

**“Reassembling the Social” in  
Entrepreneurial Innovation and Academic  
Entrepreneurship Studies:  
The “Amphibious Scientist” Phenomenon**

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# Agenda

- Research object: **approccio “critico”** alla formazione della “domanda di ricerca”
- Theoretical Context: **entrepreneurial innovation & academic entrepreneurship**
- Empirical Context: **dinamiche organizzative (a livello di *agency*)** di innovazione imprenditoriale come pratiche sociali emergenti
- Methods: **historical institutionalism** sull'emergere dei componenti di una DBF; una etnografia dal/nel laboratorio dell'IGA-Technology Services all'interno dell'Istituto di Genomica Applicata (**ANT as research strategy**)
- Findings: fenomeno degli **amphibious scientists** come processo di *social assembling* (“**across multiple, intertwined social and material networks**”)
- Discussion & Conclusions: **relational, temporal, and performative dimensions** del fenomeno

### **1. Introduction**

### **2. Theoretical context**

*2.1 Entrepreneurial Innovation*

*2.2 Academic Entrepreneurship*

### **3. Methods**

*3.1 Data collection*

*3.2 Empirical contexts*

*3.3 Analytical process: ANT as research strategy*

### **4. Findings: Social Dimensions Assembling DBF**

*4.1 Science, Finance, and Commerce: Networked Components of DBF Emergence (1968-1981)*

*4.2 An Organizational Hybrid: IGA & IGA-Tech as DBF Variant*

### **5. Discussion: Relational, Temporal, and Performative Aspects of Academic Entrepreneurship**

*5.1 How the Biotech Market Becomes a(n) (Arti)Fact (1968-1981)*

*5.2 Amphibious Entrepreneurs and Entrepreneurial Innovation*

### **6. Conclusion**

### **References**

# Oggetto della ricerca/ Motivating Questions (\*):

- la **materialità dei processi imprenditoriali** e il **ruolo della conoscenza pratica**:  
i) ridefiniscono l'**innovazione imprenditoriale** in un “campo di forze” che mette insieme persone, tecnologie, strutture sociali e conoscenze; ii) ed è tale processo di “stabilizzazione” che permette ad un progetto imprenditoriale di essere messo in opera in termini di **imprenditorialità accademica**
  - “**amphibious scientist**” come **attore-rete** (associazione di materiali umani e non-umani in alleanze instabili che vengono stabilizzate come un attore collettivo)
- **N.B. (1) - l'unità di analisi**, per superare la dicotomia **agency v. structure**: (i) no “struttura”; (ii) no “gruppi” o “individui”; ma (iii) **practice-based approach (\*\*)**
  - **N.B. (2) - attenzione “critica”** a fenomeni considerati tra loro **interdipendenti**:  
(i) l'insieme dei processi trasformativi, di trasferimento, di **traduzione** o di espansione spazio-temporale, (ii) attori, idee/concetti come effetti del **campo di relazioni** in cui sono inseriti, (iii) **materialismo relazionale** e **performatività** come indicazioni metodologiche per interpretare i processi imprenditoriali

(\*) sull'approccio di “critical management” e sulla “problematization methodology”: Alvesson, Sköldbberg 2009; Alvesson, Bridgman, Willmott 2009; Alvesson, Sandberg 2013;

(\*\*) sul concetto di pratica organizzativa: Schatzki *et al.* 2001, Schatzki 2002, 2005; Gherardi 2006; Feldman, Orlikowski 2011; Nicolini 2012

# Problematizzare l'entrepreneurial innovation *(Garud et al. 2014)*

Approach	Micro-Macro approaches		Multilevel approaches		Constitutive approaches	
<b>Analytic focus</b>	<b>Antecedents:</b> factors that explain EI		<b>Events:</b> Episodes when EI is “found” or “made”		<b>Journey:</b> Dynamics whereby EI emerges	
<i>Perspective</i>	<i>agentic-centric</i>	<i>context-centric</i>	<i>discovery</i>	<i>creation</i>	<i>co-creation</i>	<i>narrative</i>
<b>Emphasis</b>	entrepreneurial agency	entrepreneurial contexts	opportunity discovery	opportunity creation	dynamic equilibrium and ongoing change	meaning making through interplay of E&E
<b>Locus and nature of agency</b>	agency established by actor attributes	agency prescribed by institutional structures	agency cultivated by being alert or by spanning structural holes	agency derived from capacity to bricolage and accentuate	agency located in ecology of interactions	agency “translated” through social and material networks
<b>Role of the context</b>	Contexts not explicitly considered	contexts explain EI	moderate availability of opportunities	moderate viability of creations	both medium and outcome of actions	constituted through performative efforts

# Academic entrepreneurship: una prospettiva narrativa

- le dimensioni della **narrative perspective (\*)** sulla “entrepreneurial innovation” (Garud *et al.* 2014, p.1181):
  - **relationality** (“relational facet refers to the constitution of agency through existing and anticipated relationships across social and material elements”)
  - **temporality** (“temporal facet refers to the various accounts of the past, present, and future that are offered as innovation unfolds”)
  - **performativity** (“performative facet highlights how narratives serve as triggers for action towards goals that are forever changing)
- **novelty** nella “academic entrepreneurship” come “**organizational practice**” (Padgett, Powell 2012) (\*\*):
  - **recombination** (“moving practices from one sector into another where they are recognizable”)
  - **transposition** (“moving practices into settings where they are foreign represents a boundary crossing”)

(\*) *narrative perspective*: Bruner 1986; Czarniawska 1997, 2004; Polkinghorne 1988; Ricoeur 1984;  
(\*\*) “the practice-based approach re-specifies organizing processes in terms of practices and foregrounds that materiality is integral to organizing, positing that the social and the material are *constitutively entangled* in everyday life” (Orlikowski 2007, p. 1437).

# Contesto empirico (1a): a livello “macro” (Bernman 2012)

«It is unquestionable that the scientific breakthroughs in the biological sciences that took place in the 1950s, 1960s, and especially the 1970s paved the way for **biotech entrepreneurship**. Yet the scientific breakthroughs are not enough to explain why ivory-tower academics ended up starting firms to commercialize their research in significant numbers.

The fact that expertise in biotechnology could only be found in academia certainly played a part. But while academic expertise was necessary for the development of the technology, it still conceivably could have been incorporated into large firms through more traditional means, like consulting or the hiring of new PhDs. The risk-averse nature of big pharmaceutical and chemical firms, along with the sharp line between **academia and industry in the biosciences**, were clearly obstacles that made that particular path more difficult to take. But identifying those obstacles is not the same as providing a positive explanation for the path biotechnology did take – being developed in an independent industrial sector closely integrated with academia.

In order for that to happen, **starting a company** had to look exiting and promising enough that a critical mass of reputable scientists would risk stepping off the traditional academic career path and braving the disapproval of their peers in order to do it. **Then their companies had to be successful enough that their example would encourage yet more bio-scientists to become entrepreneurial**» (pp. 122-123).

# Contesto empirico (1b): basi “promettenti” per indagare l’emergere di un mercato

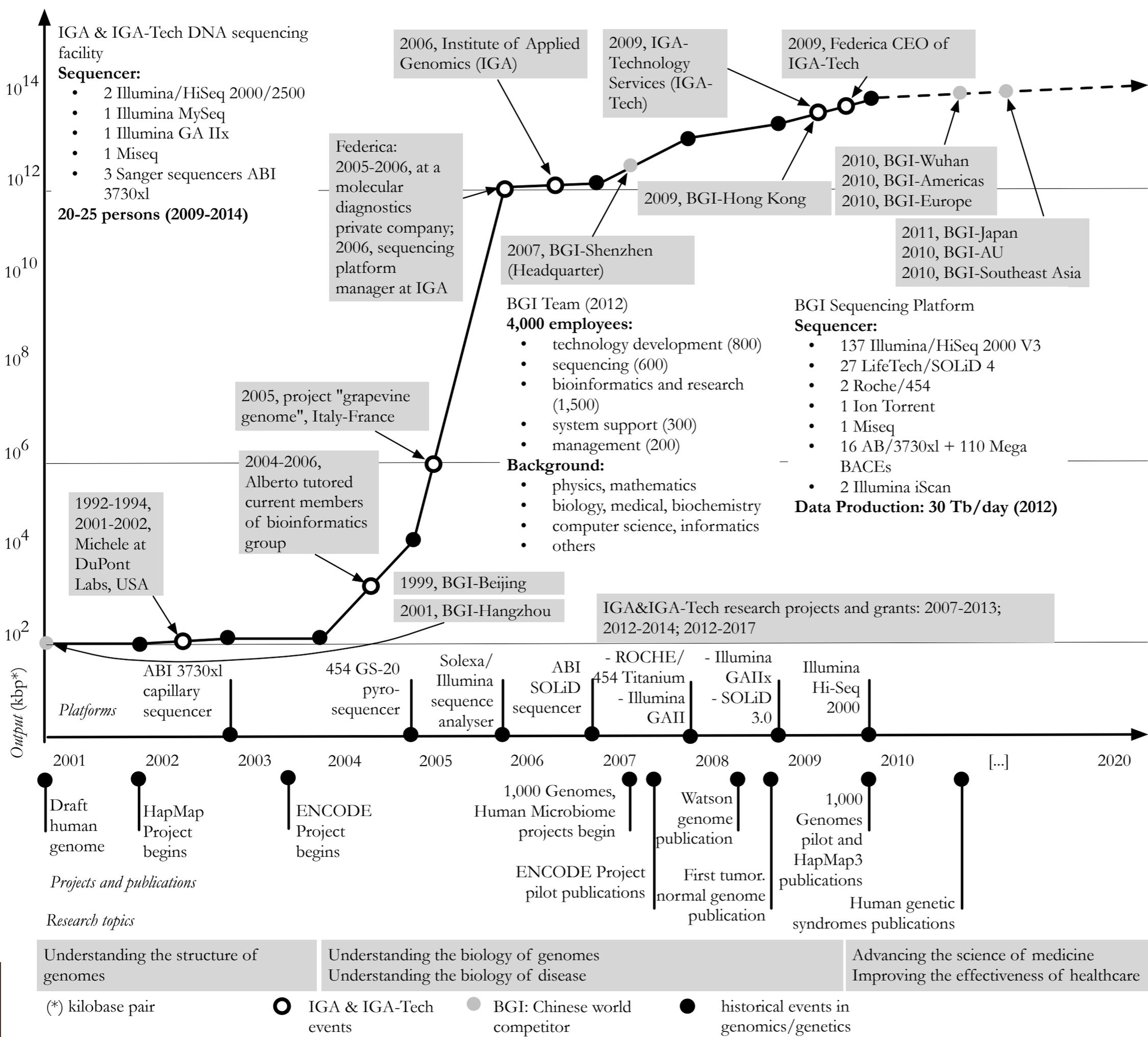
- Padgett e Powell 2012 (“**The Emergence of Organizations and Markets**”), Powell e Sandholtz 2012a e 2012b, descrivono un contesto di riferimento in cui:
  - i) “**life science research breakthroughs outpaced capabilities of established firms**”
  - ii) “considerable enthusiasm and neo-liberal **support for university-industry technology transfer**”
  - iii) “close 5-4 Supreme Court decision (**Diamond v. Chakrabarty, 1980**) permitted patenting of man-made living organisms”
  - iv) “ERISA and “Prudent Man” rulings permitted pension funds and endowments to be invested in **high-risk VC funds**”
  - v) “but: **poisedness** does not imply **predictability!** **No evidence that there was any blueprint** for a new organizational/business model”

# Contesto empirico (2): “early biotech firms” (1968-1981)

Company	Year	Location	Founding model
ALZA	1968	Palo Alto, CA	“A great place if it were a nonprofit think tank”
Cetus	1972	Emeryville, CA	Academic playground or “Free Space”: biotech tools would be applied to a host of problems
Genentech	1976	South San Francisco, CA	“Best of both worlds”: serious science and VC funding create a new model for basic research
Genex	1977	Montgomery, MD	Low-cost producer: apply biotech methods to the manufacture of industrial chemicals
Biogen	1978	Geneva, Switzerland	Transatlantic network of world-class scientists
Hybritech	1978	La Jolla, CA	New diagnostic tools for the war on cancer
Centocor	1979	Philadelphia, PA	Bridge between academia and commercial health
Amgen	1980	Thousand Oak, CA	To become a fully integrated pharmaceutical company
Chiron	1981	Emeryville, CA	“get in or lose out”: tired of losing top scientists to biotech ventures, UCSF department chair starts his own company
Genzyme	1981	Boston, MA	Niche collector; “Company of singles rather than home runs”
Immunex	1981	Seattle, WA	Academics find a “pugnacious” entrepreneur willing to back “underdog” scientists

# Contesto empirico (3):

## IGA & IGA-Tech



# Metodo (1): *data collection*

- uno **studio di caso di stampo etnografico** (Garfinkel 1967; Van Maanen 1988; Agar 1996), indagine basata su un **approccio interpretativista** (Marcus e Fischer 1999)
- materiali di ricerca (**tabella 1a**):
  - interviste in profondità (CEO di IGA-Tech, Fondatori di IGA; stakeholder esterni; gruppo di ricerca di bio-informatici);
  - materiali d'archivio;
  - progetti di ricerca, finanziamenti nazionali e internazionali, pubblicazioni scientifiche;
  - rassegna stampa nazionale e internazionale
- “attori organizzativi”:
  - fondatori dell'IGA (Michele, Alberto, Raffaele, Gabriele)
  - CEO dell'IGA-Tech (Federica)
  - gruppo di ricerca dei bio-informatici IGA-Tech
- materiale d'archivio/materiale secondario storia di life science e biotecnologie (**tab. 1b**):
  - progetto “Oral Histories, UC Berkeley Bancroft Library”
  - “Life Science Foundation Magazine-Telling the Story of Biotechnology”
  - Berman E.P. (2012), *Creating the Market University: How Academic Science Became an Economic Engine*, PUP
  - Hughes S.S. (2011), *Genentech. The Beginnings of Biotech*, UCP
  - Stevens H. (2013), *Life out of Sequence. A Data-Driven History of Bioinformatics*, UCP

# Metodo (2a): *processo di analisi*

- **Historical institutionalism/Historicism in Entrepreneurship Theory** (Bucheli, Wadhvani 2014)
  - percorsi di sviluppo/crescita alternativi: **“reconstructing entrepreneurs’ understanding of their historical conditions and their place within historical narratives”** (p. 211)
- **Actor-Network Theory (\*) (ANT)** come strategia di ricerca (Callon 1998; Latour 2005; Law 2006)
  - tra “entrepreneurial agency” e “opportunity discovery/creation”: da **“actor attributes”** e **“capacity of bricolage”** a **“agency translated in social and material networks”**

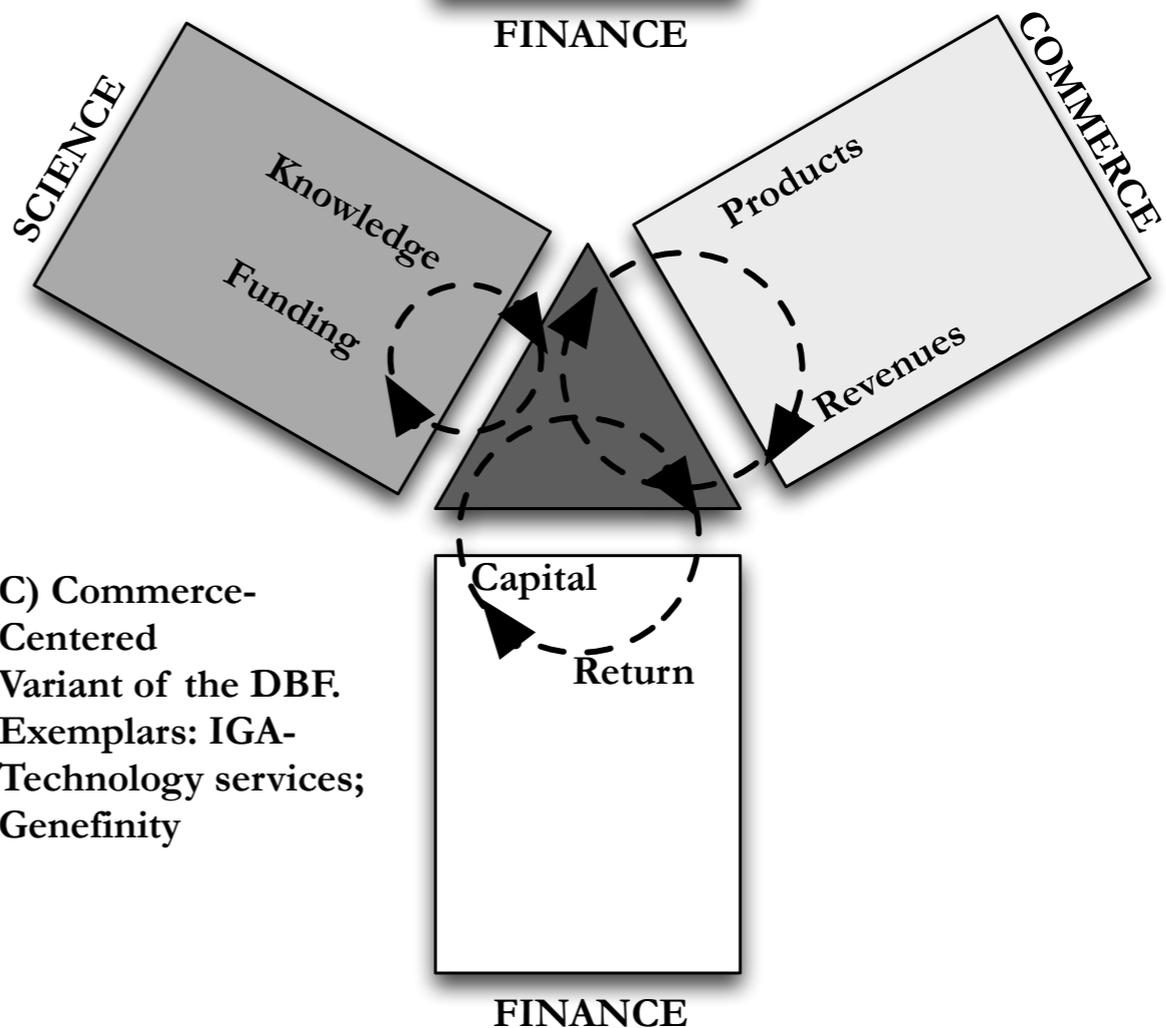
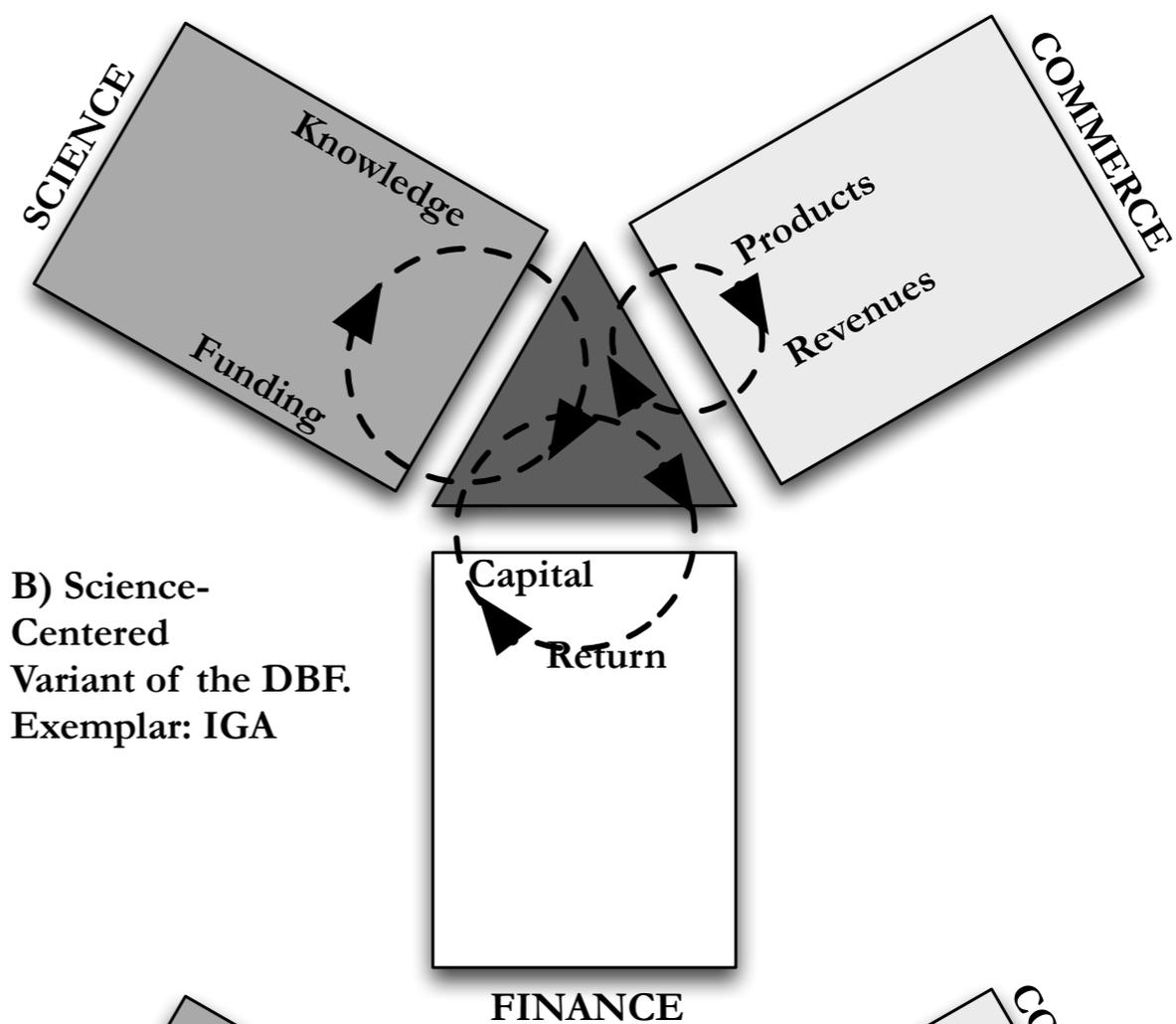
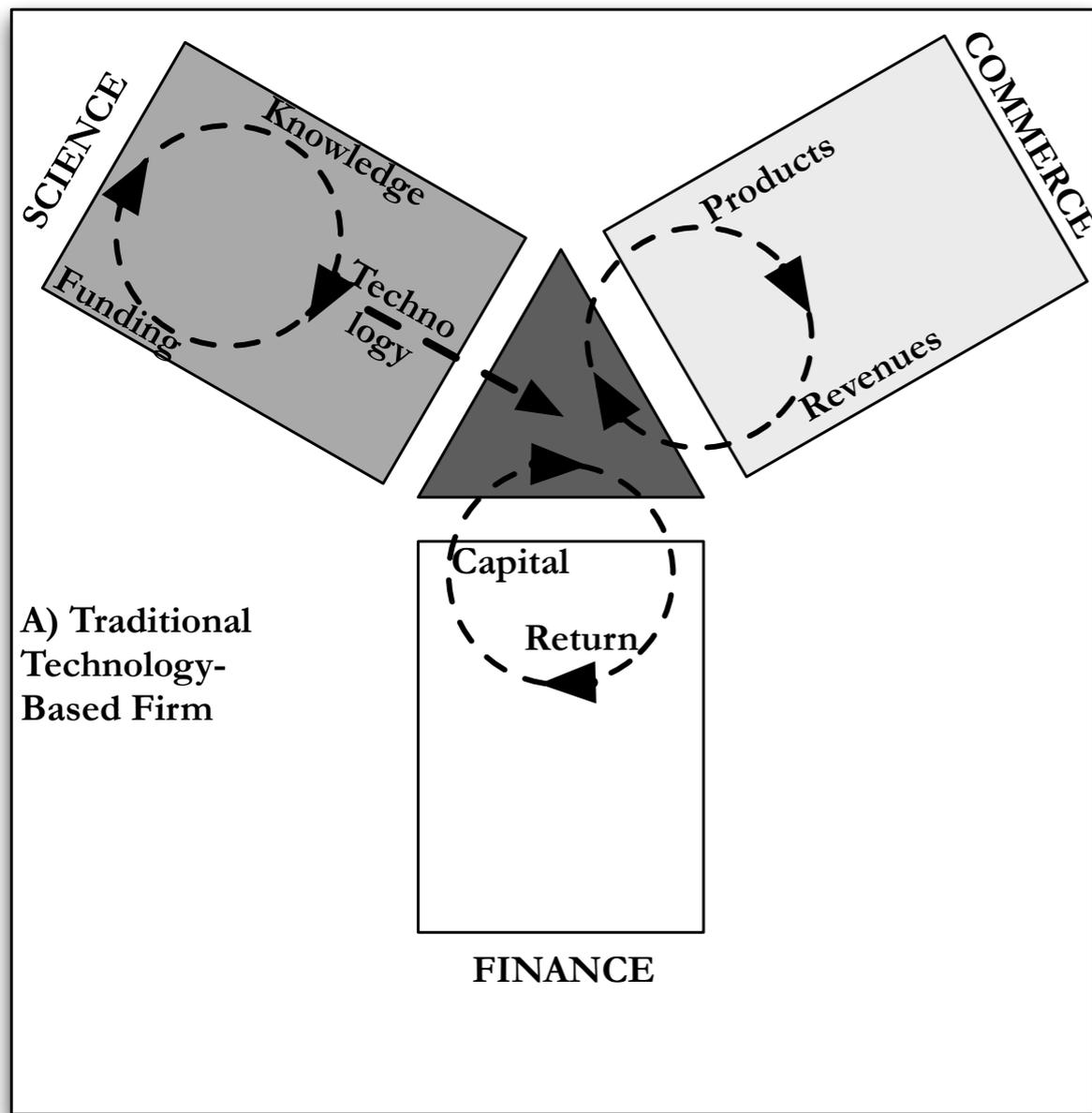
(\*) literature on laboratory and science-based contexts (*Science and Technology Studies*, STS: Knorr-Cetina 1981; Latour 1987; and *Social Construction of Technologies*, SCOT: Bijker et al. 1987

# Metodo (2b): le fasi del processo di “traslazione”

“Traiettorie organizzative” del trasferimento tecnologico (\*): l’emergere dell’imprenditorialità accademica come costruzione collettiva

- Fase 1      **Problematizzazione:** reciproca definizione degli attori e definizione di un punto di passaggio obbligato
- Fase 2      **Interessamento:** l’insieme di azioni che una entità cerca di imporre per stabilizzare l’identità degli altri attori così come è stata da loro definita nella fase di problematizzazione (oggetti materiali e discorsivi costituiscono artifici per interessare gli attori e per isolarli da potenziali concorrenti)
- Fase 3      **Arruolamento:** il fatto che gli attori accettino e portino avanti i ruoli loro attribuiti
- Fase 4      **Mobilizzazione degli alleati:** attraverso una catena di intermediari si arriva ad un unico portavoce finale rendendo l’affermazione credibile e indisputabile formando alleanze e agendo come una forza unica (un “attore-rete”).  
Mobilizzare significa letteralmente rendere mobili entità che prima non lo erano e successivamente riassemblearle

(\*) suggerimenti di ordine metodologico: Law 1987, 1999, 2009; Callon 1986, 1998; Latour 1987, 2005; MacKenzie et al. 2007; Muniesa 2014



- rectangles represent the three domains;
- cycles represent the "autocatalytic" flows within and across domains;
- the triangles is the new venture
- an arrow represents a directional exchange

# Risultato (1a): tra EI e AE, le "componenti" emergenti di una DBF

# Risultati (1b): due varianti di una forma nuova (1968-1981)

## A Science-Centered Variant

Science takes the lead, with VC and management support

Renowned scientist-founders straddle domains, often occupying key executive and academic roles simultaneously

Science Advisory Board (SAB) is used for peer review

Firms exhibit a strong commitment to publishing research findings

Investors take an "empirical" approach: minimal funding of laboratory research (proof of principle), with further investment contingent on scientific results

Academic headwaters: William Rutter's interdisciplinary lab at UCSF

**Commercial headwaters: ALZA Corp.**

Exemplars: **Genetech**, **Biogen**, Chiron, Immunex

Failed attempt: **Cetus** (lacked strong scientific leader)

Mechanism of genesis: **transposition**

## A Commerce-Centered Variant

Management takes the lead, supported by VC funding and academic science

Scientifically-trained business leaders play crucial early roles

Science Advisory Board (SAB) is used as a signal of approval

Publishing is not encouraged

Investors weigh commercial considerations such as size of market, current competitors, projected cash flow, speed to profitability, etc.

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Commercial headwaters: entrepreneurial divisions of health care or pharma companies (i.e., Baxter, Abbott, Corning)

Exemplars: **Hybritech**, **Centocor**, **Amgen**, Genzyme

Failed attempt: Genex (lacked strong commercial leader)

Mechanism of genesis: **recombination**

# Prof. Kronberg (Stanford biochemist, Nobel laureate, Consultant ALZA, Scientific Founder DYMAX):

«Is biotechnology good or bad? [...] I think like any new technology, any invention, it can be some of both. But because of the enormous optimism reflected in the multi-billion dollar industry that is propelled by it, I think it is important to reflect on some of its lesser achievements, or negative influence, especially as it affects science in general and the university in particular. The heroes and heroines of Stanford-UCSF patent [*the Cohen/Boyer patents on rDNA technology, 1974*] have many accolades at the moment. But in the very long run, one wonders about the negative consequences of that patent, not so much the patent itself, but **the whole climate that it generated here and everywhere else**» (source: Kronberg 1998, Oral Histories-UC Berkeley Bancroft Library).

# ALZA: A First Prototype of DBF

- «Chemistry departments traditionally were tightly linked with industry. Stanford, when I got here in 1959, had as one of its guidelines that faculty members could spend one day a week outside the university in some other activity. One day a week! But in biology it was utterly unknown. That's where the revolution was [in the late 1970s]. [...] It was completely novel. No one expected the extent of it. I had avoided consultancies or any dealings with the pharmaceutical industry. [...] My virginity ended when **[Alejandro] Zaffaroni started ALZA [1968]**. I liked him so much and he was so inspiring as a colleague that when he started this new venture and asked me to join his advisory board, I was interested and felt flattered. I served on that board for twelve years and I learned a lot about applied science and business--production, chemical trials, regulatory approval, and marketing. I learned how difficult it is to translate a good discovery to a point where it is a marketable, profitable product. Without that you're out of business. For example, growing polio virus in a kidney cell in a test tube was an important feat and earned John Enders and colleagues a Nobel prize. But until it was put into children in a reliable, acceptable, marketable form and proved its utility, the job was not finished» (*source*: Kronberg 1998, Oral Histories-UC Berkeley Bancroft Library).
- «Those who have known and worked with Zaffaroni remark freely on his **creativity in science, daring in entrepreneurship, integrity in business, and wisdom in management**. They also note his special genius for relationships – Zaffaroni displayed an uncommon knack for collaboration, mentoring, and friendship. He possessed a singular ability to inspire talented people, and to imbue collective projects with his own unique enthusiasm and spirit. Most remarkable was the rare combination of all these attributes embodied in the same person». (*source*: LSF Magazine, Winter, 2013).

# Transposition: A Science-Based Variant

- Robert Swanson (co-founder, CEO and Chairman of **Genentech**, 1976-1996) on publishing at Genentech:
- «**Boyer's philosophy**, which I agreed with, was that you gain more from interaction with your academic peers than you give up by telling the competition where you are. So with interaction you can move quicker; you gain more people willing to collaborate with you. We knew then we weren't going to have all the best ideas, and we said, where do the academic scientists go when they have an idea that they think needs to be commercialized? We want them to think of us first. We want them to come to Genentech first, because this is a group of scientists that are well published and that a university scientist would be proud to collaborate with on a scientific basis, and where I know they can get this product developed and make it available. So that was a goal from the very beginning» (source: Swanson 2001, Oral Histories-UC Berkeley Bancroft Library)

# Tom Perkins (VC and investor - Cetus, Genentech): “There had to be a lot of financial engineering”

- **“We didn’t have a clue how to price the stock.** We knew it was going to be a hot issue, and oversubscribed. But Swanson, the board, the management, the investment bankers - - we were all caught somewhat by surprise. We could have sold less stock at a higher price. It came out at thirty-five, shot up to eighty-five, then drifted back down. But that spread brought world-wide publicity. Everybody knew about Genentech. It was fantastic. It established the idea that you could start a new biotechnology company, raise obscene amounts of money, hire good employees, sell stock to the public. Our competitors started doing all of that, so much so that it became an impediment for us to hire and retain employees. We started to lose employees to other biotech startups. Our employees had originally acquired our stock as common stock. We were able to justify a ten-to-one difference in price. So if the preferred stock was at thirty-five a share, then employees got common at three-fifty a share... But you can only do that once. Once it becomes a public stock, the preferred shares convert to common and everyone is on the same platform. **So how are we going to continue to attract these people? Continue to hold these people?** It was a big problem” (*source*: Perkins, 2002, Oral Histories-UC Berkeley Bancroft Library)

# Recombination: Different Commerce-Based Variants

- Hilary Koprowski (director of the Wistar Institute) believed in commercialization of monoclonal antibody technology, as scientist-founder retained his position as director, but for this situation he was forced to resign his directorship in **Centocor** (founded in 1979) prior to the company's IPO (in 1982) (*source*: Byers 2006, Cape 2006, Oral Histories-UC Berkeley Bancroft Library)
- Following the commercial biotechnology explosion in the early 1980 and the ambitious program to become a fully integrated pharmaceutical company, **Centocor** extended its focus on diagnostics to therapeutics: «Hubert Schoemaker (**the firm's first executive hire in February 1980**), “bet the company on FDA approval of Centocor's first drug, [...] making costly investments in proprietary manufacturing and sales capabilities. When the FDA denied [drug's] application 1992, Centocor barely survived. Michael Wall [**the original founder and executive**], then in semi-retirement, came back as chairman and helped Schoemaker cut two-thirds of the company's workforce, regrouping around a pair of promising therapeutics. This marked a return to the “bridge” model of drug development» (Oral Histories-UC Berkeley Bancroft Library).

# Risultati (2a): dimensioni sociali emergenti di una DBF (IGA & IGA-Tech)

Costrutti che supportano i tre modelli di DBFs	IGA-Institute of Applied Genomics	IGA-Technology Services		
<p><b>(A) SCIENCE:</b></p> <ul style="list-style-type: none"> <li>(i) insistence that scientists publish their findings</li> <li>(ii) campus-like setting near a major research university</li> <li>(iii) founder(s) continued at or returned to university institute</li> <li>(iv) all-stars science advisory board</li> </ul>	<p>see tab. 4a: representative qualitative data</p>			
<p><b>(B) FINANCE:</b></p> <ul style="list-style-type: none"> <li>(i) research contracts with large corporation</li> <li>(ii) scientific founder(s) become VCs or angel incubator</li> <li>(iii) active VC involvement in early management</li> <li>(iv) IPO with no products/no predictable revenue stream</li> </ul>			<p>see tab. 4b: representative qualitative data</p>	
<p><b>(C) COMMERCE:</b></p> <ul style="list-style-type: none"> <li>(i) founder(s) with entrepreneurial track record</li> <li>(ii) early hiring of senior exec from health care or pharma</li> <li>(iii) initial emphasis on non-therapeutic applications</li> </ul>				

# Risultati (2b): IGA & IGA-Tech come “ibrido organizzativo”. L’emergere del fenomeno dell’amphibious scientist (v. Padgett, Powell 2012)

## original steps (\*)

## Science (\*)

*Established routines prove lacking...*

traditional R&D model is too insular and proprietary for biotech’s purposes; top-flight researchers are unwilling to leave the academy unless the research (not just economic) opportunities are abundant

*...so founders draw on existing knowledge...*

Scientific founders import the invisible college into a corporate setting, minus the grant-chasing and tenure struggles

*...and scan their social worlds for cues...*

Top scientists look to each other for validation of commercial involvement, and judge legitimacy of new model using their customary criteria: quality of scientific output (i.e., publishing). At the same time, they assess the “new” world of commerce, and realize the importance of patenting prior to publication

*...forging unique elements of a science-based organizational form*

R&D becomes a porous, networked endeavor whose results are published in the top journals. New career paths are established for academic life scientists

(\*) source: Powell, Owen-Smith 2012; Powell, Sandholtz 2012a, 2012b; Powell *et al.* 2012

(\*) source: Powell, Owen-Smith 2012; Powell, Sandholtz 2012a, 2012b; Powell *et al.* 2012

# Risultati (2c): IGA & IGA-Tech come “ibrido organizzativo”

original steps (*)	Finance (*)
<i>Established routines prove lacking...</i>	Existing VC approach (i.e., provide small amount of startup capital, increasing as product goes to market, followed by IPO) is ill-suited to the funding needs (in terms of quantity and duration) of biotech development
<i>...so founders draw on existing knowledge...</i>	VCs realize they the key issue is how to signal commercial progress in the absence of products. Without such signals, the biotech ventures will fail to attract continued investment
<i>...and scan their social worlds for cues...</i>	At the intersection of academic science and commercial drug development, VCs seize on two novel opportunities for demonstrating a biotech venture’s worthiness for additional investment: (a) research partnerships with big pharma (validating the eventual product potential of the venture’s core science) and (b) the sheer scientific performance of the venture (including stature of founders and/or SAB, and publication record of scientific staff)
<i>...forging unique elements of a science-based organizational form</i>	This results in a flowering of inventive financing mechanisms: milestone agreements; research partnerships; initial, second, and third public offerings without any commercial products; tracking stocks; etc.

(\*) source: Powell, Owen-Smith 2012; Powell, Sandholtz 2012a, 2012b; Powell *et al.* 2012

## Risultati (2d): IGA & IGA-Tech come “ibrido organizzativo”

### original steps (\*)

### Commerce (\*)

*Established routines prove lacking...*

Barriers to entry in the pharma business are formidable: clinical trials, FDA approval, creation of distribution channels, scaling up manufacturing. Traditional “bootstrap” model (i.e., start small and channel early revenues into growth) was not feasible. There is no such thing as a credible “low-budget” clinical trial, and cutting-edge life-science production processes could not be outsourced to low-cost contract manufacturers

*...so founders draw on existing knowledge...*

Biotech founders import a proven commercialization model from the world of academia: technology transfer. In the new setting, tech transfer is between two for-profit entities with resource asymmetries: biotechs have crucial knowledge that big pharma lacks, while big pharma has commercialization capabilities

*...and scan their social worlds for cues...*

To remain viable as commercial entities, however, fledgling biotechs must aggressively negotiate the terms of such technology transfers. Access to legal counsel (typically via their VC’s network) becomes crucial, as biotechs learn to “sell” their scientific advances to pharma partners without jeopardizing their future independence

*...forging unique elements of a science-based organizational form*

As a result, a wide variety of partnerships are created between small, science-rich biotechs and large, wealthy product-driven pharmaceutical companies. Many of these bargains prove Faustian, as biotechs forfeit ownership and control in exchange for resources

# Discussione: “reassembling the social” in EI & AE studies

- **Biotech Market as a(n) (Arti)Fact (1968-1981):** “Creating the market university” come **processo di “traslazione”** (problematizzazione; interessamento; arruolamento; mobilitazione)
- le dimensioni narrative dell’innovazione imprenditoriale (**relazionale; temporale; performativa**) collegate al fenomeno dell’**“amphibious scientist”** nell’imprenditorialità accademica (**come attore-rete**):
  - **“Academic entrepreneurship” as novelty in new organizational form emerges across multiple, intertwined social networks**

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