

**A DYNAMIC TECHNOLOGY STRATEGY
FOR XEROX TO RESPOND TO THE THREAT
OF HIGH-TECH COMMODITIZATION**

**Richard de Neufville,
Professor and Chairman, Technology and Policy Program,
Massachusetts Institute of Technology
77 Massachusetts Avenue, Building E40-251, Cambridge, MA 02139, USA
Tel: +1-617-253-7694, Fax: +1-617-253-7140, E-mail: ardent@mit.edu**

**Ali Pirnar,
Senior Consultant, Renaissance Solutions, Inc.
55 Old Bedford Rd. Lincoln, MA 01773, USA
Tel: +1-617-402-1169, Fax: +1-617-259-0565, E-mail: apirnar@rens.com
(formerly Research Associate at Massachusetts Institute of Technology.)**

Abstract:

This paper shows how Xerox can make decisions to respond to the threat of high-tech commoditization in copiers. The extent of the threat is seen in the example of the computer industry's commoditization by personal computers, and the negative effects on the industry leader IBM.

The threat to Xerox is presented by the personal copier segment possibly being quite different, eroding existing competencies technologically and in markets, threatening profits, market share, and revenues.

Decisions on digital technology, being first mover, and transition risks from the organizational competency perspective are combined using dynamic strategic planning which recognizes risk and the imperfection of technological and market forecasts.

Decisive strategic moves into digital technology appear to provide the best response to the threat of commoditization of the copier industry.

Aggressive strategies have higher expected outcomes under extreme commoditization, but also higher variances and risk. Doing nothing is the worst strategy. The value of each strategy depends on the level of future commoditization, and the risk aversion of decision makers.

Keywords:

High-tech commoditization; Personal computers; Personal copiers; Digital technology; Organizational competency; First mover; Dynamic strategic planning; Dynamic technology strategy; Risk aversion.

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Biographical Notes

Professor Richard de Neufville is the Founding Chairman of the post-graduate Technology and Policy Program (TPP) at the Massachusetts Institute of Technology (MIT). This Program is unique in that it is based in Engineering and thus brings a strong understanding of technological issues to the questions of managing technological development. Prof. de Neufville regularly teaches Management of Technology courses at MIT as well as in France and England, and works worldwide as a consultant with multinational companies. He has received numerous awards for innovation, professional excellence and effective teaching.

Ali Pirnar obtained a B.S. degree in Electrical and Electronics Engineering from Middle East Technical University in Ankara, Turkey in 1986. He worked as a software engineer and manager, in electronic information products and applied research with Alcatel and ITT in The Netherlands until 1994. He obtained an S.M. degree in Management of Technology, and an S.M. degree in Technology and Policy, from the Massachusetts Institute of Technology in 1996. Mr. Pirnar is currently a senior consultant with Renaissance Solutions, Inc.

Introduction

This paper considers how Xerox, a dominant company in the high-tech copier industry, should respond to the threat of commoditization. Commoditization involves radical change in the providers, manufacturers, and distributors of a product, resulting in major changes in revenues, profits, and market share from the perspective of the dominant company.

Commoditization of personal computers had a major impact on the computer industry, as indicated by the experience of IBM. Commoditization could have similar effects on other high-tech industries, in particular on copiers - which case this paper examines in detail.

The first section defines the threat of commoditization with an illustration drawing parallels between IBM's experience with personal computers and the copier industry today.

The second section identifies possible major responses to the threat. Crucial to this thinking is a technology strategy framework that considers the progress of digital technology, the effects of being a first mover, and transition risks from the organizational competency perspective.

The third section introduces dynamic strategic planning as the methodology for identifying game plans for dealing effectively with complex, risky situations. The premise of dynamic strategic planning is that, since the future is uncertain and all choices are risky, it is necessary to build flexibility into the planning process and to manage developments according to the outcomes that occur over time. Good dynamic strategic plans basically create options which managers can exercise (or not) as expedient.

Dynamic strategic planning guides managers to position their companies moderately aggressively so that they can respond decisively if circumstances warrant, without having to risk the company itself. In effect it suggests that they should invest in creating options which they can take up (or not) as future circumstances warrant. The fourth section applies this methodology to the case of the copier industry and leads to the following ideas:

- a) Steady maintenance of current processes and practices is probably the worst response to the threat of commoditization.
- b) Moderately aggressive positioning of the dominant company to either introduce new, digital technology or to develop new market niches provides a better balance of risks and rewards than an all-out attempt to digitize the industry and establish whole new sets of standards.

1. Threat of Commoditization

High-tech proprietary producers are vulnerable against low-end commodity producers. The computer industry and the fall of IBM provide prime examples of high-tech commoditization and its effects. The copier industry seems to be approaching commoditization. Xerox and IBM, in the high tech copier and computer industries respectively, certainly show historical, organizational and technological parallels.

The typical characteristics of a commodity versus non-commodity (also called niche) product or segment are displayed in Table 1, which shows the specific example of IBM computers.

For a commodity, in the absence of any further added value, the basis for competition is price, delivery terms and timing of the product. If there is a need for ongoing availability there may be an opportunity to add value and differentiate the product through service or warranty agreements. This is seen in the case of personal computers and consumer electronics where manufacturers or retailers sell optional additional warranties. For example, Xerox has a 3 year warranty scheme on its copiers. [1]

Commodity products are interdependent with other products; they are part of a network of use that goes beyond their immediate manufacturer. Examples include battery (sizes) and appliances; computers and connecting peripherals (connectors and protocols); trains and train tracks (gauge). Even low-tech commodity products such as grains or metals must eventually conform to standard sizes of metal ingots or bushels required for widespread storage, transportation, or trading. This dependency may be crucial for high-tech products.

Commoditization is the transition of a product or industry segment from being a niche to being a commodity business. Commoditization of high-tech products is specifically their transition to a mass market.

A feature of high-tech commodity products is that they were once niche products, or some of their features were niche features. A corollary is therefore that every high-tech niche product risks becoming a high-tech commodity product.

Commoditization is a commercial threat to the manufacturers of high-tech products because it leads to loss of market dominance, proprietary standards and margins. It is also a cultural threat to both the dominant high-tech companies and their employees: they have to shift from working in a protected environment, producing the products themselves and distributing them through their own channels, to competing aggressively, abandoning

their own manufacture in favor of outsourcing, and marketing indirectly through mass retailers (such as Egghead, Staples, etc.)

New features added on commodity products can be used to create temporary niches or non-commodity products. For example, adding new peripherals or new higher performing processors to personal computers for multimedia applications, or adding features previously feasible at the high-end copiers such as networking, or color, to low-end copiers, can take these products out of the commodity markets for a short time.

The IBM example

The history of IBM illustrates how commoditization can impact dominant, proprietary producers of high-tech products. As there are many parallels between the computer industry and the copier industry, the IBM example should be especially interesting to Xerox.

IBM, as Xerox, 'invented' a new industry and held a near-monopoly.[2] Early products required large capital outlays which required financing of customers through leasing. Because the first computers had approximately 35,000 active components and were unreliable, IBM developed a large sales and service force, as did Xerox. IBM's large lease base and the strong sales and service organization helped to capture and retain dominance of the emerging computer industry. As with high-end copiers in document replication centers, early computers and subsequent high-end computers depended on economies of scale by batching sufficient numbers of users. Dedicated "data centers" and administrative units emerged in organizations. IBM's sales organization was geared towards these administrative units and their purchasing bureaucracies.

During the 1970s, IBM remained with large mainframe computers as its core business and its performance weakened. It lagged in the commercial development of distributed processing and personal computers. Although IBM's research was strong (it led in the development of RISC technology) as Xerox's is at PARC, it failed to apply the advantage. In the 1980s IBM did not move promptly into minicomputers, and entered late into personal computers.

Personal Computers (PCs) appeared first in 1975. Many products were already being sold by 1981 when IBM entered the personal computer market with the IBM-PC. The IBM-PC was developed by an independent internal unit, and sold by PC retailers (such as Computerland) distinct from the large IBM sales force.

The IBM-PC was a commodity product because it relied on standard, outsourced components. It contained the Intel microprocessor, and the Microsoft software (MS-DOS). These critical parts were accessible to IBM

competitors whom Intel and Microsoft had every reason to encourage: Both chips and software enjoy huge economies of scale from sharply declining manufacturing costs following large development investments. The IBM-PC also had an open architecture, allowing easy development and installation of third party hardware and peripherals. Businesses supplying IBM or producing competing or complementary enhancements could build volume on the de-facto IBM-PC "standard" by encouraging competitors and the commoditization of the product.

Commoditization of the computer industry hit IBM hard: After 1987 its stock price dropped by a factor of four, from almost \$170 to a low of \$40 by late 1993. While IBM was able to retain market share in the high-end niche market, it lost out in the now larger PC segment. Personal computers are the largest segment of the worldwide computer industry, (estimated to be US\$ 120 billion in sales in 1993), accounting for 54% of the market. Mainframes are the smallest, accounting for only 18%. [3] IBM's worldwide market share in 1993 was 12% in PCs, and 70% in mainframes. Within the US PC market, which is about half of the worldwide PC market, the market shares of IBM in 1994 were even less, only 8.8%. [4] Industry commentators noted that "everything that's growing has low gross margins, and everything under pressure has high gross margins...and IBM's physical plant and infrastructure was designed to be supported by much higher margins." [5] IBM is no longer the dominant leader, it has been reduced to a smaller player in a larger industry.

Computerization of copier technology

Digital xerography is the coming alternative to traditional xerography using light-lenses. In digital xerography the image is scanned, digitized and stored in memory where it can be processed. This is done using a combination of Application Specific Integrated Circuits (ASICs,) Digital Signal Processing (DSP) chips, and sufficiently powerful microprocessors. Thereafter the copy can be produced by digitally controlled laser.

Digital technology has replaced most of the light-lens technology in high-end copiers beginning in 1985 [6]. Both light-lens and digital technology are still in use in the middle segments [7]. Most copiers produced today use microprocessors and digital technology to synchronize the modules to perform the overall function of copying. The cost of memory is not yet low enough to introduce digital storage of images for processing in personal copiers.

Digital technology empirically follows Moore's Law which estimates that computational capability doubles every 18 months for the same cost. As the theoretical physical limits to miniaturization, speed gains and Moore's Law, are not yet within sight, it is expected that digital technology will eventually be more cost effective than light-lens technology for personal copiers.

Digital technology can fundamentally alter the architecture of copying in two ways:

1. Copiers can be interfaced and networked with the rest of the digital office and world; and
2. Image processing can be migrated outside the copier box, creating a 'virtual distributed copier.'

With computerization, the needs of copying, printing, faxing, or more generally document and information processing can be performed in several ways. They can be concentrated all in one box, or distributed on the network, spanning a range of central/decentral, and local/remote options. Choices can be made based on the individual performance attributes of the various boxes and the user's needs.

Networked scanning and printing can substitute for standalone copiers. As an example, the introduction by Hewlett-Packard of the ScanJet 4Si scanner, capable of scanning 15 pages per minute, is seen as "hastening the decline of the office copier." [8]

Additional --value adding-- functions related with scanning, faxing and printing can be performed outside the boxes, on workstations. For example the Xerox Document Workcenter 250 is a networkable multi function device (MFD) that includes software for optical character recognition (OCR), fax management, and device set-up for execution on a personal computer. Notably, approximately two thirds of this device's spec sheet covers purely system requirements and the software for personal computer connection. [9]

Due to performance reasons, the image processing has so far remained dedicated to special hardware within each box. However the algorithms used for image processing are universal and could equally be implemented on general purpose hardware such as a workstation, or any of the other boxes. Given sufficient communication, storage, and processing capability at competitive costs, image processing could migrate from a dedicated copier box.

The threat of commoditization to the copier industry

Commoditization is already happening in personal copiers. This segment of the industry is fast growing, has low margins, is marketed through retailers, and is increasingly undifferentiated. (See Table 2)

The personal copier segment has been growing the fastest. Its compound annual growth rate was over 20% from 1989 to 1994, compared with a weighted average of 4% for all other segments. [10]

Overall gross margins in the personal copier industry are estimated at 18%, [11] compared to typical industry gross margins of 46%. [12] As a result of

the lower margins and difficulty of selling low-end copiers through dealers, the personal copiers are mostly sold through off the shelf retail channels such as Staples or Office Max. Higher segments are also showing signs of moving through alternate distribution channels. [7]

Personal copiers are now much less differentiated than medium or high-end copiers. From a sample of 287 low end copier models, 70% were seen to have identical features, while only 43% of 112 medium copiers, and 15% of 26 high-end copiers had identical features. [13]

More commoditization is likely to take place. Looking at Table 2, one can anticipate more competitors, loss of brand equity and the possibility for the dominant producers such as Xerox to be locked out of important segments of the market -- if they do not act decisively to set standards for the networking and the development of substitute products.

New standards will indeed be set. While historically copiers only had to be compatible in a few basic specifications (electric supply voltage and plug; standard paper sizes, and acceptable size and footprint within the typical office environment), in the future as copiers merge with computer peripherals they will have to be compatible with many more: Local area networks (LAN), printer languages, (e.g. HP-PCL), fax/modem controls (e.g. Hayes, ISDN), and scan/print content files (e.g. Postscript).

If the dominant producers fail to adapt their products to the networks they threaten their margins. Network externalities and adherence to standards measurably influence the value of products. [14] For example, in spreadsheet software, products compatible with the Lotus menu tree interface appear to command a 30% premium over the average price in the market.

The digital threat is compounded by the potential for personal computers or other non-copier boxes to substitute some of the image processing tasks of copiers.

Commoditization may also spread from personal copiers to the entire industry, just as it has for computers. Diffusion of technologies and features to the low-end in an attempt to differentiate personal copiers cannibalizes the high-end products, creating a dilemma for the established dominant producer. Meanwhile new entrants, with no stake in the profitable high-end products will be glad to commoditize the higher-end products.

The bottom line is that the copier industry is vulnerable to commoditization, particularly through digitalization and networking of the copying process. There is no fundamental reason why the experience of IBM could not happen to Xerox. The question is, how should Xerox respond to this threat?

2. Possible Responses

Responding to the major threat of commoditization and radical change in the industry requires major strategic commitments as well as a detailed plan. These commitments concern the:

1. Timing of the response, early or late relative to competitors; and
2. Boldness of the response, that is the degree to which a company is prepared to move from its established base of competencies to the new industrial structure.

First mover or follower ?

Leaders in the development of an important new technology sometimes gain decisive and enduring advantages. [15] While it is rarely possible to study the pioneering firms which failed, the data on surviving firms show that mean market shares are 30% for pioneers, 19% for early followers, and 13% for late entrants. Moreover, more than 70% of current market leaders were pioneers. An *Advertising Age* study based on revenue data, shows that of 25 market leaders in 1923, 19 were still market leaders in 1983, and all were in the top five. [16]

Late entrants into a new industry can become leaders if they hold dominant positions in related products providing shared economies across product lines. These advantages may be due to brand recognition, trade secrets, patent "thickets", distribution, production, or managerial expertise. For example, IBM's success in mainframe computers provided it with instant brand recognition and a strong distribution advantage because it could enter the PC market via large corporate accounts. This is known as "asset leverage" or the leverage of "complementary assets".

In entering the personal copier business, Canon leveraged technical assets from its camera business, but had to create a distribution system from scratch. By choosing to distribute through retailers instead of using a sales force as Xerox does, Canon avoided having to compete against Xerox's very significant complementary asset.

Successful early entry into a market appears to depend on two factors [16]. An early entrant must be able to:

1. Change, even at the cost of its current position in some other mature markets, by cannibalizing and rendering existing products obsolete before the same is inflicted by competitors; and
2. Transfer its strengths to the new market, for example by applying a strong brand in high end computers or copiers to personal devices.

The above factors parallel the two critical dimensions of competency stability developed in the technology and market stability framework next.

Creation and destruction of technological and market competencies ?

Radical changes in the industry destroy traditional technological and organizational strengths. The commoditization of the computer industry, by altering the locus of design (e.g. to Intel and Microsoft), the mode of manufacturers (to outsourcing), and the channels of distribution (through retailers), virtually destroyed the values of IBM's competencies in these areas. To adapt to major industrial changes, established companies need to reorient their established competencies -- before new entrants do it for them, as they did to IBM.

The "technology and market stability" framework provides a powerful view of technological and market changes. See Figure 1. [17] The dimensions of interest are the technological competency of the people in an organization, and the linkages with existing market contacts such as customers and suppliers. The basic idea is that technological competency and market contacts are important assets. Though not explicitly accounted for on a balance sheet, both are key factors in determining a company's success and relative position in an industry. The concept of this framework can be appreciated by using it to examine the development of the copier industry to date.

New entrants in a new type of industry conveniently first establish themselves by dominating niche markets, before moving on toward the mass market. This is what the manufacturers of personal computers did. This is also the history of Xerox's own development.

When xerography first emerged, there were no established technical competencies or market linkages. Xerox's initial situation was in the top right quadrant of Figure 1(a).

Xerox initially applied its technology to a small part of the existing lithography market -- a niche. Mass copies were not a driving force in either the invention or the early marketing. [18] Thus a move was made to the top

left quadrant as shown in Figure 1(a), once technological competency and viability was established.

During its progress, Xerox became the expert organization on xerographic technologies, and developed deeply rooted relationships with its customers. This outcome places Xerox in the lower left quadrant of Figure 1(a). This is a common pattern in the creation of mass markets.

The technological and marketing assets which Xerox built up on its way to market dominance were:

- Invulnerable patents;
- Financing of customers through leasing; and
- Strong field service to cope with product shortcomings.

These assets of Xerox eroded when:

- Patents expired or were licensed out due to anti-trust actions;
- The lease base was sold off; and
- Canon introduced personal copiers not requiring field service or sales forces.

Canon's attack on the copier industry bypassed Xerox's marketing assets, and made them inapplicable. Canon took the established technology and established a niche market largely by distributing personal copiers through retailers, see Figure 1(b). The subsequent growth of market in personal copiers made some of Xerox's marketing assets -- such as its sales force or lease base-- a liability as they could not be converted or reinvested quickly.

The technology and market stability framework thus provides a way of placing in perspective the possible specific responses to the threat of commoditization.

The question is: How boldly should a dominant company in a high-tech industry respond to the challenge of commoditization? Specifically, how should Xerox respond to the potential digitalization and commoditization of copiers?

Possible Specific Responses

The threat of digital commoditization to the xerography copier industry is represented at the upper right quadrant in Figure 2(a). It involves the introduction of new technology and new market linkages, either by a new entrant, an existing competitor, or indeed by Xerox itself if it chooses to move aggressively.

The specific responses to the threat of commoditization represent combinations of choices about technology, networking and timing. These choices are between:

1. Digital and analog technology -- There is a technological discontinuity between digital technology and the limits of analog technology. A change to digital technology would increase the risk of losing existing competencies in the previously dominant technology.
2. Network or standalone copiers -- Once digital devices are networked and require interoperable hardware and software, they depend on other digital products. Networked devices would thus probably involve the new channel of computer stores, but standalone devices could continue to be distributed through office stores. Changes in marketing channels increase the risk of losing existing competencies in a previously dominant market.
3. First mover or late follower -- The first mover can, at some risk, increase market advantages using product interdependencies.

The responses to the threat can be viewed as strategic decisions to move in varying degrees to different quadrants in the framework shown in Figure 2(b).

Possible specific responses combine these choices. As summarized in Table 3, the major ones appear to be:

- A. Radical Change -- Introduce new technology through new marketing channels (Digital, networked, early, in computer stores).
- B. Moderate Market Niche -- Introduce technology slowly through new marketing channels (Digital, networked, late, in computer stores).
- C. Moderate Technical Innovation -- Introduce technology early through existing market channels (Digital, not networked, in office stores).
- D. Steady Maintenance -- Introduce technology slowly and incrementally, or not at all, do not introduce new market channels (Analog, in office stores. Digital, late, in office stores).

3. Planning

Concept

The premise of dynamic strategic planning [19] is that the future is uncertain and all choices are risky. Dynamic strategic planning recognizes risk as an inescapable reality. Even with the most elegant reasoning and most sophisticated statistics behind them, forecasts are rarely realized. By

recognizing risk, dynamic strategic planning addresses a range of possible futures instead of being limited to one forecast.

When there is risk it is desirable to identify the actions leading to the best, or least unsatisfactory, portfolio of risk. The best portfolio involves flexibility; the development of options, either by investing in development of possible new products or markets (similar to call options) to enable managers to take advantage of favorable opportunities, or by acquiring insurance (similar to put options) to mitigate catastrophes.

Paying for flexibility is a key way to address risk. This involves the purchase of some form of “real” options (that is options represented by products instead of financial instruments.) Their value is not defined by whether they are always used or needed, but by the degree to which their value balances their cost when needed. Buying the right capability to respond easily to future events is key to building an optimal strategy.

A strategy is a general way of dealing with an issue rather than a particular detailed plan. A strategy is flexible; it defines the first steps of action and leaves later steps to be defined according to the way events develop. A strategy emphasizes good positions and moves that permit easy response to the potential range of circumstances.

Decision analysis methodology

Decision analysis is an easy way to define a preferred strategy. It involves four elements:

1. Identification of issues;
2. Recognition of risks;
3. Enumeration of choices and ranges of possible outcomes; and
4. Identification of the optimal strategy.

Decision analysis structures the problem to bring out all the relevant choices, and all the important possible outcomes. The means for doing this is the decision tree. This is a conceptual device for enumerating each of the major possible decisions that can be made and each of the possible outcomes that may then arise from each of the scenarios that may occur. As a single initial decision can have many outcomes, after which there can be many more decisions, the possible combinations expand over time. Thus the decision tree branches out.

The decision tree represents a sequence. It consists of the alternation of:

1. Decisions D_i , taken at various moments, followed by the
2. Chance events C_j , of the scenarios which follow, after which later decisions and chance events can take place.

The chance events C_j that follow any decision D_i occur with some probability P_j and lead to results or outcomes O_{ij} measured in numerical terms such as profits. These items of information are usually associated with each scenario or chance event as follows:

D_i - C_j - Probability, P_j - Outcome, O_{ij}

The essential principle of decision analysis is to choose the decision that offers the “best average value”. The “average” value relevant to a risky decision, D_i , is simply its expected value $EV(D_i)$, the outcomes weighted by their estimated probability of occurrence:

$$EV(D_i) = \sum_j P_j O_{ij}$$

The calculations are straightforward if one carefully follows the structure of the decision tree. Specifically, the process consists of two steps for a single stage: The calculation of first the probability of the outcomes, and then of the best decision.

Decision analysis presumes that while estimation of risks is imprecise, at least some assessment of the probability of events is possible. Being imprecise, these estimates must be tested.

Sensitivity analysis addresses the stability of the decision analysis under varying probability estimates. It gives an indication of the confidence that may be placed in the recommendations of decision analysis. The sensitivity of the outcomes is analyzed by examining a range of probability sets, which includes the actual estimated probabilities and others within a confidence range below and above.

When the sensitivity analysis shows that the recommended management decisions do not alter significantly as the probabilities of chances are varied, this stability indicates that the decision analysis has modeled some invariant properties of the system. Highly sensitive recommendations indicate that the assumptions being made are very critical, and need to be explored further.

A strategy that yields a great expected value might also have great variance, and thus might not be preferable to an alternative strategy with lower expected value with lower variance, and hence lower risk. The choice between the different risk portfolios associated with different strategies requires a tradeoff between expected value and risk. The choice depends on the risk portfolio desired by the decision makers and their degree of aversion to or preference for risk.

4. The Analysis for Xerox

Structure of Analysis

The range of possible outcomes for each of the possible responses by Xerox to the threat of commoditization are displayed in the decision tree of Figure 3.

This analysis estimates the value of the outcomes in terms of gross margins in US\$, as on Xerox's income statement [20]. Each response would lead to a range of outcomes, whose expected values, maximum, minimum and median results appear in the decision tree.

The outcomes will be determined by a variety of future states of the copier industry. For this analysis, the major factors were taken to be:

1. Industry structure, viewed as market share of Xerox;
2. Gross margin percentage;
3. Volume, as seen by market proportion of personal copiers; and
4. Growth in sales of industry.

The probabilities of future levels of the chance determinants of outcomes were estimated [21] with respect to:

- The current status of the personal copier industry as a starting point.
- The current status of the comparison industry of personal computers which is highly commoditized as an extreme case.
- The current status of niche markets such as mainframe computers or high-end copiers where reversal of commoditization might happen as another extreme case.
- Empirical studies [14], for effect of standards and product interdependence on pricing.

Since the estimates of the probabilities of chance events are ultimately subjective, it is important to test the sensitivity of the results to these estimates. This is done by examining different scenarios for the speed of commoditization which imply different probability distributions.

Three different scenarios for the speed of commoditization were considered. The first corresponds to the case of moderate commoditization with a higher probability that the personal copier share within the overall copier industry will remain low. The second and third cases are increasingly aggressive estimates of personal copier share in the overall copier market, coupled with more aggressive estimates of Xerox market share sensitivity to networking, and to early entry. [21]

Results

The results of the analysis are displayed in Table 4. These display the range of values for each possible response, under the three different scenarios about the rate of commoditization.

The interesting question is which response is best now, when the speed of commoditization is not yet known. To see this, we need to examine each scenario.

Assuming moderate commoditization, the strategy of moderate technical innovation (C) dominates all others. Further the steady maintenance strategy (D) dominates the others as it has similar payoff but lower variance. Therefore the tradeoff is between moderate technical innovation (high payoff, high variance,) and steady maintenance (low payoff, low variance.)

Assuming increased commoditization, the radical change strategy (A) dominates. The moderate technical innovation strategy (C) dominates the others as it has high payoff and low variance. Therefore the tradeoff is between radical change (high payoff, high variance,) and moderate technical innovation (low payoff, low variance.)

Assuming extreme commoditization, the moderate niche market strategy (B) dominates. The moderate technical innovation strategy (C) dominates the others as it has highest payoff and low variance. Therefore the tradeoff is between either a moderate niche market strategy (high payoff, high variance,) or a moderate technical innovation strategy (low payoff, low variance.)

The preferable responses for each scenario about the speed of commoditization are summarized in Table 5. This suggests the following conclusions:

1. The steady maintenance strategy - of doing nothing special appears attractive only if commoditization is relatively slow. Otherwise it lets competitors take over - as was done to IBM. It is probably the worst strategy.
2. The radical change strategy is attractive only in special circumstances and is in any case risky. This is probably not the preferred approach at this time.
3. The best strategies are moderately aggressive responses, in particular the strategy of introducing digital technology soon. This approach appears to enable good results under almost any circumstances.

With the reasonable assumption that the copier industry is moderately commoditized now, and will eventually transition to increased, and then extreme commoditization; the strategy of introducing digital technology now

into copiers looks quite safe. It implies transitioning from a high payoff/high variance results to a safe results with low payoff/low variance strategy.

Conclusion

Commoditization of the copier industry in general by digital personal copiers is a threat. This threat is very similar to the commoditization of the computer industry by personal computers, leading to the great difficulties experienced by IBM. Dominant companies in the copier industry, Xerox in particular, risks losing its existing advantages and competencies both technologically and in markets.

To deal with this threat, our analysis indicates that Xerox can respond in one of four major strategies of:

- Radical change, featuring early introduction of digital networked personal copier technology in new marketing channels such as computer stores;
- Moderate niche market, slowly introducing digital networked personal copier technology in new marketing channels such as computer stores;
- Moderate technical innovation, with the early introduction of digital standalone personal copier technology in existing office stores; and
- Steady maintenance, featuring late introduction of standalone digital personal copier technology, or staying with analog technology, in existing office stores.

Whatever the progress of digital commoditization or the risk aversion of decision makers, it seems that the strategy of steady maintenance, of sitting still, should be avoided. Late introduction of a digital standalone personal copier in existing office stores, or staying with existing analog technology in existing office stores, looks like the worst scenario.

Moderately aggressive positioning of the dominant company to either introduce new, digital technology or to develop new market niches provides a better balance of risks and rewards than an all-out attempt to digitize the industry and establish whole new sets of standards.

Based on subsequent discussions with representatives of Xerox, it is our understanding that the company has indeed made an independent corporate decision to focus on digital technology for all major new products.

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Tables

Table 1: Commoditization in IBM brand personal computers contrasted with a non-commodity IBM product [22]

Characteristic	Commodity (IBM PC)	Non-commodity (IBM Mainframe 390)
Industry structure (market share %)	Competitive (IBM=8.8%)	Few competitors (IBM=70%)
Gross Margin	Low 18%	High 48%
Volume	High \$10.2m	Low \$6.2m
Growth (revenue)	High 14%	Low 6%
Market	Mass	Niche
Supply Chain	Outsourced	Vertically integrated
Distribution	Indirect	Direct
Service	Low	High
Product Differentiation	Low	High
Product Brand	Unimportant	Important
Product Standards	Intel/Microsoft	Proprietary
Interdependence (Network Externality)	High	Low

Table 2: Commoditization in copiers

Characteristic	Commodity Definition	Personal Copier	Non-commodity copiers
Industry structure	Competitive	Few competitors (?)	Few competitors
Gross Margin	Low	Low	High
Volume	High	High	Low
Growth (units)	High initially	20%-40%	max. 10%
Market	Mass	Mass	Niche
Supply Chain	Outsourced	Outsourced	Vertically integrated
Distribution	Indirect	Indirect	Direct
Service	Low	Low	High
Product Differentiation	Low	Low (?)	High
Product Brand	Unimportant	Important (?)	Important
Product Standards	Industrywide	(?)	Proprietary
Interdependence (Network Externality)	High	LAN, MFD, OCR (?)	Low

Notes: Shaded: Items in conflict with commodity definition of Table 1
 (?): Items which might yet be determined due to technology

Table 3: Characteristics of specific possible responses to threat of commoditization

Possible Response	Choice			
	Digital or Analog	Networked or Standalone	Early or Late	Marketing Channel
A. Radical Change	Digital	Networked	Early	Computer Store
B. Moderate Niche Market	Digital	Networked	Late	Computer Store
C. Moderate Technical Innovation	Digital	Standalone	Early	Office Store
D. Steady Maintenance	Digital or Analog	Standalone	Late	Office Store

Table 4: Value of possible responses to threat of commoditization under range of scenarios (in estimated gross margins, millions of US\$)

Possible Response	Minimum	Median	Maximum	Expected Value	Standard Deviation
A. Radical Change	0.0	2.5	913.8	57.7	181.0
B. Moderate Niche Market	0.1	9.8	611.9	55.7	120.9
C. Moderate Technical Innovation	0.5	29.7	472.2	98.5	159.4
D. Steady Maintenance	19.1	19.1	188.9	53.0	70.7

(a) Moderate commoditization scenario

Possible Response	Minimum	Median	Maximum	Expected Value	Standard Deviation
A. Radical Change	0.0	1.9	734.3	45.5	145.6
B. Moderate Niche Market	0.1	6.6	416.4	37.6	88.9
C. Moderate Technical Innovation	6.7	25.7	70.8	33.6	26.3
D. Steady Maintenance	13.1	13.1	61.7	21.5	21.2

(b) Increased commoditization scenario

Possible Response	Minimum	Median	Maximum	Expected Value	Standard Deviation
A. Radical Change	0.1	1.7	293.7	21.9	59.4
B. Moderate Niche Market	0.1	6.5	312.3	29.8	66.6
C. Moderate Technical Innovation	7.7	20.0	47.2	24.7	15.3
D. Steady Maintenance	9.8	9.8	42.6	15.5	15.0

(c) Extreme commoditization scenario

**Table 5: Dominant responses by Xerox
for the range of possible rates of commoditization**

Degree of commoditization	High payoff and high variance strategy	Low payoff and low variance strategy
Moderate	Moderate Technical Innovation	Steady Maintenance
Increased	Radical Change	Moderate Technical Innovation
Extreme	Moderate Niche Market	Moderate Technical Innovation

Figure Captions and Figures

Figure 1 [17]

(a) Strategic history of xerography:

The originally radical position of xerography has gradually become established as indicated by arrows.

(b) Recent development: Canon's attack on the copier industry is through the creation of a niche market in personal copiers marketed in a new way.

Figure 2

(a) The Threat: Digital commoditization would be a radical change to the copier industry.

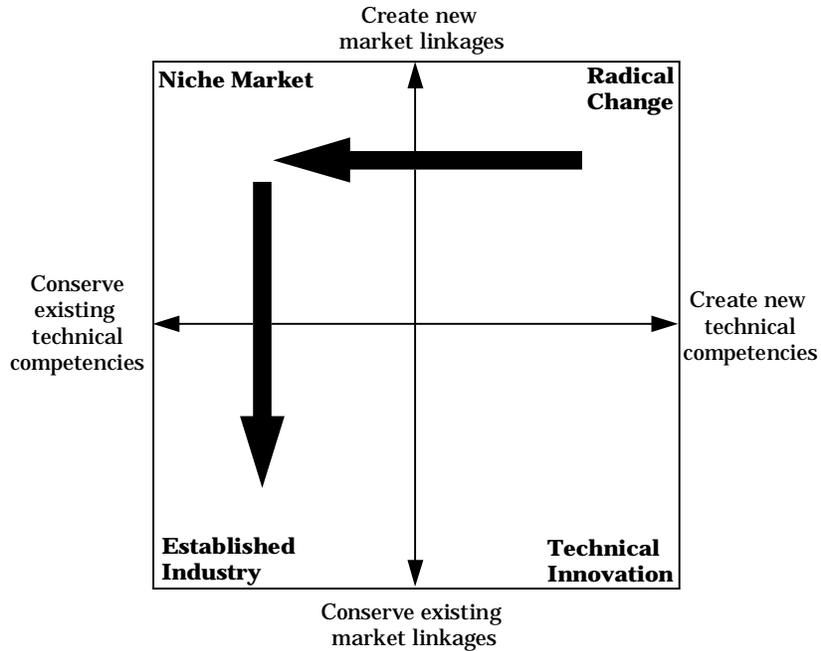
(b) Possible strategies to respond to threat:

A=Radical Change, B=Moderate Niche Market,
C=Moderate Technical Innovation, D=Steady Maintenance

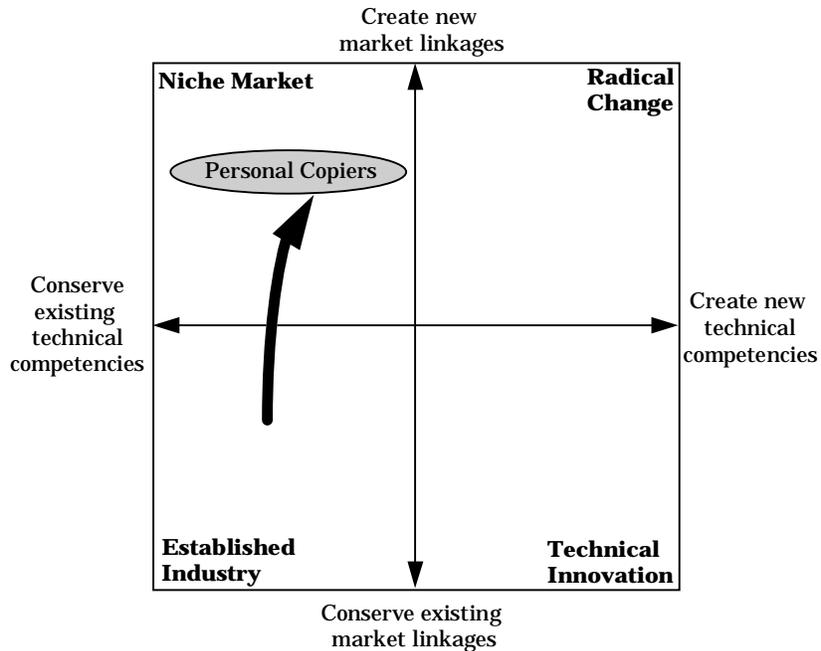
Figure 3:

Decision tree for possible responses by Xerox
to threat of commoditization

(data assumes moderate commoditization, as in Table 4)

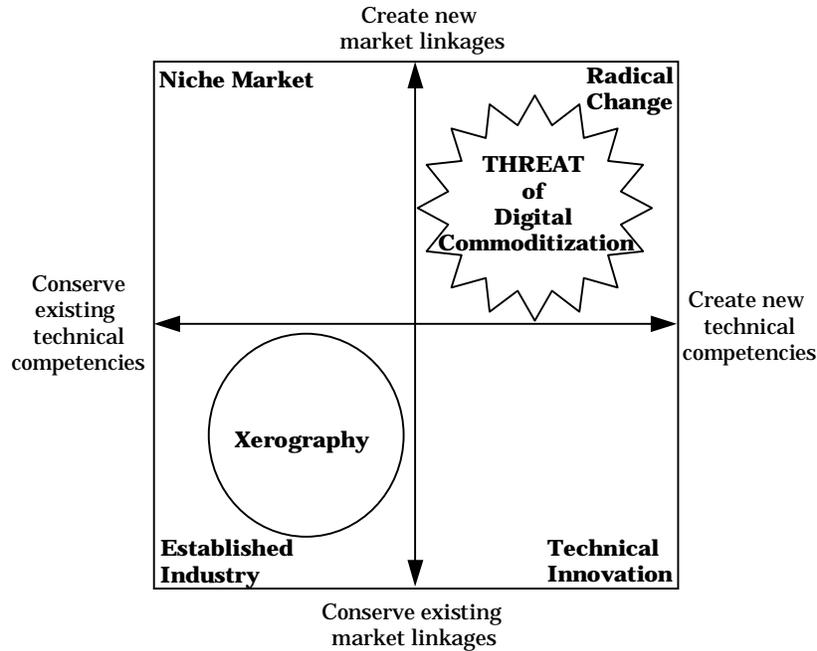


(a) Strategic history of xerography:
The originally radical position of xerography has gradually become established as indicated by arrows.

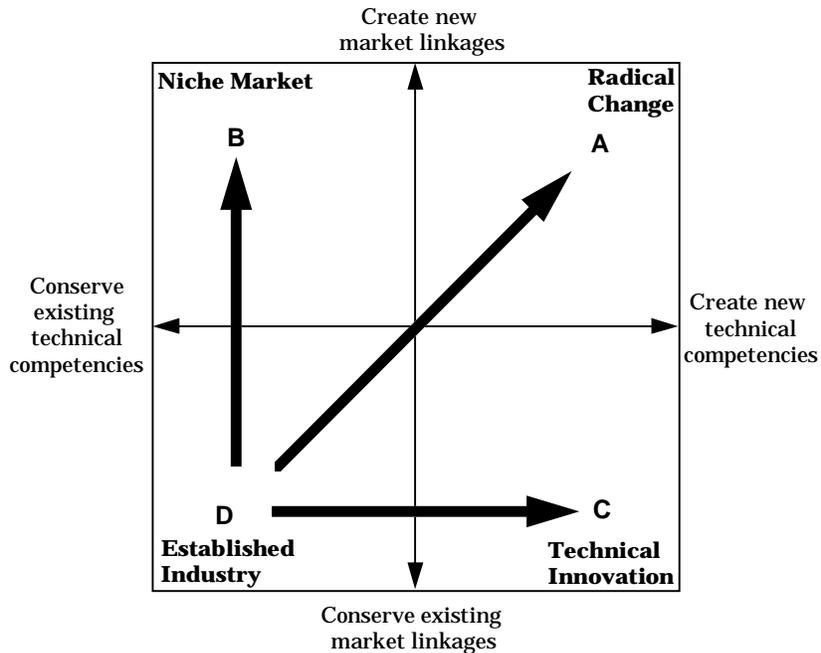


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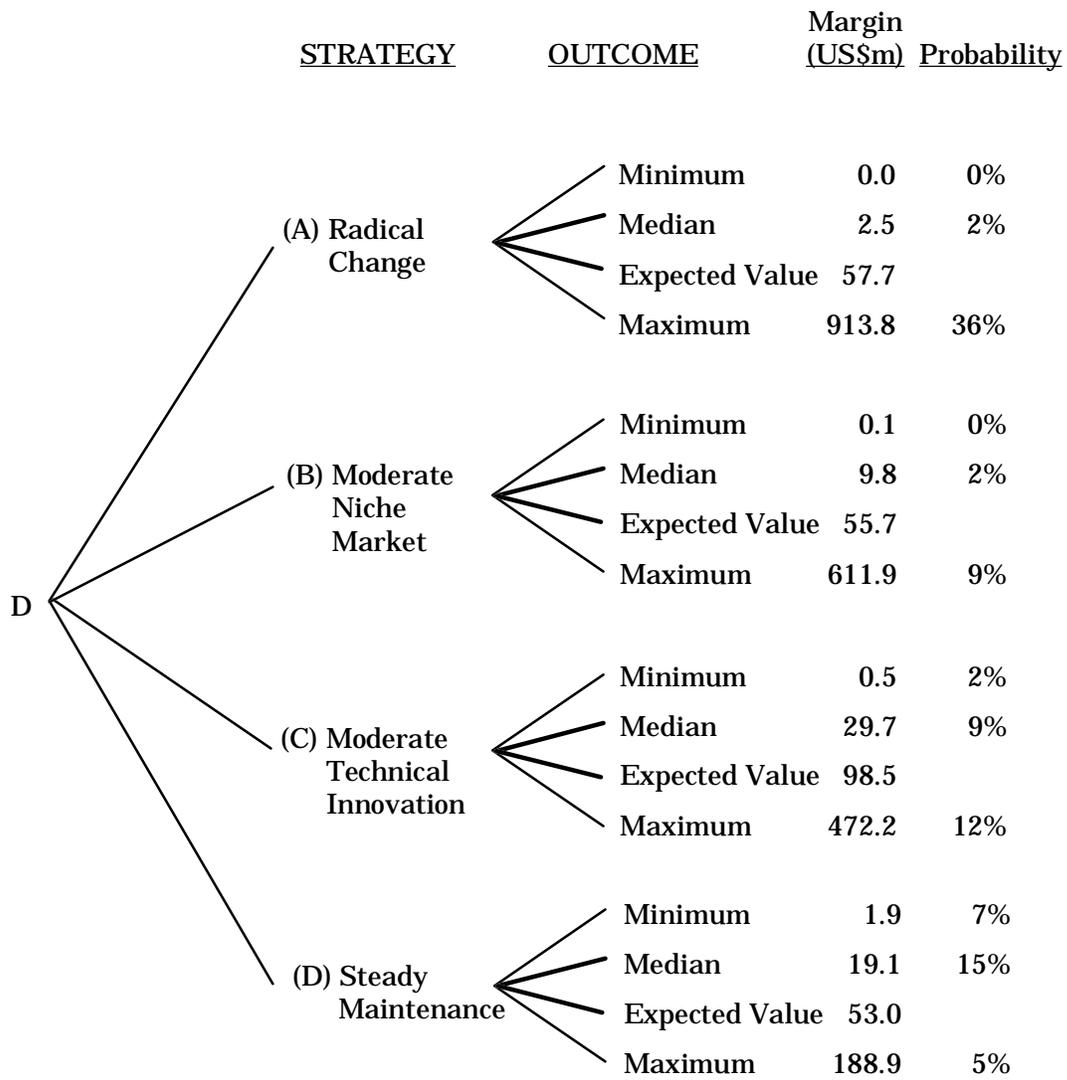


Figure 3: Decision tree for possible responses by Xerox to threat of commoditization (data assumes moderate commoditization, as in Table 4)