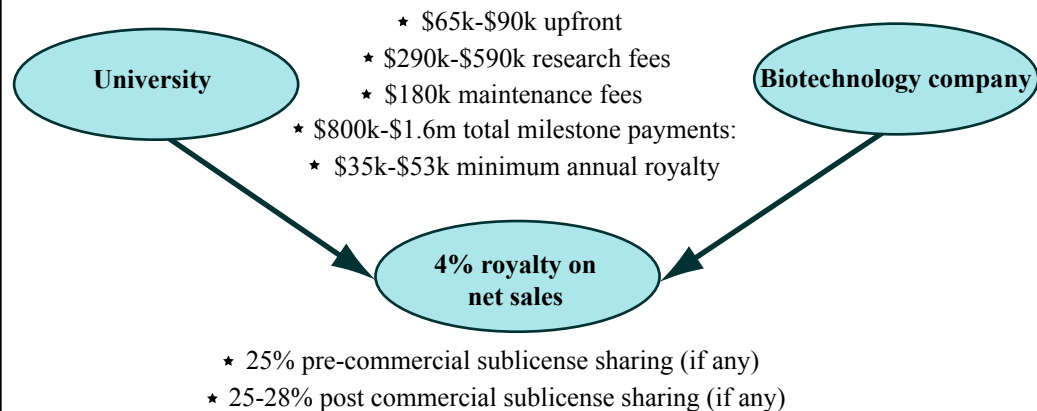
Typical deal terms in biotech

a) 1975-1985



a 1975-1985

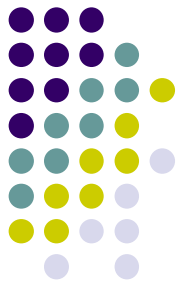
b) 1995-2003



b 1995 onwards

Source: Edwards,
Murray & Yu, 2003

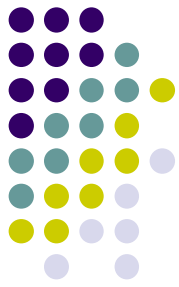
University Equity



- European universities tend to take more equity
- European universities generally take a greater role in company formation – in the US especially Cambridge, we let the market for ideas take care of this...
- More difficult for hospitals to take equity (esp if trials are involved)
- Universities differ on whether they also fund spin-outs

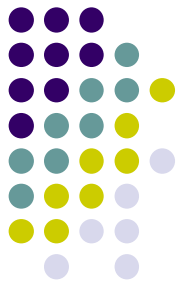
Do faculty get founders equity?

Depends upon faculty attitudes to patents & licensing & role in start-up



- Interviews with over 60 MIT faculty (Biology, Chemical Engineering, Chemistry, Biological Engineering, HST)
 - Open Science Purist (5%) – philosophically opposed to IP
 - Shelver (30%) – patents & leaves on the shelf
 - Burned Cynic (5%) – may patent but has a poor view of “business-types” (e.g. Anderson in SpudSpy) – little commercialization
 - Graduate Mentor (50%) – patents & lets grad student take the lead – faculty & student get equity
 - Aggressive Pursuer (10%) – patents & pursues commercialization – faculty takes equity

Typical issues to consider in equity splits



Past contributions: Who came up with the Big Idea? Helped refine the idea? Put money into the company to help get it started? Helped find another co-founder or seed investor?

Future contributions: What role will each person play in the early months? Will that person still be playing a key role in a year or two (or more)? Still be working for the company at all?

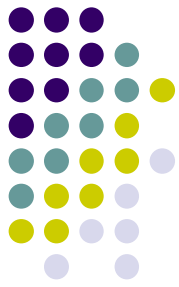
Opportunity cost: Is one founder giving up a cushy job at a top company, while the other is not currently employed? Is one dropping out of a good school, the other otherwise unemployed?

Your relationship: Do you trust your co-founder to surrender equity to you later if you end up feeling like you're contributing more than he is? Are you willing to fight over the equity (e.g., sacrifice some of the relationship with your co-founders in order to get another 5%)?

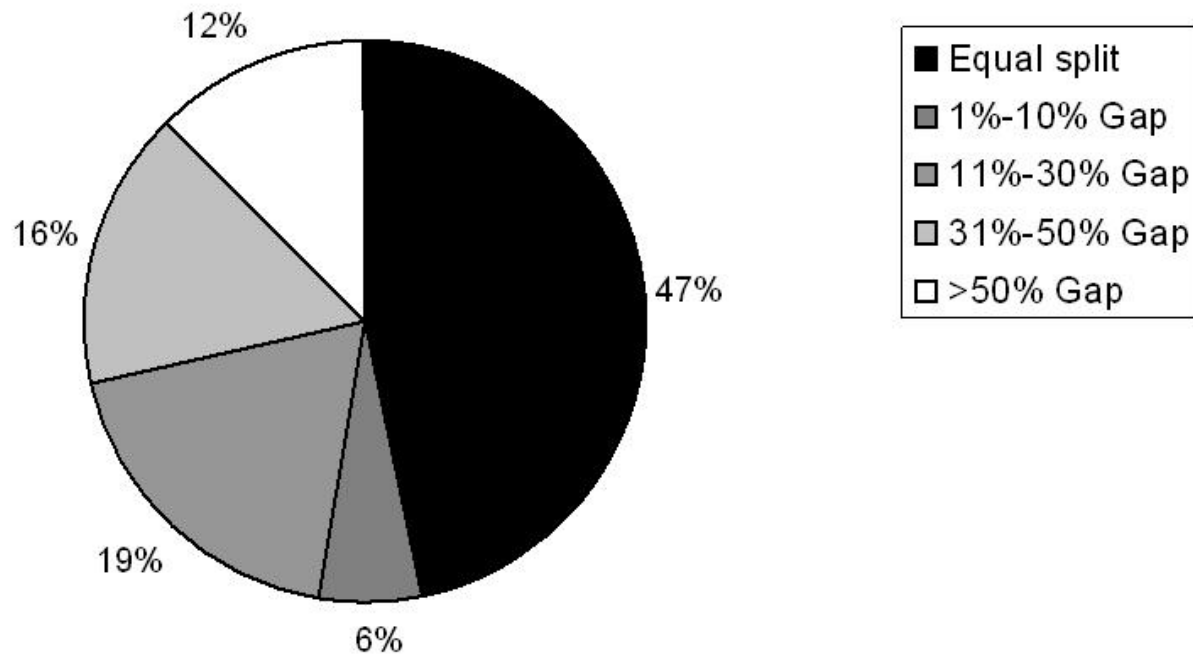
Courtesy of Noam Wasserman. Used with permission.

“Splitting the Pie: Founding Team Equity Splits” in Noam Wasserman’s “Founder Frustrations” blog. January 15, 2006.

Founder Equity Gaps



Gap in Founder Equity Stakes, 203 IT Ventures (2005 Survey)



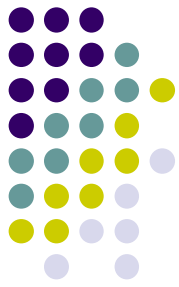
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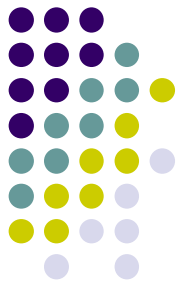
All important equity issues

Equity goes to university via the licensing agreement & to faculty via founders equity



Comparison of university versus faculty values (ATVs)

	# of IPOs	Number of IPOs with university equity (%)	Total value of university equity (millions) (% ATV)	Number of IPOs with faculty equity (%)	Total value of faculty equity (millions) (% ATV)
Class of 2004	34	14 (41%)	\$20 (0.6%)	17 (50%)	\$291 (8.6%)
Class of 2000	65	16 (25%)	\$170 (1.1%)	25 (38%)	\$754 (4.9%)
Class of 1997	53	16 (30%)	\$88 (3.1%)	28 (53%)	\$140 (4.9%)



Opportunities for alignment do exist

- Experienced & willing faculty-founder with a clear SOP (e.g. Langer) – self-selection!
- Interested technical graduate scientist(s) – self-selection!
- Committed MBA team & preferably an experienced manager or early-stage financial backer – makes it more credible
- Right timing – adequate technical development
- Clear technical path with defined roles for:
 - Professor (advisor, chief of SAB etc., or benign neglect)
 - Lab (sponsored research – rare; patent stream)
 - Company (research; patents)
 - Additional firms (research; proof of concept)

University entrepreneurship is more than licensing...

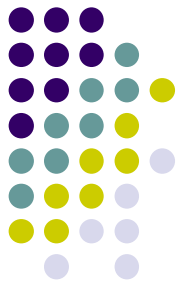


- People who understand the technology
- People who can implement the ideas
- People to move the ideas forward



- People who can advise
- People who bring status/ reputation
- People who can connect to other “stars”

Typically need to manage BOTH licensing & sponsored research



	Ex ante – Sponsored Research	Ex post – Technology licensing
New Firm	e.g. D-Wave	e.g. SpudSpy e.g. AIR (licensed after development – no more formal univ role)
Established Firm	e.g. DuPont-MIT Alliance	e.g. Micro bioreactors

Two sets of curved arrows, one in the 'New Firm' row and one in the 'Established Firm' row, indicating a cycle between the 'Ex ante' and 'Ex post' columns. Each set consists of two arrows: one pointing from the left column to the right, and another pointing from the right column back to the left.