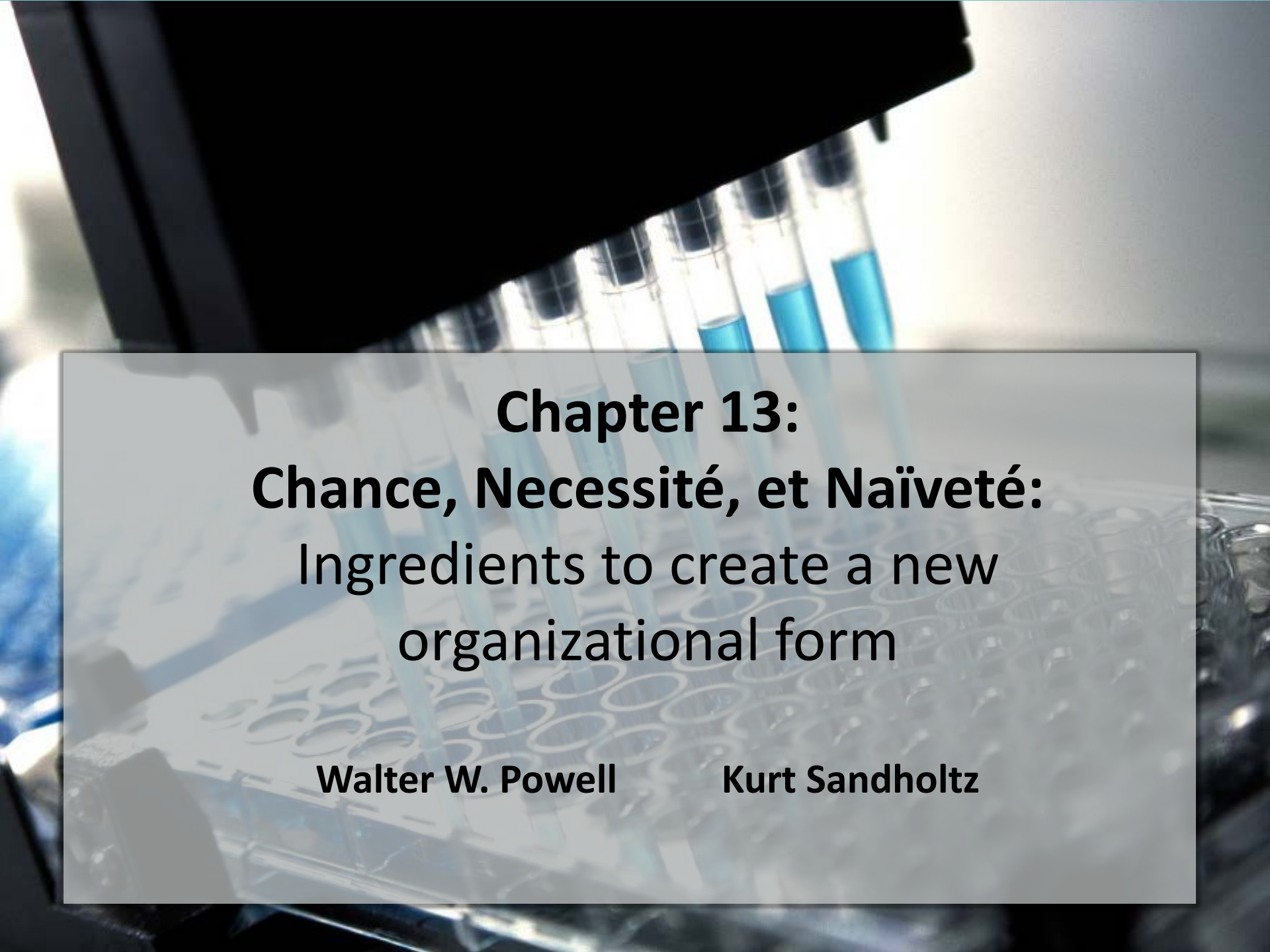


Chapter 13:
Chance, Necessité, et Naïveté:
Ingredients to create a new organizational form

Walter W. Powell **Kurt Sandholtz**

Motivating question: *Where do new practices and models of organization come from?*

- Focus on components – separable parts that are assembled in novel ways
- "Lash up" (Law 1984; Latour 1987)
  - How do diverse elements become interactively stable?
- Why are certain building blocks, but not others, incorporated into a new enterprise?
- How do re-purposed practices reverberate back into the domains from which they were borrowed?

Organizational and technical change: a pragmatist view

- When established routines prove lacking, people search and experiment.
- People draw on stock of existing knowledge to forge new tools for coping with situations without precedent.
- Individuals who repurpose old tools are “moral entrepreneurs” or “rule creators” (Becker 1963).
- People who cross formerly separate domains are trespassers – not boundary-spanners doing import and export.
- Traffic across social worlds creates new social spaces, which may be unencumbered by the baggage of established practices.

Building on Schumpeter, Nelson & Winter

- Schumpeter (1939: 85): "The making of the invention and the carrying out of the corresponding innovation are, economically and sociologically, two entirely different things."
- All novelty is "a recombination of conceptual and physical materials that were previously in existence" (Nelson and Winter, 1982: 130).
- We argue it matters a great deal whether recombination occurs on familiar terrain or happens in a new setting where the components are foreign.

Recombination v. Transposition

- ***Recombination*:** Moving practices from one sector into another where they are recognizable *(i.e., computing to digital cameras, Hollywood film to theatre, telephones with video)*
- ***Transposition*:** Moving practices into settings where they are foreign; a boundary crossing *(i.e., science or religion into commerce)*
  - Less frequent, and much less likely to be successful
  - But even failures at trespassing can generate "fresh" action that can have profound tipping effects

Data and Methods

- Historical multi-case analysis
  - Reliance on first-hand, founders' accounts from the time period
  - 1,800 pages of oral histories in UC-Berkeley Bancroft Library collection
  - Supplemented with new interviews with founders, board members, and VCs
- Rationale

  "A major source of this difficulty [demarcating an unambiguous start or origin of an activity, industry, or population] occurs, we think, because we lack the analytical framework to identify and describe the early steps in industry or form emergence…. As a next step, ***ethnographic and other qualitative research might prove extremely useful in simply identifying and describing interesting relevant cases****."* (Hannan, Polos & Carroll 2007: 58)

Fertile ground for studying emergence

- Life science research breakthroughs outpaced capabilities of established firms.
- New enthusiasm and legal support for university-industry technology transfer.
- Close 5-4 Supreme Court decision (*Diamond v. Chakrabarty*, 1980) permitted patenting of human life forms.
- ERISA and "Prudent Man" rulings permitted pension funds and endowments to be invested in high-risk VC funds.
- BUT: *poisedness does not imply predictability!* No evidence that there was any blueprint for a new organizational model.

Sample of First-Generation Companies

Company	Founding Year	Location	Founding Model	Currently
ALZA	1968	Palo Alto, CA	"A great place if it were a nonprofit think tank"	No longer in existence
Cetus	1972	Emeryville, CA	Academic playground or "Free Space"; biotech tools would be applied to a host of problems	No longer in existence
Genentech	1976	South San Francisco, CA	"Best of both worlds": serious science and VC funding create a new model for basic research	Subsidiary of Roche
Genex	1977	Montgomery, MD	Low-cost producer: apply biotech methods to the manufacture of industrial chemicals	No longer in existence
Biogen	1978	Geneva, Switzerland	Transatlantic network of world-class scientists	Biogen Idec
Hybritech	1978	La Jolla, CA	New diagnostic tools for the war on cancer	No longer in existence
Centocor	1979	Philadelphia, PA	Bridge between academia and commercial health care	No longer in existence
Amgen	1980	Thousand Oaks, CA	To become a FIPCO (fully integrated pharmaceutical company)	Independent
Chiron	1981	Emeryville, CA	"Get in or lose out": tired of losing top scientists to biotech ventures, UCSF department chair starts his own company	No longer in existence
Genzyme	1981	Boston, MA	Niche collector; "Company of singles rather than home runs"	Subsidiary of Sanofi-Aventis
Immunex	1981	Seattle, WA	Academics find a "pugnacious" entrepreneur willing to back "underdog" scientists	No longer in existence

Table 13.1

There was no blueprint for a science-based company

- Brook Byers, VC backer and first CEO of Hybritech:

  "We were naïve. ***I think if we had known everything about all the potential huge competitors, we might not have even done it****. One of the benefits we had, I suppose, was some combination of naïveté and ambition and this desire to do something on our own…I think there was a feeling of a green field, and that we were the first. We didn't know all the answers, but we had time to figure it. . . .* ***We did not have the business model mapped out, or the ultimate value proposition, which are all things that we do today in doing a startup.*** *We're much more sophisticated now. Back then, we didn't have any of that."*

Tom Perkins on financing Genentech

"What was so different about Genentech was the astonishing amount of capital required to do all of this. I know, on day one, if anyone had whispered into my ear that, 'for the next twenty years you will be involved in raising literally billions of dollars for this thing,' I might not have done it. But in 1979, it occurred to me that for something of this importance, that there was enough money out there for us to do whatever we needed to do. I always viewed my role – my ultimate responsibility – was to make sure that the company didn't run out of money. That was my job. [CEO Robert] Swanson's job was to make sure the company deserved more money, at ever increasing prices. We both had a pretty clear notion of that. It worked for a long time. Hence, all the different things that we did – ***the private rounds, the research partnerships, the public rounds, and all the deals****. It was always more capital than I anticipated. It dawned on Swanson before it dawned on me. I can't remember at what point it dawned on me that Genentech would probably be the most important deal of my life, in many terms – the returns, the social benefits, the excitement, the technical prowess, and the fun. By 1979 I was a total Genentech junkie."*

The Dedicated Biotech Firm (DBF), a New Organizational Model

- Operated according to different principles from the traditional corporate hierarchy. Key components:
  - Strong commitment to publishing research results in top science journals
  - Horizontal structure of information flow; project-based organization of work
  - Porous organizational boundaries; a strategy of pursuing innovation through collaborative ventures
  - A heavy reliance on intellectual capital
  - Often produced no marketable products
- In sum, an odd mixture of elements from three distinct domains: ***science, finance,*** and ***commerce***

Distinctive Features of Early Biotech Firms

	Alza (1968)	Cetus (1972)	Genentech (1976)	Genex (1977)	Biogen (1978)	Hybritech (1978)
SCIENCE	♦ All-star science advisory board ♦ Campus-like setting near a major research university	♦ All-star science advisory board ♦ Campus-like setting near a major research university ♦ "Free space" for scientists ♦ Scientific founder stayed at university full-time, consulted with company	♦ Insisted that staff scientists publish and contribute to public science ♦ Scientific founder stayed at university, consulted with company ♦ "Virtual" start-up: all initial research conducted by contract with UCSF and City of Hope Hospital	♦ All-star science advisory board ♦ Scientific founder stayed at university initially	♦ International consortium of top academic labs (i.e., science advisory board was the company) ♦ "Virtual" start-up: all initial research conducted in founders' labs ♦ Scientific founders stayed at their respective universities full-time	♦ Scientific founder stayed at university full-time, consulted with the company ♦ Key founding role for talented lab assistant ♦ Campus-like setting near a major research university (UCSD) and research institute (Salk)
FINANCE	♦ Went public with no products, breakthroughs, or revenues ♦ Used research partnerships with big pharma to generate funds	♦ Used research partnerships with diverse array of large corporations ♦ Record-breaking IPO in 1981	♦ Meager funding until scientific "proof of concept" ♦ Invented "milestone payment" form of incremental financing ♦ First biotech IPO (1980): gene dreams for Wall Street ♦ Used research partnerships to share costs and risk	♦ Numerous research contracts with large companies	♦ Modest initial VC funding ♦ Out-licensed early breakthroughs to big pharma	♦ Venture capitalist was first CEO ♦ First company to commercialize mono-clonal antibody techno-logy for diagnostics
COMMERCE	♦ Founder went on to start numerous biotech firms	♦ Wide range of commercial applications for biotech	♦ Swing for the fences – focus on blockbuster medicines	♦ Pursued low-cost, high-volume strategy (e.g., biotech production of industrial chemicals) ♦ Early investment in manufacturing plant ♦ Scientific founder went on to start additional biotech firms	♦ Targeted blockbuster medicines ♦ Scientific founders ran the company for first seven years	♦ Scientific founders became serial entrepreneurs and/or VCs ♦ Recruited senior exec from Baxter to run the company ♦ Focused on diagnostic products; avoided long clinical trials

Table 13.2

Distinctive Features of Early Biotech Firms

	Centocor (1979)	Amgen (1980)	Chiron (1981)	Genzyme (1981)	Immunex (1981)
SCIENCE	♦ Aggressive in-licensing of research from public science ♦ Initially located in a business incubator on Univ. of Pennsylvania campus ♦ Close relationship with research institute (Wistar)	♦ All-star science advisory board	♦ Founders stayed at universities initially ♦ Skills of academic administration applied to business ♦ Insisted that scientists publish and make contributions to public science ♦ Transfer of founder's existing research grant from university (UCSF) to company ♦ Used research partnerships with pharma and universities as a mode of exploration	♦ Transfer of founder's existing research grant from university (Tufts) to company ♦ Key founding role for talented lab assistant ♦ Hired science advisory board intact (i.e., Bio-Information Associates, a consulting firm of MIT and Harvard profs)	♦ Insisted that scientists publish and make contributions to public science ♦ Founding scientists resigned from academic jobs to avoid conflict of interest ♦ Campus-like setting near a major research university (U. of Washington) and research institute (Hutchinson Cancer Center)
FINANCE		♦ IPO as salvation, despite no products, or patented breakthroughs.		♦ Used tracking stocks to compartmentalize risk ♦ Grew through numerous small acquisitions	♦ Out-licensed early patents to large pharma, then later reacquired them
COMMERCE	♦ Bridge between academic labs and big-pharma manufacturing/ marketing ♦ Recruited senior exec from Corning's medical products business to run the company ♦ Focused on diagnostic products	♦ Recruited senior exec from Abbott's diagnostics division to run the company ♦ Novel decision-making process for allocating resources to projects	♦ Focused on large potential market underserved by big pharma: vaccines ♦ Scientific founders ran the company	♦ Founder was serial entrepreneur from the packaging industry ♦ Focus on niche markets and orphan drugs ♦ Recruited senior exec from Baxter to run the company	♦ One of founders was a proven executive and turn-around artist

Table 13.2

The DBF is a composite, not an ideal type

- No company had all of the elements of the eventual model.
- Unclear if any of the participants were aware that they were creating a novel organizational form.
  - Some chafed under the constraints of existing organizational practices.
  - Others wanted to experiment with new conditions and rules.

Novelty flowed from “improvisational trespassers”

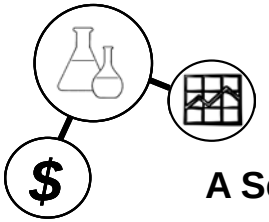
- “Amphibious” scientists traveled between formerly separate domains, bringing new tasks into the confines of existing settings until such arrangements no longer proved viable.
- Examples:
  - Genentech: a virtual company for two years, operating out of labs at UCSF and City of Hope hospital.
  - Biogen: first breakthrough came from the lab of one of its founders at the University of Zurich.
  - Centocor: began by licensing a patent for a monoclonal antibody developed by two of its founders at the Wistar Institute on the University of Pennsylvania campus.

Clusters of Characteristics Suggest Two DBF Variants

DOMAIN	Cetus 1971	Genen-tech 1976	Biogen 1978	Chiron 1981	Immu-nex 1981	ALZA 1968	Genex 1977	Hybri-tech 1978	Cento-cor 1979	Amgen 1980	Gen-zyme 1981
SCIENCE											
Insisted that scientists publish their findings	X	X	X	X	X	X					
Campus-like setting near a major research university	X	X		X	X	X			X		
Founder(s) continued at or returned to university or institute	X	X	X	X			X	X	X		
All-star science advisory board	X		X			X	X			X	X
FINANCE											
Research contracts with large corporations	X	X	X	X	X	X	X	X		X	
Scientific founder(s) *became* VCs or angel investors		X		X	X		X	X			
Active VC involvement in early management		X						X			X
IPO with no products or predictable revenue stream	X					X				X	
COMMERCE											
Founder(s) already had entrepreneurial track record	X			X			X		X	X	X
Early hiring of senior exec from health care or pharma						X		X	X	X	X
Scientific founder(s) subsequently *became* serial entrepreneur(s)					X	X	X	X	X		
Initial emphasis on non-therapeutic applications	X					X	X	X	X		

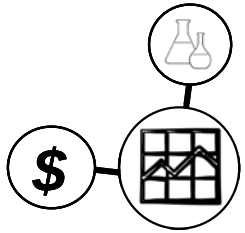
Note: This analysis was created by coding for the presence/absence of distinctive elements *Table 13.3*

Two Variants of the DBF Form



A Science-Centered Variant

- Science is central, supported by funding and management
- Renowned scientist-founders straddle domains, often occupying key executive and academic roles simultaneously
- Scientific Advisory Board is peer review
- Strong commitment to publishing research results
- VCs invest "scientifically": minimal funding of initial experiment (proof of principle), followed by increasing investments
- Investors place bets on proven scientific accomplishments
- Academic headwaters: William Rutter's interdisciplinary UCSF lab
- Commercial headwaters: ALZA Corp.
- Exemplars: Genentech, Biogen, Chiron, Immunex
- Failed attempt: Cetus (lacked strong scientific leader)
- Mechanism of genesis: *transposition*



A Commerce-Centered Variant

- Commerce is central, supported by funding and science
- Scientifically-trained business play crucial early roles
- Scientific Advisory Board is signal of approval
- Publishing is not encouraged
- VCs invest traditionally: focus on markets, products, etc.
- Commercial headwaters: entrepreneurial divisions of health care or pharma co.s (Baxter, Abbott, Corning)
- Exemplars: Hybritech, Centocor, Amgen, Genzyme
- Failed attempt: Genex (lacked strong commercial leader)
- Mechanism of genesis: *recombination*

Table 13.4

Commerce- v. Science-Centered: Publication and Citation Counts*

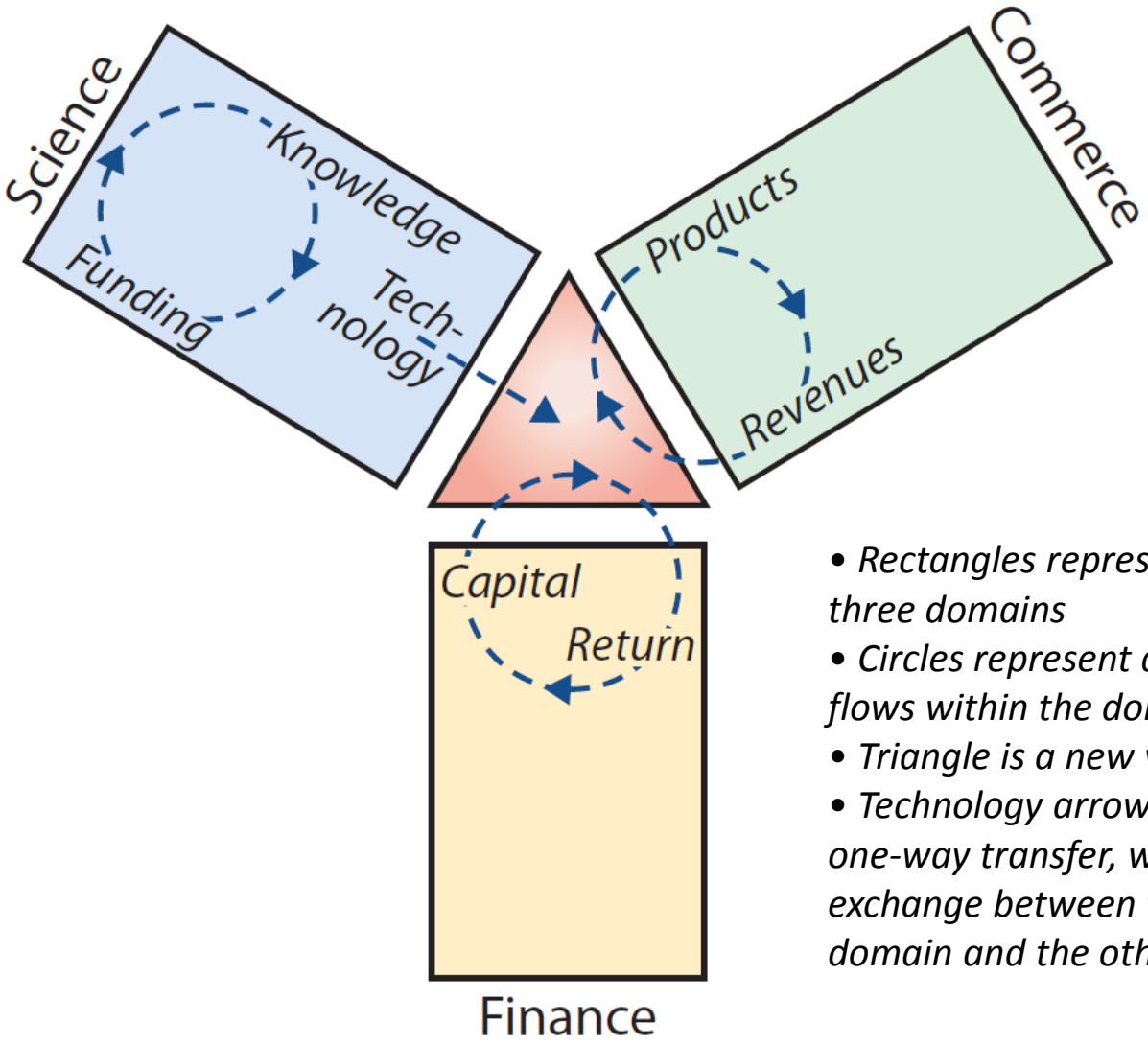
COMPANY	YEAR OF IPO	TOTAL PUBS	AVG PUBS/YR	TOTAL CITATIONS	AVG CITES/PUB	H-INDEX[1]
Alza	1969	116	11.6	2,608	22.48	26
COMMERCE						
Genex	*1982*	*163*	*16.3*	*12,262*	*75.23*	*51*
Hybritech	*1981*	*272*	*27.2*	*5,678*	*20.88*	*36*
Centocor	*1982*	*250*	*25*	*15,677*	*62.71*	*61*
Amgen	*1983*	*798*	*79.8*	*55,950*	*70.11*	*122*
Genzyme	*1986*	*235*	*23.5*	*15,064*	*64.10*	*59*
SCIENCE						
Cetus	1981	1,000	100	107,469	107.47	146
Genentech	1980	1,656	165.6	198,608	119.93	218
Biogen	1983	623	62.3	54,272	87.11	115
Chiron	1983	905	90.5	86,453	95.53	141
Immunex	1983	710	71	61,616	86.78	133
t-test (1-tail)		0.009		0.009	0.004	0.003

[1]The h-index is a measure of publication quality and quantity. To derive *h,* each company's publications are listed in descending order by times cited. The value of *h* equals the number of papers (*N*) in the list that have *N* or more citations. Source: ISI Web of Science®.

* Publication and citation data are from the 10-year period following initial public offering.

Table 13.5

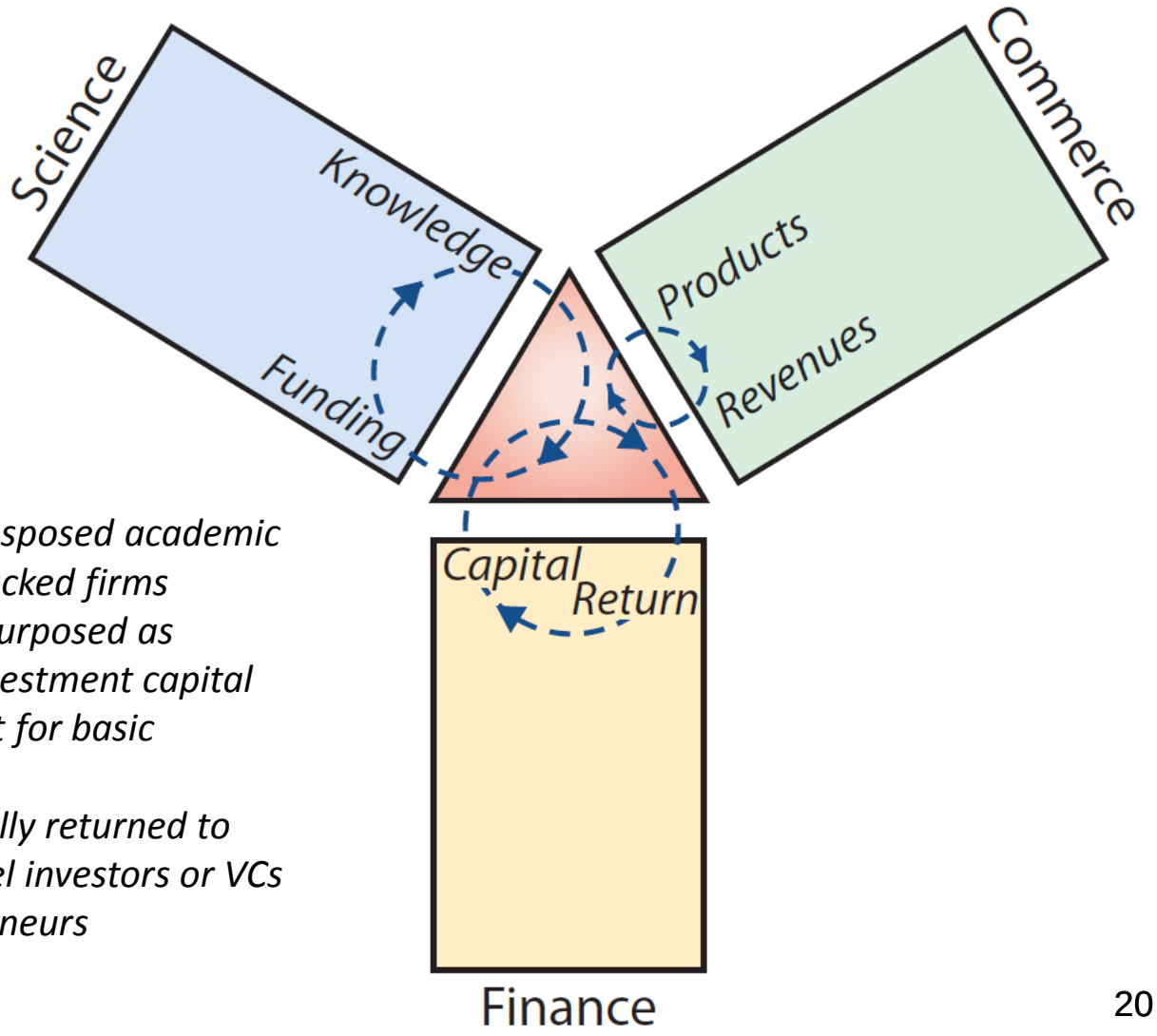
A Traditional Technology-Based Firm



- *Rectangles represent the three domains*
- *Circles represent autocatalytic flows within the domain*
- *Triangle is a new venture*
- *Technology arrow indicates a one-way transfer, with little exchange between the Science domain and the other domains*

Figure 13.1

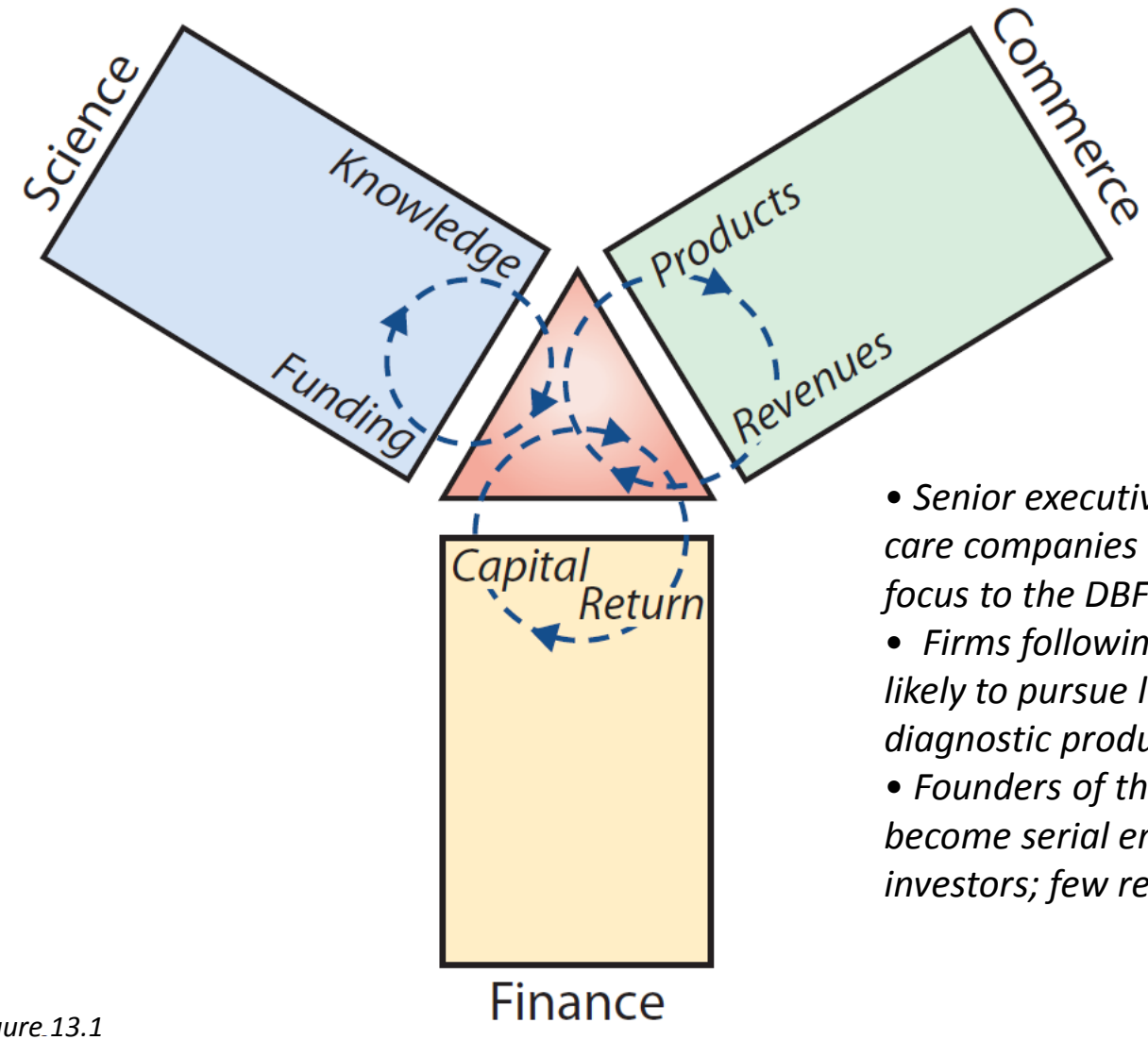
A Science-Centered Variant of the DBF



- *Renowned scientists transposed academic culture into the venture-backed firms*
- *Scientific output was repurposed as investment worthiness; investment capital was repurposed as support for basic research*
- *Scientific founders typically returned to academia, or become angel investors or VCs rather than serial entrepreneurs*

Figure 13.1

A Commerce-Centered Variant of the DBF



- *Senior executives from pharma or health care companies brought a commercial focus to the DBF*
- *Firms following this model were more likely to pursue lower-risk, quicker-return diagnostic products*
- *Founders of these firms tended to become serial entrepreneurs rather than investors; few returned to academia*

Figure 13.1

The Creation of Novelty, Step-by-Step

	SCIENCE
Established routines prove lacking . . .	Traditional corporate R&D model is too insular and proprietary for biotech's purposes; in addition, 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 a new firms 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.

Table 13.6

Robert Swanson on publishing at Genentech

"[Scientific founder Herb] 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."*

Steve Gillis on doing science at Immunex

"We encouraged scientists within the company to publish their findings, to speak at meetings. . . . [T]hat resulted in spreading the influence of the company, and actually ***allowed us to get collaborators*** *who otherwise might not have been open to collaborating with us.*

"Genentech would publish in their annual report . . . a graph of ***how many times Genentech scientists were cited versus other companies****. And they were proud that they were always in a leadership position. But* ***we were always either second or third****. That was something that gave us pride, and, believe it or not, in the early days,* ***Wall Street analysts looked at that, too****. Obviously, those days are long gone."*

The Creation of Novelty, Step-by-Step

	FINANCE
Established routines prove lacking . . .	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.
. . . so founders draw on existing knowledge . . .	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.
. . . and scan their social worlds for cues . . .	At the intersection of academic science and commercial drug development, VCs see 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).
… forging unique elements of a science-based organizational form.	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.

Table 13.6

Tom Perkins on "financial engineering"

"[At IPO, the stock] came out at $35, shot up to $85, then drifted back down. . . . 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 ***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 10:1 difference in price. So ***if the preferred stock was at $35 a share, then employees got common at $3.50 a share. . . . But 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 and hold these people? It was a big problem.*

Tom Perkins (continued)

"We got an opinion from the accountants that this stock was worth 1/10th of what the regular common stock was worth, and ***we called it junior common stock****. It would convert to ordinary common stock in case of certain events. . . . events they had to work towards which have a risk factor.*

"By diddling that formula over about four years, ***we were able to use that form of stock to attract and hold key employees. We were the first company to ever have such a thing****. . . . We were very careful to run these plans through the SEC. They approved it. We never had to retract any of that stock. However, the idea was stolen by all of our competitors and so grossly abused that* ***the SEC made most of our competitors retract and eliminate those stock plans****."*

The Creation of Novelty, Step-by-Step

	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 cannot be easily outsourced to contract manufacturers.
. . . so founders draw on existing knowledge . . .	Biotech founders import a proven commercialization model from the world of academia: technology transfer. In this setting, the transfer will be between two for-profit entities, but the resource asymmetries are similar: 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.

Table 13.6

Feedback Dynamics

The repurposing of scientific values into commerce catalyzed changes in industry:

- Demise of insular internal R&D lab in Big Pharma
- More dependence on external sources of knowledge
- Creation of corporate nonprofit institutes to do collaborative work
- Funding of postdocs
- Greater encouragement for publishing scientific findings
- Campus-like settings to attract the creative class
- Entrepreneur-in-residence programs at venture capital firms

Feedback Dynamics

The scientific achievements of the early biotech firms reverberated back into the academy:

- Academic entrepreneurship has been embraced
- Departments and schools have been restructured to focus on translational research
- Fueled creation of interdisciplinary research centers
- Adoption of metrics to evince innovativeness
- Industry jobs no longer frowned upon

Feedback Dynamics

In both the academy and industry:

- Evolution from discipline/department to projects
- Not a "settlement" (Rao and Kenney, 2008), but a continuing disruption, most notably in careers and rewards

Recombination v. Transposition revisited

An intriguing paradox:

Recombination *(exemplified by the commerce-centered firms) proved a more robust business model.*

Transposition *(exemplified by the science-centered firms) has had more far-reaching institutional consequences.*

What happened to the first generation?

Alza	Ahead-of-his-time founder (Alejandro Zaffaroni) created a prototype for future biotech firms; acquired by Johnson & Johnson in 2001.
Cetus	First-mover advantage didn't hold due to lack of focus; acquired in 1991 by Chiron.
Genentech	Science married to finance created a new model for commerce. Despite resistance, became a fully-owned subsidiary of Roche in 2009.
Genex	Low-margin business model became unsustainable without investment by corporate partners; acquired in 1991 by Enzon.
Biogen	"World class research seminar" made corporate governance challenging; licensing model proved robust. Merged with IDEC in 2003.
Hybritech	Entrepreneurial scientist found world-class VC, who recruited a pharma escapee to run the show. Bred for eventual sale and acquired by Eli Lilly in 1986.
Centocor	"Academic scavengers" almost lost their company due to FIPCO aspirations. Acquired by Johnson & Johnson in 1999.
Amgen	Savvy VCs set out to "do biotech right" by recruiting stellar SAB and putting talented pharma veteran in charge, resulting in biopharma titan that is still independent.
Chiron	Scientist-entrepreneur moved the invisible college to a business setting. Became a wholly-owned Novartis subsidiary in 2006.
Genzyme	Venture capital group went shopping for a new venture, and built a business around orphan drug opportunities. Acquired by Sanofi-Aventis in 2011.
Immunex	Despite stellar scientific record, business success came late. Acquired by Amgen in 2002, resulting in the loss of local "Immunoid" culture.