

How do rivals compete: strategy, technology and tactics †

Philip H. Birnbaum-More ^{*,a}, Andrew R. Weiss ^b and Russell W. Wright ^a

^a Department of Management and Organization, Graduate School of Business Administration, University of Southern California, Los Angeles, CA 90274-1421, USA

^b Department of Economics and Business, Monmouth College, Monmouth, IL 61462, USA

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This paper reports the results of an exploratory analysis of the actions taken by rivalrous firms to create competitive advantage in 13 US product market segments. Twenty-four actions taken by competitors to achieve competitive advantage were identified. These were examined in greater detail through use of a survey that identified the common and unique actions used by the rivals. The findings indicate that a focused approach to the market together with increased use of product and process technology throughout market growth and concentration phases of industry maturity are important elements of successful competition.

Introduction

A firm's strategy can be defined in terms of its actions to achieve and sustain competitive advantage. Competitive advantage is created by the firm's actions that create unique and sustainable product or service attributes that are valued by customers. Understanding competitive advantage has become a major area of interest for researchers in strategic management as well as industrial organizational economics [5,20,23]. Sources of competitive advantage include resources

and actions that result in customer valued differences in products and services.

This article reports on the actions that lead to competitive advantage. We empirically derive specific types of strategic actions associated with different levels of competition between products and services. We identify those types of strategic actions common to all firms competing within the specific market segment. Then we identify those strategic actions that are unique to the outlying successful firms. Finally, we develop propositions for further research. These findings and propositions are from a study of competition in US industrial product markets between 1974 and 1984.

Background and conceptual framework

One approach for understanding competitive advantage derives from economics and is becoming known as the resource based view. From a resource based view, a firm is an integrated collection of resources and capabilities required for competition [2,10,18,19,28,34,36]. In this view, it is the hard-to-copy attributes of the firm's resources that create competitive advantage [1,6,24]. However, despite the importance of specific resources to a firm's potential for developing a competitive advantage, they represent an inanimate potential for action and not a realized competitive advantage. Action is what transforms resources into realized competitive advantage. What we mean by action is observable behavior, intended or unintended [16], that creates attributes of value to customers.

* Corresponding author.

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Observable behavior is, however, still based on available resources. These resources need not be owned by the firm, but can be borrowed in whole or in part. For example, some pharmaceutical firms design/synthesize and manufacture their own drugs but subcontract the distribution function. Some semiconductor firms design and distribute their chips but subcontract the fabrication to outside suppliers. Some firms in the plain paper copier industry use their name and reputation to distribute products manufactured by their competitors. For example, Pitney Bowes and Savin relabel and distribute copiers manufactured by Ricoh who compete with them in copiers. Whether owned or borrowed, resources only represent a potential for creating a competitive advantage. Actions by firms to employ these resources lead to attributes of products or services that are valued by customers.

Competitive advantage

Firms or groups of firms do not compete; their products or services compete within specific markets. When the products or services are competing for the same customer, competitive advantage refers to the unique attributes of the product or service that are valued by the customers. That is, a competitive advantage is a significant difference in a competing product or service that meets a customer's key buying criteria [7]. The sustainability of a firm's competitive advantage is a function of the competitors' difficulty in imitating or innovating around the incumbent's unique product or service attributes.

A competitive advantage is both a supply and demand concept since the unique attributes are provided by the supplying firm and valued by the demanding customer. In addition, attribute uniqueness that customer's value can occur because of the intrinsic or the extrinsic characteristics of the product or service. Increased efficacy and reduced side-effects are intrinsically valued attributes of patented pharmaceuticals. Commodity products from different suppliers, such as saline solutions, may all have the same intrinsic properties but may be differentiated extrinsically by the producing organization so they meet hospital buying criteria of cost savings. For example, Baxter Travenol successfully differentiates saline, a commodity product, by delivering it in premea-

sured, frozen, plastic bags directly to hospital wards, thereby saving hospital handling costs.

Basis of competition

Schumpeter [27] was one of the earliest scholars to describe competition as a dynamic process in which a strategic innovation establishes a competitive advantage which is eroded by imitation or displaced by another competitive innovation. In other words, firms seek to erode competitors' advantages by actions to imitate their product or service attributes or by generating strategic innovation that meets the customers' needs. When the attributes of value and positioning are replicated by competitors, they lose their ability to differentiate and cease being sources of competitive advantage. These attributes, however, often become a basis for further competition. We refer to those attributes which all competitive products or services must possess to compete in a specific market as the 'basis of competition.' For example, ethical pharmaceutical firms offering drugs for sale in the US market must all possess attributes of safety and efficacy that meet U.S. Food and Drug Administration (FDA) requirements before being introduced. Therefore, all companies who successfully introduce a drug in the US must be able to take the actions necessary in using their resources to produce the drug, test it, and present its safety and efficacy results for review by the FDA.

This base of common attributes among competing products and services broaden over time as resources and skills in creating these attributes diffuse through the competitors. Three factors help the diffusion of resources and skills. First, expertise that uniquely meets customers' purchase criteria confers a relative advantage to its possessor and therefore encourages rapid diffusion [22]. Second, imitation of the resources and skills that drive competitive advantage is difficult to prevent. Even the imitation of resources and expertise afforded the legal protection of intellectual property rights has been difficult to prevent [31].¹ The arguments [11,15] and findings [12,13,

¹ It remains to be seen whether the traditional enforcement difficulty in semiconductors will persist after recent settlements such as those received by Texas Instruments from eight Japanese and Korean firms for DRAM patent infringement, the IBM/Fujitsu settlement, and the Intel/NEC settlements.

14,15,25] show that detailed information on new products and processes is available to competitors very rapidly, sometimes within 12 months of introduction. Third, whenever the implementation of a strategy involves resource acquisition, a strategic factor market develops [1]. For example, firms seeking to imitate a competitor's technological innovation might seek the required research and development skills in the labor market for research scientists. This diffusion of first mover resources and expertise means that the common attributes of competing products increases over time.

As we noted previously, the sustainability of a first mover advantage depends on the follower's difficulty in imitating or innovating around the first mover's unique product or service attributes. In the early stages of a market, the customer's knowledge of the new product is usually limited and customer expectations are not well established. During this early stage of rapid growth, first movers are most vulnerable to attack from innovating rivals. However, as the market matures, customer expectations evolve and the base of common attributes required to meet those customer expectations broadens. First movers who continue to pursue attribute uniqueness while also providing the basis of competition should be able to minimize their vulnerability. However,

those first movers who do not continue to pursue uniqueness could be vulnerable to attack. Second moving firms should be successful in attacking a first mover during this period if they change or exceed the customer's expectation. This assumes that in the early stages, the first mover is setting the customer expectations.

So far, research has focused primarily on resources [6] and not on the actions necessary to translate resources into competitive advantage through creating customer valued attributes to products and services. One difficulty has been identifying the set of actions taken to create competitive advantage. Because of the dearth of research on actions, this study uses an exploratory framework to classify the actions taken by competitors to identify any patterns in their use.

Method

Stages of data collection

The data were collected in five stages and from multiple sources. First, public information was collected on each of 13 market sectors from 1964 to 1984. Based on this information, histories covering the 20-year period were written in order

Table 1
Product market segments ^a

Industrial sector	Compound annual growth rate (CAGR) 1974-1984 (%)	4-Firm concentration level (%)	Manufacturing type	No. firms	No. inform.
8-Bit microprocessor	94.60	41	Lg batch	20	3
PROMS	37.14	62	Lg batch	12	3
Plain paper copiers	82.37	60	Lg batch	17	3
Fire retardant chemical	49.81	98	Lg batch	5	3
Class-8 diesel truck engines	9.21	95	Lg batch	4	10
Crawler tractor diesel engines	4.35	90	Lg batch	9	3
Machining centers	0.29	46	Lg batch	22	4
Gate arrays	149.03	23	Sm batch	8	3
Spot-welding robots	53.04	29	Sm batch	9	5
Material handling-machine loading robots	56.44	34	Sm batch	13	5
Water treatment chemicals	11.91	55	Sm batch	8	2
Antihypertensive drugs	4.87	76	Sm batch	11	3
B&M spectrum antibiotic drugs	34.29	49	Sm batch	20	2

^a Only 49 out of the 72 separate interviews (95 individuals) were analyzed because they dealt with specific industrial sectors. The 22 unanalyzed interviews were not sector specific.

to better understand each market segment. Second, we conducted semi-structured open-ended interviews lasting from one to three hours with market experts using an ethnographic approach [33]. Third, we constructed a cross-sectional survey questionnaire based on the histories and interviews to assess the competitive actions of each firm in the three surveyed segments. Fourth, we used a three-step judgmental sampling plan to select the market segments and participants for the study. Finally, we administered the questionnaire and collected archival data on market shares, resource allocations, executive backgrounds, patent applications, and publications for each firm between 1974 and 1984.

Interviews

We conducted 72 separate interviews in the United States, Great Britain, The Netherlands, the Federal Republic of Germany, and Belgium. The interviews sought to identify the specific actions that competing firms were taking in 1984. The interview approach we used focused on the activity under study as if it were a play and asked who the actors were, when they moved on and off stage, what their script was, and so on. (See Appendix A for the interview protocol.) This provided us with detailed qualitative descriptions of the most common actions taken by firms in the various market segments.

The interview informants were experts in that market segment based on their reputations, work experience, and training. We identified these experts by contacting the trade associations representing each industry, leading consulting firms, academics, trade publications, and the *Institutional Investor's* 'All American Team' of leading security analysts. Table 1 shows the industry sectors and their characteristics together with the number of informants and their affiliation. We recorded 49 out of the 72 interviews (68%).

Transcribed computer readable answers to the interview questions were content analyzed using Logic-Line 2 [29], to identify a dictionary of synonyms. Logic-Line 2 is an artificial intelligence expert system which enables a synonym dictionary to be built up by using a key word and identifying words which are statistically related to it. This set of 24 words, synonyms, and phrases identified through Logic-Line 2 was then analyzed for word

and phrase frequency within each separate interview using Textpack V [17], a quantitative content analysis program [32, p. 7]. The overall procedure has been described in detail elsewhere [4].

Cross-sectional survey questionnaire

Based on the results of the content analysis of the interviews, we identified 24 general action areas (Appendix B). The 24 general action areas were used to create 24 multiple-item scales. Each of the 24 multiple-item scales consisted of 111 specific, representative actions. We developed and pre-tested a cross-sectional questionnaire containing the 111 representative actions. The 111 items were randomly ordered and reversed to prevent response bias (Appendix C). In addition, the questionnaire asked for a list of the ten issues most critical for competitive success and for general comments.

Sample selection

The first step in constructing a judgmental sample involved selecting the market segments for study. Based on the advice of key interview informants, we first selected industrial market segments that varied by rate of growth, concentration level, and manufacturing technology. Further, we limited the sample to industrial products in order to observe more clearly the effects of product and process technology without excessive advertising. We only selected industrial market segments in which competition was confined within a single industry, expert opinion was accessible, and archival data were available at the product level. In addition, we only selected industrial market segments that had existed throughout the 1974–1984 period.

In the second step of the judgmental sampling plan we selected firms with at least 1% of the world market share in 1984. This criterion helped insure meaningful ratings of the firms' market segment activities in 1984. The third and final step of the sample selection involved selecting three of the market segments suitable for a cross-sectional questionnaire survey and administering the questionnaire. The three market segments selected varied by technology, concentration levels, and growth rates and represented the range of market segments on which the interviews were based.

8-bit microprocessor market segment

Semiconductors are classified into two major groups: semiconductors and integrated circuits (ICs). Microprocessors (MPUs) are ICs and are grouped by word length into 8-bit, 16-bit, and 32-bit MPUs. The 8-bit MPU represented the largest sector of MPUs in 1984. These 8-bit MPUs accounted for 88% unit market share by word length and more than 51% of the market revenues in 1984 [8]. The 8-bit MPU sector was high growth with a compound annual growth rate (CAGR) of 94.6% from 1974–1984. It was also an oligopolistic sector producing its product through large batch manufacturing.

Water treatment chemicals market segment

The water treatment sector supplies specialty chemicals for sealed boiler and cooling water systems to prevent rust and scale build-ups that decrease system performance. This sector experienced steady growth from \$345 to \$926 million in sales between 1975 and 1984 except a decline in 1982. The overall water treatment chemical CAGR was 11.91% between 1974 and 1984. The four largest firms controlled 55% of the total market. Therefore, this sector was more concentrated than the 8-bit MPUs, but less concentrated than the diesel engine sector.

Class-8 diesel truck engine market segment

Class-8 trucks, the largest of the on-highway trucks are almost all diesel powered. Weighing over 33 000 pounds, these trucks require engines with at least 250 hp. Although only a small part of the entire truck, the engine is one of the most important components. Truck owners and manufacturers often specify the type of engine they want in their vehicle. For example, in 1983 Freightliner bought 76% of its engines from Cummins, 18% from Caterpillar (Cat), and 6% from Detroit Diesel Allison (DDA). This segment of the diesel engine industry is highly concentrated with the four largest firms (Cummins, Cat, DDA, and Mack) accounting for 95% of the market share.

Truck sales are cyclical, following the GNP with a six to twelve month lag. From 1964–1974 the diesel engine sector experienced slow steady

growth as diesel increased its penetration into heavy trucks from 56% to 87%. This growth in product demand was accompanied by increased power, ease of use and installation as the engine manufacturers responded to customer requirements. However, the 1973 oil embargo together with increased environmental concerns caused a severe slowdown in the sector in 1974 that lasted through 1976. The competitors responded with engines with increased fuel efficiency, lighter weight, and less air and noise pollution. As slow growth returned to the sector, the competitors expanded into international markets. However, in 1980 the recession, soaring interest rates, and slowing of construction caused major cutbacks in truck and engine demand. The demand for trucks dropped by 40%, the largest single year drop in 20 years. The result was plant closing and lay off of many workers. This downturn was followed in 1983 by a resurgence in demand of more than 40% of the 1982 total. Workers were recalled and competitors continued to pursue international diversification as well as improved fuel economy.

Questionnaire administration and archival data collection

During the interview stage of data collection, the interview informants helped us to identify experts in the various market segments who would be the most appropriate choices for participation in the study. In every case, the interview informants and the expert raters (questionnaire responders) were different people. Expert raters identified by the interview informants in the interview stage were surveyed in the 8-bit MPU, water treatment chemicals, and class-8 truck diesel engine sectors. Each rater was promised anonymity and was asked to rate up to five firms in a sector as of 1984.

For each of the firms in the sample we also collected archival data on market shares, resource allocations, executive backgrounds, patent applications, and publications between 1974 and 1984. This information was compiled from sources such as financial reports, industry journals, Dialog database, confidential reports, Standard and Poors annual reports, and so on.

In addition, the questionnaire asked for a list of the ten issues most critical for competitive success and for general comments.² Rater re-

sponses were averaged after insuring within group homogeneity of variance [21] and 16 multiple-item scales applicable across the sectors were constructed. We analyzed the agreed upon competitive actions to identify the bases of competition and competitive advantages and which of these were related to market share performance. Appendix C lists the 16 scales and their reliabilities.

Results

Basis of competition and competitive advantage in three sectors

Table 2 shows the questionnaire response rates.

Table 3 presents the common actions or basis of competition for each market segment derived from the questionnaire data.

Three points are particularly worth noting in Table 3. First, note that the most rapidly growing market segment (8-bit MPUs) has the fewest number of common actions. In contrast, the market segments experiencing the lowest sales growth rates (e.g. diesel engines and water treatment market segments), have the greatest number of common actions forming their bases of competition. Finally, the market segment with the slowest sales growth rate and highest concentration (e.g. diesel engines), has the greatest number of common actions or the largest basis of competition.

Figure 1 presents the changes in market share for selected firms from the three sectors. In each case we selected the firm that had achieved the strongest market share performance as well as the firm with the weakest market share performance. The 8-bit MPU sector chart shows market shares for Nippon Electric Corp. (NEC), Intel, and Texas Instruments (TI) over the period. Intel remained the market share leader from the start of 8-bit MPU availability in 1975 until 1983, although they lost share each year. In 1983, NEC became the leader in this sector after gradually increasing their share in almost every year. TI, on the other hand remained a negligible competitor in this sector apart from their initial surge in 1976.

Table 2
Three product market segment response rates

	Questionnaires			Total usable response rate (%)	Response rate ^a (%)
	out	in	usable		
8-bit micro-processors	95	69	45	72.6	47.4
Class-8 truck diesel engines	44	25	21	56.8	47.7
Water treatment chemicals	69	44	44	63.8	63.8
Overall	208	138	110	66	53

^a Only response rates for the data reported are included here.

Figure 1 also shows the market shares of Betz, Nalco, Drew, and Chemlink in the water treatment chemical sector. Nalco and Betz were the 1984 market share leaders, retaining less than 20% of the market throughout the period, while Drew steadily lost share until 1981 when it stabilized near 4%. Chemlink, on the other hand steadily increased its share, but only slightly more than 1% of the market by 1984. Finally, Fig. 1 presents the market share changes for selected manufacturers in the class-8 truck diesel engine sector. Cummins' share fluctuated over the period, but gained more often than it lost. Cat gained share throughout the period, while DDA usually lost share (except 1977–1979). Cummins remained the market share leader throughout with over 60% of the market in 1984 while Cat grew the fastest in market share.

Sector bases of competition

The questionnaire provided us with a list of the ten issues most critical for competitive success as perceived by each of the expert raters. These rater responses were averaged after insuring within group homogeneity of variance [21]. Using these rater response averages, the 16 most critical multiple-item scales applicable across the sectors were identified. We analyzed the agreed upon competitive actions to identify the common and unique actions. We also examined which of these actions were related to market share performance. Appendix D lists the 16 scales and their reliabilities.

² The ten critical issues were inconsistent across segments and, therefore, were not used.

In order to evaluate the relative size of the competitive actions taken by each competitor, we computed the overall market segment mean of each scale and then took the standard deviation between the sector mean and each competitor's score for each scale. Then we arrayed the scales from left to right based on the largest difference between the market segment mean and the 1984 market share leader's score. We placed the scale

with the largest negative difference at the left end and the scale with the largest positive difference at the right end.

Figure 2 shows the competitive actions for-all three sectors. The 8-bit MPU results show that NEC exceeded the sector average in 12 areas and exceeded both Intel and TI in ten out of the 16 competitive actions. Specifically, NEC exceeded Intel and TI in focused distribution, finance, la-

Table 3
Actions that create the basis of competition

Competitive actions	8-Bit MPU	H ₂ O chemicals	Diesel engines
Shared manufacturing costs		X	X
Used common inputs across products	X	X	X
Trained a skilled labor force			X
Acquired financial capital on good terms		X	
Serviced products it sold		X	X
Developed career sales personnel			X
Recruited R/D/E managers from industry			X
Insured others paid for distribution costs		X	
Made deliveries when requested		X	
Reduced production worker turnover			X
Selected suppliers that provided flexible delivery			X
Reduced salesmen turnover			X
Recruited line managers from industry			X
Recruited from stable salesmen labor market		X	X
Made fast deliveries		X	
Minimized direct labor costs			X
Created good reputation for products	X	X	
Trained expert service personnel		X	
Trained expert salesforce			X
Priced to include service	X	X	
Controlled inventory costs		X	
Recruited salesmanagers from industry			X
Company used flexible manufacturing		X	
Products designed to minimize labor			X
Developed career R/D/E managers			X
Worked to extend reputation to each product		X	
Developed career salesmanagers			X
Financed operations internally		X	X
Maintained minimum safety stocks		X	
Maintained good outside links for new products			X
Responded to service calls quickly			X
Developed career R/D/E personnel			X
Avoided stockouts		X	
Enforced strict quality control limits		X	X
Purchased centrally		X	
Offered systems-level applications		X	
Proprietary product technologies		X	X
Maintained confidence of customers in firm's longevity	X	X	X
Trained customers			X
Solved customer's problems fast		X	
On good terms with work force			X
Sales managers had industry experience		X	X
Totals	4	24	27

bor skill, service, product focus, labor cost, manufacturing, distribution cost, product quality, and product cost. Product price was important, but NEC and TI both had lower prices than the sector average and Intel showing that, by itself, low product price was not enough for competitive success.

Figure 2 also shows that in the water treatment chemical sector, Betz exceeded the sector average in only four areas: labor cost, delivery, product focus, and distribution cost and exceeded Nalco in 11 of the 16 actions. These 11 actions help account for Betz's taking the lead in water treatment chemicals in 1982 (cf. Fig. 1). Nalco only exceeded the market segment average in delivery and labor cost. Chemlink, the fastest

growing firm exceeded Betz, Nalco, and the market segment mean in 13 of the 16 action areas and exceeded Drew in nine out of the 16 action areas. Drew, which has steadily lost share throughout the 1974-1984 period exceeds the sector average, Betz, Nalco, and Chemlink in only six of the 16 areas including input cost control, manufacturing cost control, service, price, labor skill, and product focus. These results imply that product and process technology are less important competitive advantages than labor cost control and delivery.

Finally, Fig. 2 shows the same comparison for class-8 diesel truck engines. Again we include the fastest growing and least significant competitor for comparison with the market leader. In this

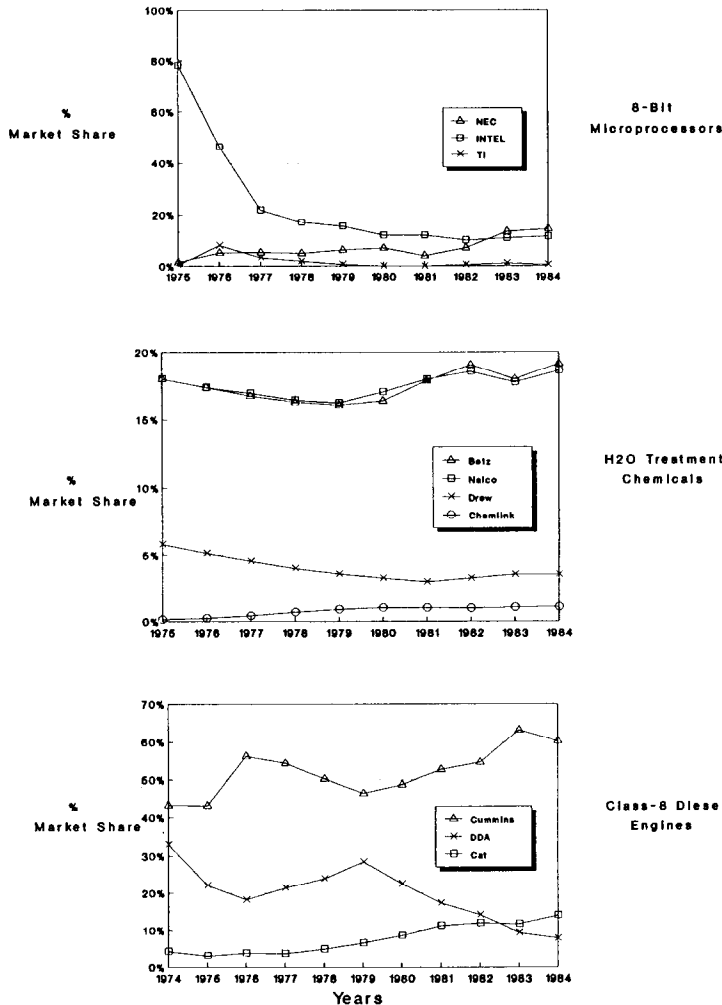


Fig. 1. Sector market shares of select firms.

mature, highly concentrated sector, the market share leader exceeded the sector mean in eight out of the 16 areas and both Cat and DDA in only three out of the 16 areas tying at least one of them in another three areas. Specifically, Cummins exceeded the sector mean, Cat, and DDA in: product innovation, delivery, and labor skill while tying DDA in product quality and Cat in product network. The fastest growing firm, Cat on the other hand, exceeded the sector mean in

ten actions and exceeded Cummins and DDA in eight out of the 16 actions. These data and the reports of our informants show that Cummins' success in maintaining share was related not only to product technology, delivery, and labor skill but also to the customer group that it targeted to focus these advantages on. Cummins focused its advantages on the largest market segment, the large fleet end-user. Recently, they have begun to direct their efforts toward the OEM assembler

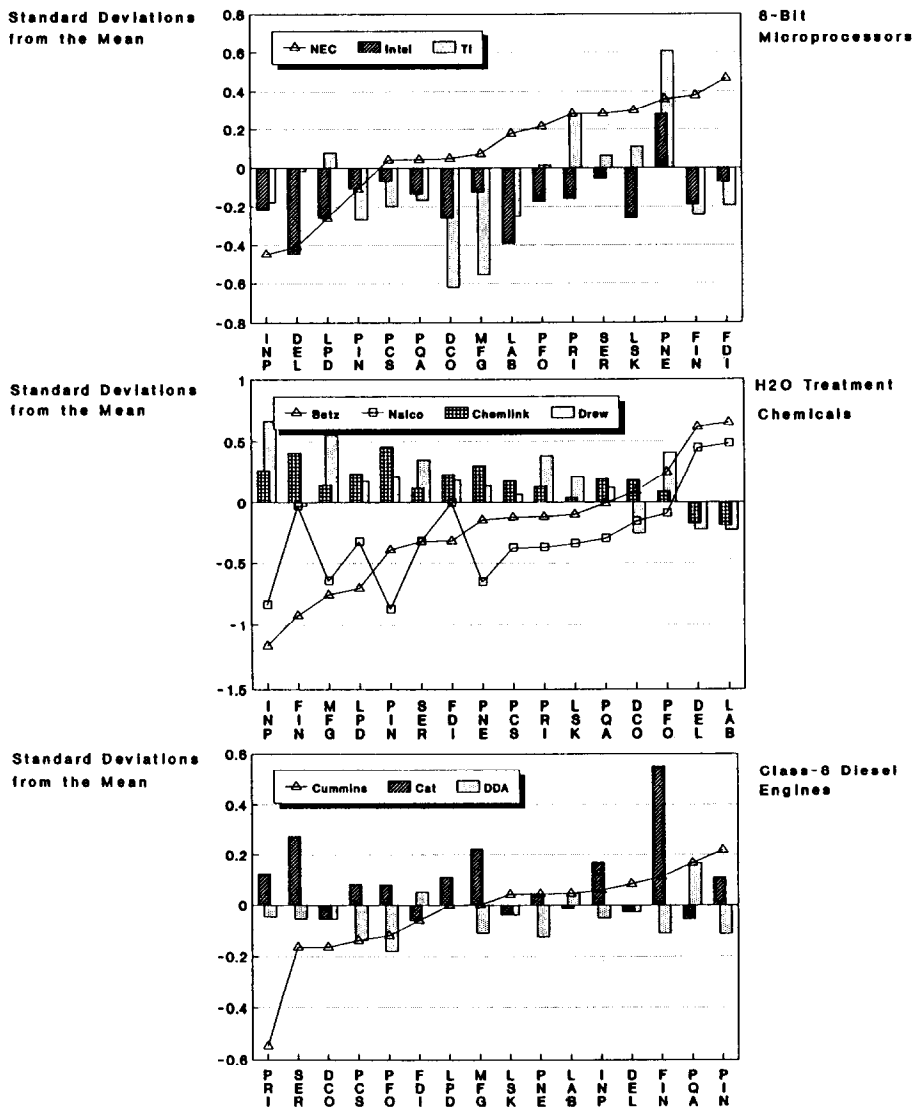


Fig. 2. Actions of select firms by sector. DCO, distribution cost control; DEL, delivery; FDI, Foducese distribution; FIN, finance; INP, input cost control; LAB, labor cost control; LPD, labor productivity; LSK, labor skill; MFG, manufacture cost control; PCS, product cost control; PFO product focus; PIN, product innovation; PNE, product network; PQA, product quality; PRI, product price; SER, service.

with a matched component approach through joint planning and production that minimizes the OEM assembler's costs of engineering redesign. DDA's poor performance was attributable to its below average performance on 11 out of the 16 actions.

Examining the three sectors in Fig. 2 together, we find that the attacking firms, NEC, Chemlink, and Cat exceed the competitive action mean more often than the defending firms of Intel, Betz, and Cummins. Further, the attackers also exceed the action means by a larger amount than the defenders. Finally, the attacking firms all exceeded the action means in product focus, manufacturing cost control, product cost control, lower price, financial support, and service while defenders did not in these same actions (except for water treatment in product focus and diesel engines in financial support). In addition, the attacking firm only succeeded in overtaking the market leader during a period of high growth and low industry concentration. This finding is consistent with previous work [35] in the consumer cigarette market.

In order to explore more fully the use of product and process technology we examined

their use on the basis of competition and as unique competitive actions. Figure 3 shows the results of this comparison by arraying the sectors from left to right in order of increasing concentration and decreasing compound annual growth rate (CAGR). This comparison shows that the percent of competitive actions based on process and product technology increases with increased concentration ($r = +0.91$) and decreased CAGR ($r = -0.95$). Further, the process technology basis of competition also increases with increasing concentration ($r = +0.96$) and decreases with CAGR ($r = -0.88$). The process technology competitive actions also increase with concentration ($r = +0.98$) and decreases with CAGR ($r = -0.84$).

However, even though overall technological actions and process technology increase with increased concentration and reduced CAGR, the product technology basis of competition remains a small portion of the total actions across changes in concentration and CAGR appears to be an 'inverted U' shape. The unique product technology competitive actions are more, but appear to be 'U' shaped in relation to increasing concentra-

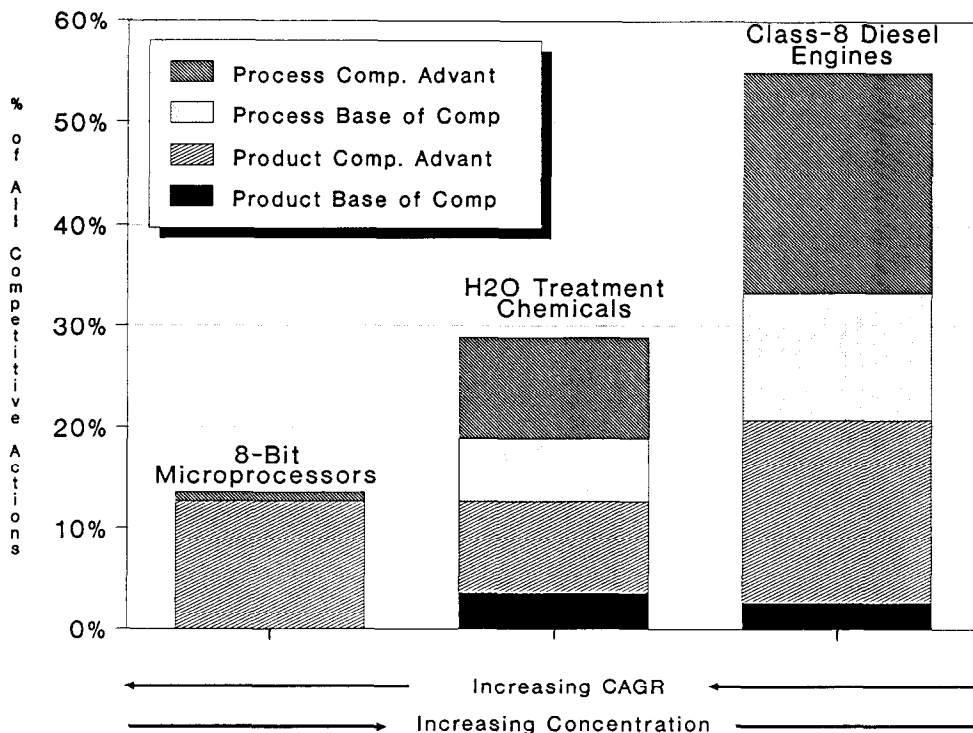


Fig. 3. The basis of competition and competitive advantage in process and product technology.

tion and decreasing CAGR. This comparison supports the findings by Utterback and Abernathy [30] that major process innovation increases with industry maturity (e.g. concentration), but contradicts their findings that major product innovation decreases with maturity. Product technology was not found decreasing with industry maturity, but changes as a non-linear function.

Discussion and conclusions

Through quantitative content analysis of transcribed interviews 24 competitive actions were found to be in use across 13 industrial sectors. Based on these 24 actions, we constructed a survey questionnaire and obtained responses in three representative sectors.

The results showed that actions leading to the basis of competition and competitive advantage varied by industry structure and manufacturing process and that this variation was systematic and not random. These data support the argument that actions leading to the basis of competition should be a function of the market sector's sales growth rate and the number of competitors. In rapidly growing market sectors, common actions should be fewer than in slower growing sectors because of the difficulty competitors face attempting to identify and then imitate the actions leading some to superior performance [9]. Further, competitive uncertainty is low [3] because competitors are numerous and unable to affect each other's prices and therefore competitors are less likely to seek new competitive actions so long as their sales are growing with the market. Rapid sales growth implies that new customers are being attracted to the product or service with the general expectation that this innovation will better satisfy their needs. In this early stage of market growth, customer uncertainty over having their needs met helps account for the advantage gained by first movers able to reduce the uncertainty and gain the trust of these new customers [26].

However, as the sales growth rate slows and the sector matures, the actions change. With slower growth and sector maturity, competitive uncertainty increases [3] and with it the incentive to adopt the successful practices of others. So, the rate of diffusion of the common competitive

actions increases and with it, the basis of competition level. Further, with maturity comes increasing consolidation of competitors which moves the market structure from more purely competitive to more oligopolistic. The reduced number of competitors affects each other's competitive behavior more, increasing uncertainty over which competitive moves to make and the incentive to adopt the successful actions of others. Combined with increased competitive uncertainty and visibility of the competitor's move is an increased standardization of customer needs around a de facto performance standard. The combination of structural consolidation and customer need standardization leads competitors to identify more easily their competition and the successful actions each is taking. This, combined with the increased need to reduce uncertainty, results in a strong incentive to adopt the successful practices of others. This argument leads to our first two proposition:

P₁: Lower market concentration and faster compound annual growth will be positively associated with greater numbers of unique competitive actions.

P₂: Greater market concentration and slower compound annual growth will be positively associated with a larger common set of competitive actions.

Not only is change in competitive action non-random, but the adoption of specific actions is non-random as well. These preliminary data show that attacking firms exceeded the sector average for both the number and size of actions they took in comparison to the defending firms. Further, these data show that across all three market sectors the attacking firms centered their advance on actions that both reduced price and increased service. Attackers, for example, achieved above average performance on product focus, service, and financial assistance to customers and lower cost manufacturing, product cost, and average sales price. These findings suggest the following propositions:

P₃: Attacking firms that increase their market share will exceed the market average for the number of actions taken.

P₄: Attacking firms that increase their market share will exceed the market average for the size of actions taken.

P₅: Attacking firms that increase their market share will compete by above average service and lower than average price.

P₆: Defending firms than have smaller loss of market share will minimize the difference between the number and size of their actions and those of the attacking firms.

The preliminary data shows that even in technology intensive industries such as semiconductors, competitive advantages based on either product or process technology are less than 20% of the total competitive actions used. As the sector concentration increases and sales growth declines, technology becomes a larger proportion of total competitive actions with the common actions increasing in process technology but not in product technology. This implies that process technology which provides competitors with a temporary advantage will be rapidly copied by watchful competitors to the extent that it is visible and unambiguous [22]. This implies our seventh and eighth propositions:

P₇: Unambiguous process technology that is observed to confer competitive advantage will be rapidly copied by competitors.

P₈: A competitive strategy based on process technology by itself will not be associated with market share growth.

These propositions deserve further study since they directly contradict the prevailing arguments concerning benefits from economies of scale and first mover advantages. The first mover in 8-bit MPUs, Intel, was unsuccessful in maintaining a dominant position despite initial economies of scale and first mover advantages. In class-8 diesel truck engines, Cummins, the market share leader held onto its lead, but not through the use of economies of scale. Betz and Nalco are similar stories in water treatment chemicals. In all of the sectors intensively studied so far, market share leadership was achieved by focusing on a particular group of customers and providing them with a product or service that was non-reproducible by the competition. This requires a thorough understanding of the customer and their needs and the ability to translate that understanding into coherent action through internal coordination between functional areas.

Further work is needed to identify the functional forms of the relationships and how these change over time. Further, the actions of each competitor within each sector need to be analyzed within the context of the total firm's strategy in order to decide whether competition within these sectors benefited from the firm's technological actions in another sector or whether these sectors provided benefits for competition in another sector.

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Appendix A: interview protocol

1. Define the sector.
2. Identify the companies that do business in the sector.
3. Estimates of market shares of competitors
 - (a) % market now
 - (b) No. of competitors that account for 50%
 - (c) No. of competitors that account for 75%
 - (d) changes in shares or position of firms with largest shares over the past ten years (1974–1984)
4. Nature of competition
 - (a) how do firms compete?
 - (b) what are the things that a firm has to do well to be a serious competitor?
 - (1) prompt list if needed
 - (c) what are the things that the market leaders have done to distinguish themselves from the other companies?
 - (1) prompt list if needed
 - (d) What are the things that it would be useful to be able to do, but which are not necessary for, effective competition?
 - (1) prompt list if needed

Appendix C: competitive advantage scales

1. DCO = Distribution Cost Control (3-item scale Alpha = 0.40).
The company did not use distributors that carried other companies products for the same application.
The company had been able to shift costs of distribution to distributors or customers.
The company did not make use of independent distributors.
2. DEL = Delivery (3-item scale Alpha = 0.72).
The company's deliveries to its customers were reliable.
The company was good at making deliveries when the customer requested them.
The company was able to make fast deliveries to its customers.

Appendix B: sample questionnaire items

The strategic management of industrial technology study

Please indicate the extent to which the statements *accurately describe* each company's activities as of 1984 in the specific product market indicated. If the statement is not applicable in this product market, indicate NA. If you do not know the degree of the statement's accuracy, indicate DK.

	1	2	3	NA	DK
	The statement accurately describes the company	The statement describes the company to some extent	The statement does not accurately describe the company	The statement is not applicable in the industry	Do not know if the statement applies to the company
					Product Market
1. The company's deliveries to its customers were unreliable	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
2. The company shared its manufacturing costs in this product market with other divisions	1 2 3 NA DK	1 2 3 NA DK	2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
3. The company had stable access to acceptable inputs for its manufacturing process	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
4. The productivity of the company's sales force was generally high	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
5. The company had difficulty acquiring adequate capital in this business	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
6. The company used the same or similar inputs in different products	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
7. The company had hired and/or trained a highly skilled labor force in its operations in this business	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
8. The productivity of the production workers was high in the company's operations in the business	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK

9. The company had to acquire capital at unfavorable terms	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
10. Service for the company's products was provided by third parties	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
11. The company used distributors that carried other companies products for the same applications	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
12. The company had not concentrated on specific applications/areas	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
13. The sales personnel who work for the company tend to stay with the company for most of their careers	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
14. The company had minimized its indirect labor costs in this business	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
15. Research/development/engineering managers were drawn from within the industry	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
16. The company had been able to shift costs of distribution to distributors or customers	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
17. The company had been able to control costs of the materials/components it used as inputs	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
18. The company provided financing for its customers purchases of its products	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
19. The company was good at making deliveries when the customer requested them	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK
20. Turn over of the production workers was low in the company's	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK	1 2 3 NA DK

3. FDI = Focused Distribution (2-item scale Alpha = 0.52).
The company had different specialized distribution systems for different groups of customers.
The company focused its distribution system on a specific group of customers.
4. FIN = Finance (3-item scale Alpha = 0.82).
The company had difficulty acquiring adequate capital in this business.
The company provided financing for its customers' purchases of its products.
The company had a reputation for paying its suppliers on time.
5. INP = Input Cost Control (3-item scale Alpha = 0.82).
The company's suppliers provided it with flexible delivery schedules.
The inputs the company used met tight specifications.
Purchasing and negotiations with suppliers were handled centrally within the company.
6. LAB = Labor Cost Control (6-item scale Alpha = 0.82).
The company had minimized its indirect labor costs in this business.
The turnover among the company's salesmen was relatively low for this business.
The company was able to minimize its direct labor cost in its production activities in this business.
The company obtained the direct labor it needed from stable labor markets.
Research/development/engineering managers tended to stay with the company for their entire career.
The turn-over of production employees was high, relative to the industry average.
7. LPD = Labor Productivity (3-item scale Alpha = 0.88).
The productivity of the company's salesforce was high.
The productivity of the production workers was high in the company's operations in this business.
The productivity of the company's research/engineering/development personnel was generally high.
8. LSK = Labor Skill (4-item scale Alpha = 0.85).
The company had hired and/or trained a highly skilled labor force in its operations in this business.
Research/development/engineering managers were drawn from within the industry.
Line managers in the company were drawn from within the industry.
The company had extensive training programs for its sales force.
9. MFG = Manufacturing Cost Control (3-item scale Alpha = 0.83).
The company's overhead was low relative to the other companies that compete in this product market.
Relative to the industry, retooling took the company less time or was less expensive.
The company was able to keep work in process inventories small.
10. PCS = Product Cost Control (3-item scale Alpha = 0.70).
The company's products had been designed for easy servicing/minimum maintenance costs.
The company's products had been designed to minimize the cost of manufacture.
The company's products had been designed to minimize labor costs in producing them.
11. PFO = Product Focus (3-item scale Alpha = 0.70).
The company designed products to meet the specific performance standards of specific customers.
The company tied its products or services to a specific group of customers or applications.
The company targeted its products for specialized sub-markets.
12. PIN = Product Innovation (3-item scale Alpha = 0.73).
The firm did not lag behind the industry in introducing product modifications.
The company worked with other companies or the government on new product development.
The company had introduced new products more quickly than average for the industry.

13. PNE = Product Network (2-item scale Alpha = 0.37).

The company had worked with other companies or the government on new product development.

The company was on good working relationships with outside sources of product technology.

14. PQA = Product Quality (3-item scale Alpha = 0.67).

The company's products tended to have lower than average mean time between failure.

The company's products had better than average mean times between failure.

The company's products had better than average mean times between replacement.

The mean time to repair the company's products was lower than the average in the industry.

15. PRI = Product Price (2-item scale Alpha = 0.33).

The company's prices were consistently lower than its direct competitors.

The company had been able to keep the prices of its products stable.

16. SER = Service (3-item scale Alpha = 0.76).

The company trained its customers to service the products it sold them.

Routine service and maintenance was included in the cost of the product.

The company offered service beyond warranties only on a contract basis.