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The Role of the Business Model in Capturing Value from Innovation: Evidence from Xerox Corporation's Technology Spinoff Companies

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Abstract:

This paper explores the role of the business model in capturing value from technology. A successful business model unlocks latent value from a technology, but constrains the subsequent search for new, alternative models for other technologies later on - an implicit cognitive dimension overlooked in most discourse on the topic.

We explore the intellectual roots of the concept, offer a working definition, and then use it to examine the origins of selected spinoff companies from Xerox PARC. Significant transformations occurred in the business models of successful spinoffs, while search and learning in failed ventures were quite limited. The quest for a viable business model creates a valuable framework for learning, creating a basis for economic success in the venture.

Not everything we start ends up fitting with our businesses later on. Many of the ideas we work on here involve a paradigm shift in order to deliver value. So sometimes we must work particularly hard to find the "architecture of the revenues." … here at Xerox, there has been a growing appreciation for the struggle to create a value proposition for our research output, and for the fact that this struggle is as valuable as inventing the technology itself.

John Seely Brown, Chief Scientist of the Xerox Corporation and Director of the Xerox Palo Alto Research Center[1]

Introduction

Why do successful companies often fail to capture value from new technology that they helped to create? This question has long interested scholars of technology management; while many writers have advanced answers, the issue remains far from settled. Nor is this purely an academic issue. Companies that historically have invested substantial sums in discovery-oriented research have been rethinking their willingness to sustain those investments. The fundamental rationale for industrial discovery-oriented research is being reassessed and the industrial research system is clearly in transition as a result (Rosenbloom and Spencer, 1996; Buderi, 2000).

Firms can capture value from new technology in two basic ways: through incorporating the technology in their current businesses or through launching new ventures that exploit the technology in new business arenas. The focus of this paper is on the issues that firms encounter when they pursue the latter approach, which Chandler (1990) referred to as exploiting "economies of scope".[2] This matter relates more generally, as well, to work on the uses of corporate venturing to create new businesses for the firm (see Kanter 1989; Block and Macmillan, 1993; and Chesbrough, 2000a for reviews).

Firms necessarily must take technology to market through a venture shaped by a specific business model, whether explicitly considered or implicitly embodied in the act of innovation. The inherent value of a technology remains latent until it is commercialized in some way; obviously, the extent to which its value is realized is contingent upon the manner in which that takes place. In some

instances, an innovation can successfully employ a business model already familiar to the firm. In other cases, though, such a business model will not fit the circumstances of the technological or market opportunity. In the latter cases, technology managers must expand their perspectives, to find the right business model, or 'the architecture of the revenue,' in order to capture value from that technology. Failure to do so will cause technologies to yield less value to the firm than they might otherwise. Consistent failure to do so may cause the corporation to reduce, or even withdraw from, its commitment to the creation of potential technologies in the first place.

The next section develops the antecedents of the idea of the business model, while the third section offers a working definition of the idea, and an illustration of it. In the fourth section, we describe the role of business models in several ventures designed to commercialize technologies originally developed at the Xerox Corporation's Palo Alto Research Center [PARC]. While those technologies originated under the aegis of Xerox Corporation, most of the commercial spinoffs ultimately employed models that differed in important ways from the Xerox business model. The final section of the paper presents some observations on the implications of the evidence just presented.

II. Antecedents to the Business Model Concept

Alfred Chandler's seminal *Strategy and Structure* (1962) presented the first systematic and comparative account of growth and change in the modern industrial corporation. He showed how the challenges of diversity implicit in a strategy of growth called for imaginative responses in administration of the enterprise. In his subsequent work, Chandler (1990) showed how scale and scope economies provided new growth opportunities for the corporation during the second industrial revolution.

Ansoff (1965) built upon ideas from *Strategy and Structure* and applied them to emerging concepts of corporate strategy. Strategy came to be seen as a conscious plan to align the firm with opportunities and threats posed by its environment. Andrews (1971) was one of the first theorists to differentiate between a business strategy and a corporate strategy. He held the former to be "the

product-market choices made by division or product line management in a diversified company (p. xi)". Corporate strategy was a superset of business strategy. "Like business strategy, [corporate strategy] defines products and markets – and determines the company's course into the almost indefinite future…. A company will have only one corporate strategy but may incorporate into its concept of itself several business strategies (p. xi)." Thus, a firm's current businesses influenced its choice of likely future businesses as well.

While the notion of strategy subsequently was developed in a myriad of directions, one branch of its development that prefigures the argument here was research in how managers could leverage the resources of the organization beyond that organization's current business. Early work started from a cognitive model of rational calculation and full information. Edith Penrose (1959) introduced the notion of sources of growth for the firm arising from management's ability to manage additional businesses. Teece (1982) relaxed the assumption of full information, building a framework where a firm's underutilized resources, combined with imperfections in the markets, confer advantage for diversification moves. Empirical evidence has shown how a firm's technological position helped them enter nearby business areas, because experience in "related" technologies reduced the costs of entering into adjacent areas (Teece et al, 1993; Silverman, 1999). Burgelman (1983a; 1983b) has developed a process model for how a firm can enact strategic change based on managing limited information. Its middle managers provide the linkage between the corporate strategy articulated by top management (which is not necessarily fully understood by lower managers), and the opportunities identified by lower management (which are not necessarily perceived by top managers).

A later branch of the strategy literature incorporated cognitive bias into the idea of strategy. (Prahalad and Bettis (1986) introduced the notion of a dominant logic: a set of heuristic rules, norms and beliefs that managers create to guide their actions. This logic usefully focuses managers' attention, as they seek new opportunities for the firm. It facilitates organizational coordination across different parts

of the company. Importantly for the present paper, the dominant logic also implicitly filters out ideas and behaviors that do not comport with the dominant logic. This selection mechanism works to maintain focus and internal coherence among the firm's activities. [3]

The implied path dependent behavior emerging from a firm's established business also figures prominently in the technology management domain. Abernathy , Clark and Kantrow (1983) examined the history of the many technological developments in the automotive industry. While incumbent firms were able to capitalize on incremental innovations, their expertise and knowledge became liabilities in the face of radical technology changes. Tushman and Anderson (1986) studied the technological history of three different industries to develop the idea that certain types of innovation destroy organizational competences, while others enhance them. Henderson and Clark (1990) introduced the notion of architectural innovation, a type of technological shift that changes the linkages between components in a system. They argued that a change in the system linkages upsets the managerial heuristics that have developed to coordinate components – a technical variant of dominant logic. These managerial heuristics again provide a useful filter for firms coping with technological change, but they constrain the actions of firms as well. Henderson later concluded that both economic and organizational factors explained firms' abilities to respond to technical change (1993), and that certain incumbent firms could adapt to such change if they were able to develop "integrative capability" (1994).

Christensen (1997) explores a type of technological shift he called disruptive technology, which changes the basis of competition in an industry. He argues that managers commonly err in adjusting to these shifts by focusing resources on their current markets and customers, and overlooking potential markets and customers outside. He found firms to be effective and far-sighted when the technological opportunity reinforces the firm's current business, but ineffective and myopic when that opportunity disrupts the firm's current business. This is another variant of dominant logic, where internal resource allocation processes constrain the selection of target markets for new technologies.

Tripsas (1997) shows that selected incumbent firms were able to adjust to technological change in the typesetter industry when they possessed relevant complementary assets. These assets helped to buffer the firm from the difficulties they experienced in adjusting to the change. In more recent research with a colleague, she recounts how Polaroid's cognitive perceptions of photography, and how Polaroid made money in photography, acted to constrain its behavior in the transition to digital imaging (Tripsas and Gavetti, 2000). Sull et al (1997), found that previous managerial commitments to employees and local communities inhibited the ability of managers of incumbent US firms to respond effectively to technological challenges in the tire industry.

In sum, the technological management literature shows that firms have great difficulty managing innovations that fall outside of their previous experience, where their earlier beliefs and practices do not apply. Authors do not agree, however, whether the roots of that difficulty lie in characteristics of the technology itself, the management processes employed to manage it, or the means used to access the surrounding resources. Some scholars conclude that firms may indeed develop the ability to manage new technological opportunities effectively if they invest in integrative capabilities (Henderson, 1994), ambidextrous internal processes (Tushman and O'Reilly, 1997) or complementary assets (Tripsas, 1997). Other scholars believe that the firm must avoid internal resource allocation processes, and manage disruptive technologies outside the main business (e.g. Christensen, 1997).

The present paper proceeds from the assumption that managers are necessarily constrained by their current perspectives as they pursue attempts to commercialize promising new technological capabilities. It offers the business model as a construct that integrates these earlier perspectives into a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic outputs. The business model is thus conceived as a focusing device that mediates between technology development and economic value creation. We argue that firms need to understand the cognitive role of the business model, in order to commercialize

technology in ways that will allow firms to capture value from their technology investments, when opportunities presented by its technologies do not fit well with the firm's current business model.

III. The Business Model as a mediating construct between technology and economic value

While the term "Business Model" is often used these days, it is seldom defined explicitly. An exception is the following definition, offered by KMLab, Inc., a consulting firm.

> … a Business model is a description of how your company intends to create value in the marketplace. It includes that unique combination of products, services, image, and distribution that your company carries forward. It also includes the underlying organization of people, and the operational infrastructure that they use to accomplish their work.[4]

The rise of e-commerce, with its myriad new firms eschewing conventional ways of doing business, has thrown a spotlight on the topic, which is widely discussed by practitioners and investors, but not yet prominent in academic discourse. A search of the World Wide Web turned up 107,000 references for "business model", including the one quoted above. In contrast, in the academic literature, which remains slow to reflect new terminology from practice, a search of a data base of academic journals in economics found only 3 citations for the phrase, none using it in the sense implied here.[5] One reason why academic scholarship has not focused on the concept may be that it draws from and integrates a variety of academic and functional disciplines, gaining prominence in none. The academic applications, accordingly, are emerging in management curricula, rather than in the disciplines.[6] For example, the syllabus for a course called "Managing the Digital Enterprise", includes a section on Business Models that begins as follows:

> Business models are perhaps the most discussed and least understood aspect of the web. There is so much talk about how the web changes traditional business models. But there is little clear-cut evidence of exactly what this means.
>
> In the most basic sense, a business model is the method of doing business by which a company can sustain itself—-that is, generate revenue. The business model spells out how a company makes money by specifying where it is positioned in the value chain.[7]

This is one of many depictions of the variety of business models that have proliferated on the Internet. The essence of the idea is "how you get paid", or "how you make money", with a taxonomy of alternative mechanisms. A forthcoming academic book, *Internet Business Models and Strategies*, devotes a chapter to discussion of the components of a business model, which the authors define as describing "how [the firm] plans to make money long-term using the Internet." (Afuah and Tucci,2000: Chapter 4, p.2). [8]

In essence, these definitions are modern variations on Andrews's (1971) classic definition of the strategy of a business unit. They are also phrased at a high level of abstraction. We offer the following, more detailed and operational, definition:

"The functions of a business model are to:

- articulate the *value proposition*, that is, the value created for users by the offering based on the technology;
- identify a *market segment*, that is, the users to whom the technology is useful and for what purpose;
- .
- define the structure of the *value chain* within the firm required to create and distribute the offering;
- estimate the *cost structure* and *profit potential* of producing the offering, given the value proposition and value chain structure chosen;
- describe the position of the firm within the *value network* linking suppliers and customers, including identification of potential complementors and competitors;
- formulate the *competitive strategy* by which the innovating firm will gain and hold advantage over rivals.

These six attributes collectively serve additional functions, to justify the financial capital needed to realize the model and to define a path to scale up the business.

The process begins with articulating a value proposition latent in the new technology. This requires a preliminary definition of what the product offering will be and in what form a customer may use it. The business model must then specify a group of customers or a market segment to whom the proposition will be appealing and from whom resources will be received. A customer can value a

technology according to its ability to reduce the cost of a solution to an existing problem, or its ability to create new possibilities and solutions. Importantly, different prospective customers may desire different latent attributes of the technology. Thus, there is no single inherent value for the technology: if it subsequently were to be developed in different ways, it would likely accrue different value to its developer. Value, of course, is an economic concept, not primarily measured in physical performance attributes, but rather what a buyer will pay for a product or service.

A further complexity is the fact that realizing value also involves third parties, both within the vertical value chain, and from the value network (Christensen and Rosenbloom, 1995). The value network created around a given business shapes the role that suppliers, customers and third parties play in influencing the value captured from commercialization of an innovation. The value network increases the supply of complementary goods on the supply side, and can increase the network effects among consumers on the demand side. Positive alignment with the value network can leverage the value of a technology. Failure to align with a value network can dissipate potential value.

A market focus is needed to begin the process in order to know what technological attributes to target in development, how to define and configure the offering, and how to resolve the many trade-offs that arise in the course of development, (e.g. cost vs. performance, or weight vs. power). Technical uncertainty is both a function of the technology itself (such as the maturity of the technology, and the level of scientific understanding of its characteristics and interactions), and also a function of its external market. Technical uncertainty can vary with the dynamics of change in the marketplace, independently of its technical maturity.

Identification of a market is also required to define the "architecture of the revenues" – how a customer will pay, how much to charge, and how the value created will be apportioned between customers, the firm itself, and its suppliers. Options here cover a wide range including outright sale, renting, charging by the transaction, advertising and subscription models, licensing, or even giving away

the product and selling after-sale support and services. The Internet is an arena in which a multiplicity of payment models has arisen.

The business model maps from the technical domain of inputs to the social domain of outputs, as depicted in Figure 1. The cognitively challenging aspect of defining the business model for technology managers is that it requires linking the physical domain of inputs to an economic domain of outputs, sometimes in face of great technical and market uncertainty. As Figure 1 shows, the business model can be regarded as a construct that links these domains. Because of the richness and complexity of each domain, companies usually specialize personnel to focus within each domain.[9]

Having some sense of what the market will bear helps to inform what cost structure is indicated, indeed mandated, by the value proposition. The choice of a market and a value proposition also supplies the heuristic logic required to translate between the domains. In any market of reasonable size, there likely will be many technical alternatives and prospective competitors. Few development programs can afford the expense and time required to go beyond what is absolutely necessary to serve the intended market. Targeting a specific market with a clear value proposition informs choices of what must be done and what can be omitted in the technical domain. This gives scientists and engineers signals on where to focus their activities. This focus is crucial for on-time delivery and achieving competitive cost structures.

Having a sense of price and cost yields target margins. Target margins provide the justification for the real and financial assets required to realize the value proposition. The margins and assets together establish the threshold for financial scalability of the technology into a viable business: in order for the business to attract sufficient capital for growth, it must offer investors the credible prospect of an attractive return on the assets required to create and expand the model.

The Cognitive Implications of the Business Model

The realization of economic value from technology thus derives from the economic and social structure of the situation, rather than only from some inherent characteristic of the technology itself. This implies that selecting a market and constructing a value proposition involve managing significant complexity and ambiguity. Henderson and Clark (1990) conclude that cognitive filters operate in the technical domain, through the integration of component technologies into systems. We suggest that additional cognitive biases can operate at the intersection of the technical and economic domains. Whereas Christensen (1997) conceives of decision biases resulting from internal resource allocation processes in the economic domain, we regard those biases as symptoms of a larger cognitive failure: an inability to perceive alternative paths (alternative business models) that would span the domains and enable realization of greater economic reward.

Constructing business models in environments characterized by high complexity and ambiguity has much in common with Weick's (1993: 636) notion of sensemaking: "Sensemaking is about contextual rationality. It is built out of vague questions, muddy answers, and negotiated agreements that attempt to reduce confusion." We think that this process is closely related to Prahalad and Bettis's (1986) notion of a dominant logic, since that logic is intended to reduce ambiguity and make sense of complex choices faced by firms. The choice of business model constrains other choices, selecting out certain possibilities, even as other prospects are logically reinforced.

Familiar models provide both a source of value realization, and a potential source of cognitive bias, especially when they have proven successful over time. Consider the original Xerox copier, the Model 914.[10] It was not obvious *a priori* to Haloid (the original name of the Xerox Corporation) what would be the best economic use of the powerful capabilities inherent in the technology of electrophotography. Joe Wilson, Haloid's president, saw the potential for massive revenues in office copying, for which the desk size 914 copier was designed. At that time copies were made for business

use either by "wet" photographic methods or by low quality dry thermal processes. Prevailing business models for each process involved charging for the equipment at a modest markup over cost, and charging separately for supplies and consumables, usually at a much higher markup over cost – a "razor and razor blade" business model. Both copier technologies required special paper and supplies, creating an aftermarket revenue stream for vendors. Typical office machines sold for $300; the average machine in use produced 15-20 copies per day and 90% were used for fewer than 100 copies per day. The 914 copier produced high quality images on plain paper, but the manufacturing cost of the machine was estimated at $2,000. Its variable costs per copy were roughly on a par with earlier methods.

This created a problem for commercialization of the technology. Its manufacturing costs were much higher, while its supplies costs were about the same as earlier technologies. How could this new technology penetrate the market, given these economics? Haloid sought vainly to find a strong marketing partner for the 914, but was rebuffed by Kodak, General Electric and IBM. The latter rejected the 914 after a careful and highly professional market analysis by Arthur D. Little and Co.[ADL], a respected firm. ADL could not conceive a successful business model, in part because they could not identify a salient value proposition. As they reported:

> "[Because] the Model 914 … has considerable versatility, it has been extremely difficult to identify particular applications for which it is unusually well suited in comparison with other available equipment … perhaps the very lack of a specific purpose or purposes is the model[11]

ADL analysts essentially assumed the 914 would be offered within the business model then extant in the office copy machine industry – which charged customers the full price of the initial equipment and charged them again for supplies as needed. Skeptical that customers would invest thousands of dollars to acquire a copier (which was only used to make a few hundred copies a month, after all), they concluded: "Although it may be admirably suited for a few specialized copying applications, the Model 914 has no future in the office-copying-equipment market." While in hindsight

one may dismiss the ADL study as perhaps myopic, recall that Kodak and GE independently had come to the same conclusion.

On September 26, 1959, Haloid brought the 914 to market by itself, surmounting the obstacles of high cost by using an innovative business model. Instead of selling the equipment, Haloid offered customers a lease. A customer needed only to pay $95.00 per month to lease the machine, promising to pay four cents per copy beyond the first 2,000 copies each month. Haloid (soon to be renamed Xerox) would provide all required service and support, and the lease could be cancelled on only 15 days notice.

This was an attractive value proposition for customers. This business model imposed most of the risk on tiny Haloid Corporation: customers were only committed to the monthly lease payment, and did not pay anything more unless the quality and convenience of the 914 led them to make more than 2,000 copies per month. (Kearns and Nadler, 1992: 34). Only if the 914 were to lead to greatly increased volumes of copying, would this business model pay off for Haloid. Haloid's model essentially acknowledged that the ADL analysis was right, but was incomplete. Joe Wilson bet that there was greater potential value latent in electrophotography than ADL had judged, but that its realization required a different business model. .

It proved to be a smart bet. Once installed, the appeal of the machine was intense; users averaged 2,000 copies per *day* (not per month), generating revenues far beyond even Joe Wilson's most optimistic expectations. The business model established for the 914 copier powered compound growth at an astonishing 41% rate for a dozen years, turning $30 million Haloid Corporation into a global enterprise with $2.5 billion in revenues by 1972. This was an early demonstration of a proposition now more widely recognized: that technologies that make little or no business sense in a traditional business model may yield great value when brought to market with a different model.

The huge success of the 914 business model – which generated more revenues when more copies were made -- established the dominant logic for Xerox's copier business, imposing a certain cognitive bias in future years. It motivated Xerox to develop ever faster machines that could handle very high copy volumes, with maximum machine uptime and availability, and, in turn, discouraged development of low-speed copiers: As a later Xerox CEO observed: "…our profits came from how many copies were made on those machines. If a copier was slow in generating copies, that was money plucked out of our pocket" (Kearns and Nadler, 1992: 88). Meanwhile, Xerox's monopoly of plain-paper copying technology ended, as an action brought by the Federal Trade Commission forced the company to accept a consent decree requiring it to license its patents and to offer machines for sale, as well as on lease. Kodak and IBM entered the high end of the market; a host of Japanese manufacturers entered the low end – where Xerox was weak -- employing different pricing strategies and distribution channels, i.e., a different business model.

In 1968, C. Peter McColough, who had led sales and marketing of the 914, was appointed Chief Executive of Xerox, with Wilson remaining as Chairman until his untimely death in 1971. As the growth of copier revenues began to flatten at the end of the 1960s, McColough set a new direction toward "The Architecture of Information." His first steps toward realizing this vision were to enter the computer business in 1969 through the billion-dollar acquisition of Scientific Data Systems [SDS] and to establish the Palo Alto Research Center [PARC] in 1970 to lead the way technologically. Although SDS soon collapsed – shut down in 1975 – PARC outperformed all expectations, inventing many of the foundations for the future of desktop computing. [12]

Commercializing PARC Technologies

The research community within Xerox flourished during the 1970s, with generous budgets and few restraints on freedom to explore new boundaries. The first commercial payoff from PARC technology emerged in 1977 as Xerox entered the electronic printing business with a high speed

laserprinter. Xerox's high speed copier business model worked beautifully with the new printer technology, creating a new, large, and profitable business. The same year, Xerox took the first steps toward building a major line of business intended to serve the "Office of the Future." An Office Products Division, newly established in Dallas, marketed a stand-alone electronic word processor, but resistance by corporate executives delayed efforts to launch products based on the more advanced network and workstation technologies developed at PARC. In 1979, the first "office system" offering used Ethernet technology to link word processors and printers; in 1981, the "Star" workstation was introduced as the centerpiece of an integrated system for office automation.

The latter move set a pattern for the business model to be used to exploit PARC's innovations in computing. Customers were offered an integrated system, comprising a set of proprietary technologies, with no option to use third-party equipment or software. Xerox initially offered the Star workstation for purchase at $16,995; the requisite network facilities and shared printer raised the cost for a three user system to over $100,000. These systems then were sold primarily to Fortune 1000 companies through a direct sales force and supported by a field service organization.[13]

Some of the PARC scientists, though, sensed that more could be done. They questioned the pace at which Xerox was pursuing commercialization of their inventions, or disagreed with the company's commitment to proprietary standards and "systems" marketing. In pursuit of what they regarded as underexploited, latent value, they chose to leave Xerox to found new companies to exploit individual component technologies. This created a situation in which, during the 1980s and 90s, a number of new PARC technologies were being exploited simultaneously by Xerox, within integrated systems, and by independent entrepreneurial spinoff companies as stand-alone innovations. This seemed to us to offer an unusual opportunity to compare commercialization practices in a setting where the technologies and market environments were similar while the business models employed were sharply different.

IV. Exploring the Effects of the Business Model on Technology Commercialization: Xerox's Experience with Selected Spinoff Companies

The raw material for our exploration was provided by a recent comprehensive survey of 35 spinoff companies that commercialized technology emanating from Xerox's research laboratories over a 20 year period beginning in 1979 (Chesbrough, 2000b). Chesbrough defined a spinoff to be a specific organizational entity newly created for the purpose of commercializing one or more technologies developed within the corporate research laboratories of Xerox.[14] This section of the paper presents brief descriptions of six of the 35 ventures, focusing on the business models selected initially and their evolution over time.

Our choice of examples emphasized cases where the choice of a business model seemed to be important to the subsequent development of the technology and success of the venture.

We opted to review the spinoff companies to select for variance in both their approach to the business model and in the commercial outcomes that resulted. The six spinoffs described below were chosen for three reasons:

- First, we wanted to select for variance in approach to the business model, to flush out more nuances in the concept, and illustrate its application in multiple settings.
- Second, two of the spinoffs appear to have borrowed extensively from Xerox's then-prevailing business model. Since our argument contends that the business model conditions subsequent performance, it is useful to select cases where the primary elements of the model were not changed appreciably.
- Third, four of the spinoffs were selected because they went on to create significant economic value, and we wish to understand the possible role of the business model in economic value creation.

pioneering technologies, Metcalfe left PARC in January, 1979. He formed 3COM Corporation ["computers, communication, compatibility"] in June, 1979. He envisioned the company as a leading supplier of networking hardware and software to producers and users of desktop personal computers. At that time, of course, no such market existed; the PC market, led by inexpensive Apple II machines, was just beginning to emerge beyond a hobbyist enterprise; the IBM PC did not appear until August 1981. Neither was there a market yet for workstations: Apollo Computer was founded in 1980, the Xerox Star marketed in 1981, and Sun Microsystems formed in 1982.

Metcalfe was soon engaged as a networking consultant to Digital Equipment Corporation [DEC] by Gordon Bell, then the leading technical figure at DEC. Encouraged by Bell, Metcalfe successfully persuaded Xerox to license the Ethernet technology, on which it held four strong patents.[16] Xerox's agreement to this proposal reflected a strategic choice, rather than inadvertence. Xerox was a large user of DEC computers and was eager to promote a technology to link Xerox printers and workstations to DEC minicomputers. DEC's help would be vital to accomplishing that.[17] Spurred by Metcalfe's efforts, Digital, Intel, and Xerox formed an alliance [DIX] to define a standard for Ethernet LAN communication and to promote its widespread adoption as an "open standard" by the computer industry.[18]

Armed with the DIX alliance, 3COM began to seek venture capital in order to begin developing hardware products in October, 1980. In the absence of established markets for either PCs or workstations, the business plan for 3COM was necessarily vague. The search paid off in February 1981, with first round funding of a million dollars from investors who looked beyond the formal plan and were attracted by Metcalfe's vision and charisma, as well as his team's strong technical talents (von Burg 1999, p. 215). 3COM's first products linked DEC minicomputers to Ethernet LANs.

By 1982 the minicomputer market for Ethernet had begun to take off. Among this market's suppliers was the first-mover and early market leader, Ungerman-Bass. This was a market in which one sold primarily to scientists and engineers who used Unix operating systems, and distribution was accomplished through direct sales or value added resellers. Interestingly, Ungermann-Bass' early success in the Unix market (where it was much larger in sales than 3Com) may have locked it into a business model that was illsuited for the coming PC era. 3COM, although a minicomputer market participant, restrained its commitment, as Metcalfe continued to focus on the desktop market that he was sure would emerge.

3Com realized much greater success in the IBM PC marketplace, selling Ethernet adapter cards to be installed in corporate networks running Novell's operating system. The core value proposition became the ability to share files and printers via an Ethernet compatible with the nascent IBM PC standard. Metcalfe had originally expected 3COM to follow the business model of an integrated manufacturer with its own direct salesforce, which was then the prevalent pattern in the industry. After leaving Xerox, however, he had collaborated with his wife to compile a directory of independent vendors of local area computer networks across the US. When many hundreds of copies sold at $125 each, they published annual revisions for five years. Now aware of the existence of these complementary assets, 3Com elected to eschew the direct sales approach, and to reposition itself within the emerging value network by distributing its products through independent resellers.

Thus, the key ingredients in what emerged as the working definition of 3COM's business model stood in sharp contrast to the Xerox model of exploiting unique proprietary technologies through a direct sales system to a group of known customers. The latent value in the Ethernet technology really did not materialize until the technology was targeted at a different market, offering a different value proposition, utilizing an open technology platform, and sold through a new set of distribution channels.

Adobe

The spinoff of Adobe from Xerox followed a path similar to that of 3Com. Adobe's founders, Charles Geshke and John Warnock, left PARC in 1983 in order to commercialize a page description language that became their first product, PostScript. PostScript allows printers to use digital fonts to reproduce a wide variety of characters generated from a PC. Adobe Systems, Inc. went on to become a public company in 1987, and continues to operate as an independent company with a valuation exceeding $15 billion as of this writing.[19]

The technology embodied in PostScript came from Interpress, a page description software developed at Xerox PARC. Interpress was an internal, proprietary protocol used to print fonts generated

from Xerox workstations on Xerox printers. This was an effective usage of the technology, because it linked tightly with Xerox's own business model, but its latent value was limited to that of an important component in a larger system. Warnock and Geschke argued with Robert Adams, then the head of Xerox's printing division, over whether to make Interpress into an open standard, as Ethernet was then becoming. Adams strongly resisted, contending that he couldn't see how Xerox would make any money if they "gave away" the font technology. After debating this inside Xerox for over a year, Warnock and Geschke left PARC in 1982. As Geschke remembered it, "Certainly, within Xerox, none of this was going to happen. They wanted to have an industry standard, but they wanted to control everything at the same time."

Arguably, Adams was at least partly right: it may well have been that Xerox's business could never have benefited from the technology as an open standard. The business model that eventually realized significant economic value for Adobe differed substantially - both from that of Xerox and from Warnock and Geschke's original intentions. Indeed, Adobe's initial business model had contained many elements that were similar to the model then dominant at Xerox, but subsequent events forced the founders to change it. As Geschke recalled,

> *"Our original business plan was different. We were going to supply a turnkey systems solution including hardware, printers, software, etc. With this in hand, we were then going to build a turnkey publishing system. It turns out other people were trying to do this at the same time – there would have been a lot of competition if we had gone this route….*
> *"In many respects Steve Jobs and Gordon Bell (my teacher in graduate school) were key ingredients in getting things going the way they did. Gordon said, "don't do the whole system", and Steve came to us and said, "we don't want your hardware, just sell us the software". We said, "No!" Later Steve came back and said, "OK, then just license it to me". That's how the business plan formed. It wasn't there in the beginning."*[20]

Selling and supporting a turnkey publishing system, complete with its own hardware, would have required a direct sales force and a field service network very much like the one Xerox managed in its copier business. In Geschke's view, it would have taken a long time, and would have encountered a

lot of competition. The font technology on its own might not have been that valuable, in that configuration, since again it was merely a component in a larger system.

Instead, selling font libraries to computer and printer OEMs like Apple and Hewlett-Packard required very different resources to execute. This configuration allowed the font technology to capture significant value by leveraging the efforts of computer makers like Apple and IBM, and printer makers like Canon and HP into a new value network. Together, they effectively created a new value proposition that enabled the output of rich document types via desktop publishing and WYSIWYG graphics.[21] They focused on supplying just the digital font libraries to laser printer and software manufacturers, which were made increasingly valuable by the impressive improvements in PCs, printers and software. They competed through establishing PostScript as a de facto standard, and then leveraging the investments of complementors to create high switching costs for consumers. As with 3Com, the business model that eventually created significant economic value out of PostScript for Adobe differed greatly from the Xerox business model. Had Adobe persisted with its initial intentions, that latent value might never have materialized.

SynOptics

Andy Ludwick and Ron Schmidt left PARC in 1985 to form another company to commercialize PARC technology. SynOptics sought to enable Ethernet technology to run over fiber optic cabling. This was a pioneering technology commercialization endeavor. The founders intended to develop the capability to deliver a complete network system: fiber optic cabling and the software, other hardware, and networking services required to run Ethernet over that faster medium. Their original business model would have involved the creation of an extensive field installation and service organization, along with a direct sales force. They intended both to support third-part resellers to handle small accounts and to handle large customers directly. What got the company off the ground, though, was discovery of the ability to run Ethernet communications at high speeds over already-installed IBM token ring copper

wires. Ron Schmidt had been experimenting with this capability just prior to leaving PARC, but it wasn't until after SynOptics was formed that its importance became evident. SynOptics soon abandoned the fiber optic approach implied in its name, and focused instead on running networks using its protocols and software on copper wiring already installed for IBM networks. .

This allowed SynOptics to avoid providing installation, field service and support in its own part of the value chain. Instead, they were able to leverage the value network around them: relying on a network of resellers to distribute, service and support the product, and selling into IBM's substantial installed base. SynOptics made customers' copper wire more valuable, and enabled faster network transmissions – a powerful value proposition. They saved a great deal on installation costs, and customers saved a great deal on integration costs. Thus, SynOptics' eventual business model differed completely from Ludwick and Schmidt's initial business model.

Metaphor: A Xerox Spinoff with a Xerox business model

3COM, Adobe, and SynOptics created value from Xerox technologies only after they transformed their business models substantially from the one that Xerox usually employed. In contrast, the founders of Metaphor commercialized some promising user interface and database query concepts through a business model that was quite similar to the one at Xerox.

Metaphor was created by David Liddle and Donald Massaro in 1982 . It developed a series of technologies that allowed non-technical users (knowledge workers) to create sophisticated queries of large data bases. This enabled a new group of users to mine corporate data for a variety of new purposes, such as market research, pricing analyses, or analyzing possible new product features. Instead of relying on corporate programmers to write report generators to extract data from a mainframe, Metaphor would let knowledge workers construct their own database queries to access corporate data directly. The ability to extract useful corporate data directly was a potentially powerful value

proposition. It was one of the first true client-server applications, employing the graphical user interface technology out of PARC to construct data base queries in an intuitive fashion.

Metaphor's ambitious technical approach was accompanied by a business model that would have been familiar to Xerox. This included developing a proprietary software product and selling that software bundled in with proprietary hardware as a turnkey solution for its customers through Metaphor's own direct sales force. As with Xerox's business model, Metaphor had a strong systems approach to commercializing its technology, and also had a similar approach towards proprietary technology. Essentially, it eschewed an external value network. Liddle defended this approach as the only viable means at the time to implement their product strategy:

> *"The problem wasn't one of a business model. When we started Metaphor, standards weren't available and the only choice was to do the entire system – that's the way every body did it then. It's not like today. What's more, this kind of product couldn't be sold at a retail level. The only way to sell it was with a knowledgeable sales force… There was no packaged software at the*

While Liddle's defense seems plausible, many aspects of Metaphor's circumstances appear to be similar to Adobe. At the time Warnock and Geschke left PARC (not long after Liddle and Massaro left), there were no standards for fonts or generating computer characters mathematically on laser printers either. Nor was there an obvious way to distribute such a product. And Adobe's initial plans were to develop the entire system as well. The value network had to be constructed de novo. Warnock and Geschke believe that, in hindsight, they would not have succeeded, had they continued with their initial business plan. They also felt Metaphor imported this approach as a direct result of their experience in Xerox. John Warnock remarked to us that, "Metaphor took the Xerox business model

This may have been a mistake. Metaphor is not one of the great commercial successes spun out of PARC. The company did manage to survive from 1982 until its sale in 1991 to IBM, but its financial performance was meager, and it burned through a great deal of venture capital. Although the amount

that IBM paid in 1991 was not disclosed to us, we did learn that it did not reach the amount of capital cumulatively invested in the company. While there are undoubtedly many explanations for Metaphor's performance, its failure to explore alternatives to the Xerox business model stands as one plausible explanation – particularly in comparison with the value network Adobe erected for its font technology. We do not regard Metaphor's lack of success as a reflection of limitations in its technology; rather, we attribute its fate to its inability to find the model that would unlock the latent value embedded in that technology.

LiveWorks – another promising PARC technology without a viable business model

LiveWorks is a more recent spinoff, formed in 1992. The company was set up to commercialize an innovative electronic whiteboard. This whiteboard could capture comments on one board, and then transmit and display those comments on a separate white board. This was useful for coordinating group work activities between remote sites – an exciting value proposition for any company with multiple work locations that had to coordinate the work of its groups. The idea emerged from within PARC, which used the technology itself to link its West Coast developers with other Xerox personnel in other locations.

LiveWorks never developed a viable business model. Early sales were made to customers within Xerox; when the decision was taken to expand the business, a Xerox technologist was recruited to manage the spinoff. While the initial management identified a number of technical challenges to be fixed, the company was merely opportunistic in its sales. The company had a high-cost manufacturing strategy, so that the revenues it did generate did not yield a profit.[22] It tried to use Xerox's own sales force to sell its products, but this was not effective. It never did connect with third parties to establish a larger value network. As Mark Myers, then the chief technical officer of Xerox, recalled, "...we thought we would work out the

business concept someplace after we got to market... We knew there had to be [a market] out there... [but we] couldn't figure out how to make money." [23]

By the time that company executives realized that the initial approach would not succeed, a lot of money had been spent. Alternative business models, such as licensing the technology to other manufacturers, were not explored until the end of the company's life. The company was shut down in 1997, after losing tens of millions of dollars. People who saw the white boards in action found them to be an exciting technology. Arguably, the failure of LiveWorks was not due to technology with little inherent value. In our judgment, the failure was in the inability to unlock the potential value of that technology.

Documentum – A Recent Xerox spinoff success

Documentum, by contrast, illustrates what can happen when promising Xerox PARC technologies are commercialized through an effective business model. The company was formed in January of 1990, by Howard Shao and John Newton, under the aegis of Xerox's Technology Ventures (XTV) group. Hence, Documentum, like Liveworks, was formed under the sheltering presence of the Xerox Corporation, in contrast to 3COM and Adobe. Shao and Newton were invited by XTV to visit PARC for six months in order to identify a set of promising technologies to commercialize.

They soon discovered an opportunity to help customers' teams manage documents more effectively. Xerox had earlier conducted an extensive analysis of its customer needs through a study called Express. Express demonstrated the problems faced by many large Xerox customers that had enormous document flows to coordinate, for activities such as reporting progress on clinical drug trials to the FDA. There was a strong potential value proposition for any company that could help companies manage this, since it would reduce costs and speed up the processes in the companies that were creating these document flows. As Shao saw it, Xerox already had the component technologies for document

management solutions in hand at PARC. What was lacking was a process to get these technologies out of the lab and into the market through an appropriate business model.

Shao and Newton spent six months examining document workflow software products. They also spent significant time at customer locations, to understand what document management problems customers were having. They also learned about the already installed hardware and software platforms that a document management solution would have to work with, in order to be incorporated into the customer's premises. This was a key insight missing at PARC, where the technologists were trying to implement solutions on top of proprietary hardware architectures that were incompatible with customers' installed equipment. Shao and Newton eventually identified a product architecture that could provide real solutions to these customer needs, but do so in a way that was compatible with customers' installed equipment, so that every sale would not require a custom installation.[24]

This led to the creation of a business model that would create value for the customer and revenue for the document technology contained in the venture. Once customers adopted the Documentum approach, their subsequent use tended to lock them into the company's products. Documentum initially made extensive use of Xerox's sales channels, which worked well for selling this type of product. Documentum has also moved beyond Xerox's sales force to develop its own channels as well. The company went public in 1996, and realized a market capitalization of $323 million at the end of its first day of trading. For its part, Xerox owned more than 30% of the company at the time of the IPO, and so realized a handsome return on this technology commercialization effort.

V. Conclusions and Implications

The ultimate role of the business model for an innovation is to ensure that the technological core of the innovation is embodied in an economically viable enterprise. By design, in all the cases that we have examined, the technologies resulted from path-breaking inventions in a research laboratory. The

situations generally exemplified what is often termed “technology push.” Inventor-entrepreneurs sought to exploit recent inventions to serve what they perceived as latent needs. Our brief examination of these half-dozen selected ventures gives rise to a few working conclusions, which can be treated as hypotheses deserving of further refinement and empirical testing.

As we have argued above, the business model is a construct that mediates the value creation process. It translates between the technical and the social domains, selecting and filtering technologies, packaging them into particular configurations to be offered to the market. Because both technical and market uncertainty are involved in this translation, the set of all feasible business models is not foreseeable in advance. Since heuristic logic is employed to discover an appropriate business model, that “sense-making” task will be constrained by the dominant logic of an established organization. Hence, conducting that process within a successful established firm is likely to preclude identification of models that differ substantially from the firm’s current business model. In contrast, a start up seems likely to be both more highly motivated and less constrained in the evaluation of alternative models. It seems notable that among the examples we have reviewed here, while some business model was implicit from the start, a different model governed by the time the successful ventures had demonstrated their viability. Managers should be aware , of course, that today’s successful start-up is tomorrow’s established incumbent, subject to the cognitive constraints of its successful business model.

Because of the need to span the technical and economic domains, with the attendant complexity and heuristic cognitive approaches, and because of the need to make this translation in the presence of significant uncertainty, creating the business model differs from conventional notions of “strategy” (Andrews 1971; Porter, 1980). The business model is more of a tentative hypothesis, an initial exploratory foray into a market, than it is a fully elaborated and defined plan of action. It results less from a fully calculated choice from a diverse menu of well understood alternatives, and more from a

process of sequential adaptation to new information and possibilities, filtered through an heuristic logic that was established from previous success.

If a better business model to commercialize pioneering technology is to be found, our traditional notions of technology management must be expanded. Creating value from technology is not simply a matter of managing technical uncertainty; there is significant uncertainty in the social domain as well, and in the many possible ways of mapping between the domains. Identifying and executing a new or different business model is an entrepreneurial act, requiring a high degree of risk, and requiring insight into both the technology and the market. The discipline enforced by the imperative of reaching a coherent definition of the business model creates a framework for learning about both the technology and its economic environment.

Learning about the market environment was especially challenging in cases like 3COM and Adobe, where the novel technology was ahead of its time, and the value network had yet to emerge. Metcalfe, Warnock, and Geschke benefited from strong connections in the communities of users and inventors in which their firms would eventually flourish. In each case, the ultimate business model emerged from an interactive process involving the entrepreneurs' robust vision of latent opportunity – e.g. Metcalfe's persistent pursuit of a mass market for PC's in corporations well before the introduction of the IBM PC transformed the marketplace – tempered by adaptation in response to substantive interactions with potential customers and sources of funding – e.g. Adobe's redirection to a licensing strategy.

Two of the cases, Metaphor and LiveWorks, are illustrative failures in this context. Both ventures were built on technologies that seemed to embody attractive potential value propositions. And their failure should not be ascribed to shortcomings in the technologies themselves. In our judgement, the technologies held as much promise as the other PARC technologies that went on to create value. The leaders of these ventures, however, failed to discover the proper business models capable of

realizing the value latent in the technologies. In fact, the search process seems to have been very limited in these two cases, in that the business model initially adopted was little modified thereafter.

The Documentum case shows how important, and how subtle, this process of discovery can be. Before the venture was launched, PARC had already developed many of the building blocks of document management software. The Express project had given them insight into the value proposition that the technology could offer to customers. Documentum was able to utilize Xerox's own sales force for much of its revenue, so even that element of it's successful business model was already in place. The missing piece seems to have been the effective pursuit of a process to find a powerful value proposition – provided by a configuration of technologies allowing their functionality to be realized on top of customers' existing equipment – and a reshaping the technical architecture to realize that proposition. That process also applied to SynOptics' learning process. Their technological adaptation enabled their product to run on top of already installed IBM token ring hardware, and thereby leverage the customer's installed equipment, as well as the IBM PC value network.

It is important here to be careful to avoid circular reasoning. The best measure of the worth of a given business model is the success of the enterprise. But one cannot then infer simply that good business models are what lead to success. What emerges from our examples is the conjecture that the process of reshaping an initial business model (which seems to occur in a significant number of cases) creates learning opportunities that themselves may contribute importantly to success. As a disciplined framework mediating between technical and economic domains, the concept of the business model seems to provide a useful pathway to connect learning in one domain with actions in the other.

This perspective suggests that, as John Seely Brown noted in the introduction to this paper, technology managers must regard "the architecture of the revenues" as a vital and necessary element of capturing value from technology. Technology managers cannot disregard these matters or simply rely on others in the organization to address these questions on their behalf. Instead, technology managers

must themselves become conversant in these issues. Technology managers need to extend their experiments to include experiments in alternative business models. This is as important as the experiments they conduct to evaluate technical risks inside their labs. This will also require technology managers to create processes to explore the social domain far more thoroughly, from customers to third parties, and the surrounding elements of the value network. The role of the business model needs to become part of the new dominant logic for managing technology commercialization.

One source of greater insight into these issues for technology managers comes from the technology commercialization process employed by venture capitalists [VCs]. VCs necessarily commercialize technology in environments of significant technical and market uncertainty. Their portfolio companies deploy business models that implicitly map between the technical and social domains. Indeed, the very term "business model" is a commonplace in that community.[25] Many VCs conceive of their decisions as investments in business models. The VCs force change in a business model when it becomes obvious that the assumed model is not working. They provide strong incentives to motivate entrepreneurs to run the risks involved in developing a new business model. And VCs must provide careful governance and oversight to select the most promising models, and reject those that do not appear to be effective.

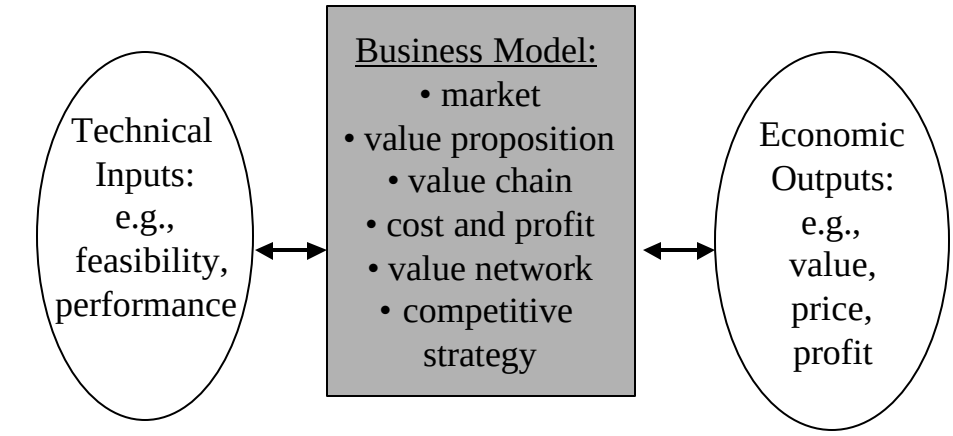
We need to learn more about the forces that facilitate and impede the search for constructive adaptation in the elements of an extant business model. The process of adaptation appears to be either more highly motivated or more easily implemented in independent ventures. Several of our cases suggest that the process of adaptation is triggered by the realities in the context of an independent business enterprise, which enable search processes for models far from the familiar business model of the parent company. Venture capital involvement is often one of those realities. Entrepreneurs securely employed in a large enterprise, itself with a strong culture – beliefs and expectations – built upon a successful and well-established business model, may feel little incentive to search for alternatives

outside that successful model. On the other hand, it may well be that the forces that apply in a de novo venture are similar in character, even if different in degree, to those found in the successful established firm. Many corporate venturing structures, for example, seek to harness these forces. These issues are well worth further exploration.

Table 1: Summary Evaluation of Xerox and Selected Spinoffs on Key Business Model Attributes

	Xerox	3Com	Adobe	SynOptics	Metaphor	LiveWorks	Documentum
Identified Market Segment	Corporate and Government Market	Corporate PC market	PC, MAC, and Laser printer market	IBM Installed Token Ring Segment	Knowledge workers in corporations	Workgroups in corporations	Project teams In Corporations
Clear Value Proposition	High quality copies At a low monthly Lease rate	Establishes file and printer sharing between IBM PCs	enables output of richer document types	Faster Network Speed on Same lines	Enables non-technical queries of Corporate databases	Facilitate Remote group collaboration	Organize Document Management via Previously Installed equipment
Elements of Value Chain	Developed entire Copier system, Including supplies. Sold through a Direct sales force	Focused on Ethernet protocol, and add-on boards	Focused on supplying fonts to laser printer mfgrs, and software firms.	Developed software and add-on boards for high speed networking	Developed and Sold Entire Systems, from hardware to software to distribution	Developed and Sold Entire Systems, from hardware to software to distribution	Developed software compatible with installed customer equipment
Defined Cost and Profit	Modest profit on Equipment, high Profit on supplies, Or per "click"	High Volume, low Unit cost	Very high Fixed cost Very low Variable cost	High fixed Costs, low Installation costs	High fixed Costs, high Margin, low Unit volume	High costs, High margins Low volume	High Development Cost, low Integration cost
Positioned in Value Network	First mover in "dry" Copy process. Did not require or pursue partners	Set the IEEE 802 Standard; utilized PC distribution channel	Defined the PostScript standard for scalable fonts	Prolonged life and value of IBM token ring copper wire; utilized VARS	No 3rd parties or complementors utilized	No 3rd parties or complementors utilized	Leveraged Xerox sales, customer's installed equipment
Formulated Competitive Strategy	Competed on tech'y Product quality, Product capability	Compete on standard, new channels	Strong Network Externalities, High switching costs	Compete on performance and time to market	Compete on Superior Technology & usability	Compete on Superior technology	Add value to customer documents, lock in customer

Figure 1
The Business Model Mediates Between the Technical and Economic Domains



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ENDNOTES

[1] The quotation is taken from Chesbrough (1999), page 1.

[2] Chandler (1990: 15) defines his research question in part as follows, "It then becomes critical to explain how and why the institution [of the modern industrial firm] grew by adding new units – units that carried out different economic functions, operated in different geographical regions, and handled different lines of products." Later in the volume, he includes the introduction of new products, based on internal research and technology, as part of this definition.

[3] Prahalad and Bettis regard managers' cognition as bounded in its scope. Prahalad's later work with Hamel around utilizing "core competence" in designing and developing new businesses (Prahalad and Hamel, 1990) effectively assumes greater rationality than his earlier work. The present paper builds upon Prahalad's earlier assumption with Bettis of more bounded rationality of managers.

[4] http://www.kmlab.com/4Gwarfare.html, June 20, 2000

[5] The Web search was done using Google.com; the economics data based used was Econolit. Searches were peformed in May, 2000.

[6] In the mid-1990s, one of the present authors designed and led a series of management workshops on "The Business Model" to introduce the concept to a group of senior technology managers. The topics in that workshop includes ideas and methods from Strategy, Finance, Operations, Logistics, Marketing, and Entrepreneurship (See Buderi, RTM 1998).

[7] This course was offered by Professor Michael Rappa at North Carolina State University at Raleigh. Quotation from http://ecommerce.ncsu.edu/topics/models/models.html, May, 2000.

[8] See also Applegate (1999)

[9] Despite the evident value of specialization, business model conception and execution clearly is aided when firms develop positions in which individuals can learn to span those domains.

[10] The following account of the 914 innovation is based on McColough (1984), Gundlach (1988), Kennedy (1989), and Pell (1998).

[11] Arthur D. Little, Inc. (1959). Quotation from Page 42.

[12] These inventions included, among others, client/server computer architecture and "personal" computers with a graphical user interface linked by Ethernet LANs, the laser printer, and precursors to Microsoft Word and PostScript. See Hiltzik (1999) and Chesbrough's (2000b) discussion of "Regime 1" technologies.

[13] Smith and Alexander (1988: 238); Hiltzik (1999: 366-7).

[14] Chesbrough (2000b) defined a Xerox "technology spinoff company" as an entity that satisfied all of the following three criteria:

i. The technology involved was initiated or pursued for at least one year's time at a Xerox research center. This criterion excluded technologies that were simply licensed into Xerox, though it includes some that originated outside of Xerox, and came in through acquisition, and then were developed further within Xerox.

ii. At least one Xerox researcher left along with the technology to become an employee of the new spinout company. This excluded technologies that were licensed or otherwise sold out of Xerox.

iii. The entity that received the technology and the researcher was separated from Xerox, and incorporated into a new legal entity. This criterion facilitates measurement of the ex post development of the technology and the organization. It excludes technologies that satisfied the first two criteria, but went into established organizations, where the influence on the subsequent performance of the company was not easily separable from the company's overall performance.

See also Block and MacMillan (1993: 30), Unlike Block and MacMillan, Chesbrough did not require that Xerox approve the creation of the spinoff entity to qualify it as a "

[15] The following account is based primarily on a personal interview with Robert Metcalfe held on July 1, 1999, supplemented by Metcalfe, (1994,) and von Burg (1999).

[16] Metcalfe was granted a non-exclusive license for a one-time fee of $1,000.

[17] One can see the implicit effects of Xerox's dominant logic at work in this decision. In the context of Xerox's established business, it made strong business sense to form an alliance with DEC to pursue Ethernet. While the terms of the $1,000 license thus made good sense with the context of the established businesses, it accorded little

or no value to the additional commercial opportunities that might arise from the technology. One can infer that Xerox managers may have filtered out any consideration of alternative business uses for Ethernet.

[18] Although this sort of strategic alliance around an "open" standard was commonplace in the 1990s, it was highly unusual in the computer industry in 1979. IBM, DEC, Apple, Xerox, and others all built their computers around closely guarded proprietary technologies. Xerox would have been able to discern Ethernet's huge ultimate value only when and if it fully comprehended the implications of competing via open standards.

[19] June 20, 2000. In comparison, Xerox's valuation was roughly $13 billion, and 3COM's $17 billion at that date..

[20] Interview with Charles Geschke, April 7, 1999

[21] The acronymn WYSIWYG stands for "what you see is what you get", connoting the ability to display text on a computer monitor in substantially the same way that it will appear in printed output.

[22] LiveWorks' revenues peaked at over $14 million, according to Chesbrough, 2000b.

[23] Myers is quoted in Chesbrough and Rosenbloom, 2000: 62.

[24] The difficulty of achieving compatibility with the installed base should not be underestimated. In Documentum's case, they had to jettison all of the existing document management software code at PARC, and write the entire program from scratch.

[25] A recent entertaining example of "business model" in colloquial use comes from Michael Lewis (2000: 256-7): "'Business model' is one of those terms of art that were central to the Internet boom: it glorified all manner of half-baked plans. All it really meant was how you planned to make money."