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ABSTRACT

This paper examines the impact of information supply and distribution on managerial information processing using a model derived from the organizational information processing (OIP) framework developed by Daft and Weick (1984). The model suggests that more supply and distribution of information will lead to greater information use and the acquisition of more knowledge, given the organization's information processing capabilities match its requirements. The model was extended to include the influence of social factors (i.e., culture and power) and the level of knowledge in the organization. Product managers in two consumer goods organizations providing different levels of information technology support were studied to compare the effect of different approaches to supplying and distributing information. The focused comparison case research method (George and McKeown 1985) was used, in which sites are selected differing only on the dimensions of interest, namely information supply and distribution.

The cases provided evidence to support the model. The company which had more data and analytic tools available for its product managers used more information and knew more about the factors that influenced the marketing of its products. In addition, organizational culture and the level of knowledge at the companies affected their approach to information supply, information use, and knowledge acquisition. The results suggest that the effective use of information technology requires a combination of managing the organization culture and fitting the characteristics of information supply and distribution mechanisms to information requirements.

1. INTRODUCTION

One of the major challenges facing the post-industrial organization is the effective acquisition and distribution of information in support of managerial decision making (Huber 1984). Little research, however, has empirically examined how managers use information in their work. The organizational information processing (OIP) paradigm provides a framework for such research by prescribing that information processing (I/P) capabilities match requirements (Galbraith 1973, Tushman and Nadler 1978) in an effective organization. Capabilities include the supply of available information and the mechanisms for its distribution. Information can come from both internal sources (e.g., transaction processing systems) or external sources (e.g., third party data vendors). Requirements include not only the amount of information needed by managers, but its structure, format, level of detail, reliability, and timeliness (Zmud 1978). The OIP framework suggests that capabilities and requirements for information should somehow be in balance. However, the factors influencing this balance are complex, and merely supplying the required information does not necessarily insure its use (Feldman and March 1981, Kiesler and Sproull 1982).

The antecedents of information requirements have been described in Goldstein (1988). This paper empirically examines information capabilities, focusing on the effect of information supply and distribution on OIP. The research is based on a model of I/P proposed by Daft and Weick (1984), in which information supply is hypothesized to affect information use, which in turn affects knowledge acquisition. Information supply and distribution includes the amount and type of data and analytic tools available to managers. Information use is defined as the interpretation and analysis of information. Analysis can be done by hand or by using analytical support tools such as calculators or computer-based decision support systems. Knowledge acquisition is the process of developing insights into the relationship between the organization and its environment.

To examine I/P capabilities in a real-world setting, one type of manager, product managers (PMs) at consumer packaged goods companies, was studied in two organizations, each with a different level of information supply. An in-depth study of similar functions in different settings allowed us to isolate and compare the impact of different approaches to information supply on managerial I/P, while holding other factors relatively constant.

Product managers were chosen because their work is information-intensive (McCann 1986), they perform highly similar functions in different companies (Quelch, Farris, and Olver 1987) and different approaches to providing information supply can be found at these companies (McCann 1986). Providing information support for product management is an important issue for MIS managers because of the complexity of integrating internal and external information (Swanson 1978), and the importance of the product management task to the organization.

One issue in the study of organizations as I/P systems is the consideration of the cost of information acquisition, distribution, and use. That issue, however, is beyond the scope of this research, which focuses on the relationship between information supply, use, and knowledge.

2. RESEARCH MODEL

The OIP framework proposes that organizations face information requirements generated by their environment, organization structure, and tasks (Tushman and Nadler 1978). These requirements can be characterized by their level of complexity and load (Driver and Streufert 1969), uncertainty (Daft and Weick 1984; Galbraith 1973), and equivocality or ambiguity (Weick 1979). High levels of information complexity can be caused by several factors, including having diverse and interrelated product lines and having many competitors. High complexity is managed by differentiation or specialization (Driver and Streufert 1969), for example, segmenting a market and assigning a product management specialist to each segment. Load is the amount of information processed per time period. Overload occurs when load exceeds processing capacity (Driver and Streufert 1969), and is managed either by reducing input, for example by aggregating data, or by increasing capacity with more efficient information exchange (Miller 1977), for example by quantitative rather than verbal reports, where applicable. Uncertainty is defined as lack of information (Galbraith 1973), the inability to predict something (Kahnemann and Tversky 1982), or volatility (Duncan 1972). High levels of uncertainty require the capability to gather relevant information in a flexible and timely manner (Poole 1978), inferring facts from incomplete information (Isenberg 1986), creating contingent procedures and plans (Galbraith 1973; March and Simon 1958) or creating information buffers (Kmetz 1984). Equivocality occurs when there are multiple and conflicting interpretations of infor-

mation (Weick 1979), and requires enacting or imposing meaning (Weick 1979) or interpretation (Daft and Weick 1984) by communication using rich media (e.g., face-to-face rather than written communication) (Daft, Lengel, and Trevino 1987).

Based on the levels of these variables, an I/P requirement is generated. The organization, in turn, provides an I/P capability to meet this requirement. I/P capability is provided by three primary mechanisms: structure, communication, and information technology (Galbraith 1973). Information technology can be useful when high levels of complexity, uncertainty, load, or equivocality exist. For example, complexity can be managed by using decision support systems which allow more variables (e.g., products, markets) to be analyzed and related. Uncertainty can be reduced by more effectively and quickly delivering the appropriate information where it is needed. Load can be managed by using information technology to filter, sort, route, or otherwise organize information for easier use and increased throughput (Hiltz and Turoff 1985). Equivocality can be reduced when managers use computer-based systems in combination with face-to-face communications (McKenney 1986).

Tichy (1980) suggests two social factors within organizations which could influence I/P capabilities: culture and power. Organizational culture affects the supply and use of information resources by influencing the values and attitudes toward information, analysis, (Feldman and March 1981; Schein 1985), amount and intrusiveness of environmental scanning (Daft and Lengel 1986), and attitude toward risk (Schein 1985). Those in power determine the goals and decision making issues, define which functions are critical to the organization, control information resources, distribute rewards and incentives, and interpret or impose meaning on ambiguous goals or events (Salancik and Pfeffer 1977). Thus power influences information supply. A group's power, influence, and behavior also may relate to who controls the larger organizational unit in which it resides (Aldefer 1987). For example, PMs may have more power and access to information in a company run by marketers than by engineers.
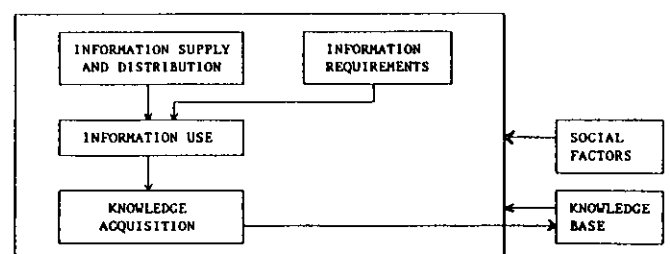

Figure 1. Information Supply Model

We propose an information supply model (Figure 1), derived from the OIP framework, focusing on the organization's availability of information, its use of information, and its acquisition of knowledge. Organizations enact cycles of information gathering, interpretation, and learning or knowledge development (Daft and Weick 1984). Knowledge plays a critical role in this process. The information available to the organization is both interpreted within the context of an existing knowledge base, and is added to that base. Knowledge can be factual, procedural, or causal (Machlup 1980). Interpretation and analysis combine information representing the state of the world with existing knowledge to increase understanding. Information use depends on information supply and distribution and its fit to information requirements. Culture, power, and the organization's existing knowledge base influence information supply, distribution, and use, and knowledge acquisition.

Our objectives were to better understand the role of information supply, distribution, and use, social influences, and knowledge within the OIP framework. In the cases presented here, the focus is on information about the environment (e.g., market share, price/volume relationships, competitor activities, etc.). The information supply model provides some guidelines for interpreting the differences between companies related to different levels of information supply. Specifically, we propose:

Proposition 1: Given a requirement for more information and an organization's capacity to process it, an increase in the supply and distribution of information appropriate to a manager's task will lead to greater information use.

Proposition 2: More information use will lead to greater knowledge acquisition and a larger knowledge base.

Proposition 3: Information supply, distribution, and use and knowledge acquisition will be influenced by the organization's level of existing knowledge.

Proposition 4: Supply, distribution, and use of information, and knowledge acquisition will be influenced by the organization's culture and its distribution of power.

3. RESEARCH METHOD AND DESIGN

Because relatively little empirical research exists on organizational information processing, we chose to conduct exploratory qualitative field research. The strength of this method lies in its ability to consider complex phenomena in relevant, real-world settings, to uncover the "hows" and "whys" of complex processes, to provide a "reality check" for theories we do not yet understand well, and to observe the importance of constructs and the range of

values or intensity in natural settings (Benbasat, Goldstein, and Mead 1987; Yin 1984).

We employed the structured focused comparison method (George and McKeown 1985). Focus was provided by selecting cases which differ on a limited number of dimensions of interest. The similarities between case sites is discussed in the following section. The primary differences were in the information technology provided to integrate, access, distribute, and analyze data; the financial and human resources allocated to information analysis; the social influences on I/P within the organization; and the level of knowledge about markets and products.

To provide structure, the participants in this study were each interviewed for approximately one hour, guided by a semistructured interview protocol to provide consistency, yet allow for free response. Eight members of the product management organization at the first company and six at the second company were interviewed. Their titles ranged from assistant product manager to vice president of marketing. The interview guide is included in Exhibit 1. Participants were questioned about their background, their work, the characteristics of the product/market environment in which they operated, and their use of information. In addition, interviews were conducted with ten information providers at the first company and nine at the second. The information providers all supplied information or technical support for PMs. They included members of the MIS, market research, and trade promotion groups at each company. They were asked about the type of information support they provided and about how the PMs used information and analytic tools. Additional structure and focus was provided by formulating research propositions to guide the data analysis (George and McKeown 1985). Participant response data was analyzed using constructs identified in Figure 1. Numbers are used to identify each participant's quotes, when they are included in the following sections.

4. RESEARCH SITES

Both organizations studied were autonomous divisions of different multi-billion dollar packaged consumer goods companies specializing in food products. Each used a traditional product (or brand) management structure, with PMs responsible for managing the "health" and performance of a specific product and for integrating various functional areas in support of that product (Quelch, Farris, and Olver 1987). Supermarkets (also referred to as the trade or the customer) were the primary wholesale customer and retail outlet for both companies.

At both companies, product management, market research, sales and trade promotion analysis were functionally separate units. Market research monitored and analyzed trends, designed research and interpreted results,

and monitored consumer attitudes and usage patterns by product. The sales force was a primary source of information about supermarket pricing and promotion, both for proprietary and competitor products. Sales promotion (i.e., coupons, give-aways, etc.) was managed regionally by the sales force. They were supported by a trade promotion analysis group, which served as a conduct of information from the sales force to the rest of the company.

Internal operations data (orders, sales, production, inventory, shipments, product costs, and profitability) were kept in a mainframe database managed by the MIS department. External marketing data purchased from third party vendors was stored in a database on a division-controlled minicomputer. It could be reviewed using pre-formatted reports or selectively displayed using a marketing decision support system (MDSS) which also provided simple file listings and limited computation. (Both companies used the same MDSS.) Exhibit 2 briefly explains the sources of external data available for purchase. Both companies had a liaison group linking product management and MIS, which helped product managers to retrieve and manipulate information from both minicomputer and mainframe databases.

Product managers in both companies used similar types of information for similar analyses: data about share of market, gross sales, price, and promotion activity was used for planning and controlling shard, volume and promotion costs, monitoring product performance and competitor actions, monitoring inventory levels, and performing special projects and ad hoc analysis to "explain" the data.

Both companies were moving from a national to a regional and local marketing focus and had transferred some responsibility for promotion and data analysis to the sales force supported by a trade promotions group. Changes in consumer food consumption patterns had affects both companies. Each had developed new products in response to these changes.

4.1 Company Alpha

Company Alpha had sales of $300 million. Its oldest product line, which represented 35 percent of sales, was declining in volume and had little competition. Its other products were facing more competition and were growing in volume. The company was generally a leader in its markets, however, one important new product was number two and was facing stiff competition in an attempt to gain market share. Consumer purchasing patterns were regional for some products but not for others. Alpha had historically operated in niche markets, creating products for those niches and avoiding head-on competition from larger companies.

Social factors. Participants from Company Alpha described it as entrepreneurial, innovative, action-oriented,

aggressive, fast moving, risk taking, and responsive to the market. Analysis was seen as getting in the way of action. Two interviewees commented:

> We want to move fast and not wait for information. (6)

> Reliance on information systems can slow a company down and make it inflexible. If you required that nothing goes out without research or analysis to back it up, you lose a heck of a lot of time and flexibility. (13)

In the past, the product management concept had not been considered very successful at Alpha. Many participants expressed ambiguity over the role of marketing in the company:

> Top management hasn't figured out what we [product management] should be doing. (7)

> If I were a product manager now, I would be concerned. (15)

Information Supply and Distribution. The company was experiencing both mainframe hardware capacity and MIS staffing constraints. End user computing was discouraged and formal support for the mainframe fourth generation language had been discontinued. The company owned thirty personal computers, some of which were available for check-out by PMs. However, there was no PC training or support, and no PMs had PCs on their desks. Although data could be down-loaded to a PC, no PMs knew how to do this. The mainframe systems provided several pre-formatted sales and inventory reports by product and customer. Additional reports could be requested, but lead time could range from two months to to over one year. One interviewee described the MIS group:

> Like many companies, we have a production-oriented MIS shop. Just understanding the concept of ad hoc data retrieval is a quantum leap for them. (8)

SAMI data could be retrieved from the divisional minicomputer using the marketing decision support system (MDSS). Use of the MDSS twice per week was considered heavy; many product managers did not use it at all. Most ad hoc analyses were prepared manually. SAMI did not provide data on competitors' goods that were delivered directly to stores. Because many of Alpha's competing products were directly delivered, it was difficult to calculate accurate market share figures for Alpha or for its competitors. Product managers obtained information for these competitors by in-store observation of shelf space and product movement throughout the country.

MAJERS data was not purchased because it was considered too expensive. Product managers, however, ex-

pressed a need for it. Sales force information on competitive activity was circulated via newsletter, not codified or stored in an information system.

Historical information on redemption rates for past promotions had limited use. The data was available on a national basis, while the promotions were implemented regionally. Promotional spending data included only expenses of the sales force and did not include rebates issued directly from corporate to the trade. One PM commented:

> Everyone wants to be more market oriented, but no one has the tools (data) to do it. So you've got to *try* a promotional program to see how well it works. (9)

The sales force was considered a very important source of information. A PM noted:

> The sales force is our eyes and ears. We have less factual information about the market compared to my previous employer. Here, I visit the market more and talk to my sales force more. (1)

The data used by PMs at Alpha were not integrated. Product managers felt that access to data was often complex and time-consuming. In general, they did not have access to all of the information they needed:

> There is a lot of information around that I can't get to. The MIS group might have some, but it's not being given to the end user. We could use one person who knows what is available on the big computer and makes it available to us. (9)

> I've never felt that there's a lot of information around here. If it's available, it's not convenient to get. What you have to go through to get it is not worth the effort. I have to spend a lot more time gathering and analyzing information than using it. (10)

> Many times we don't know what information we need until we get into the analysis. To figure out what the competition is doing and beat them, the more information the better. (6)

Product managers also faulted the currency and level of detail of the available data:

> It takes two months to learn of competitor actions using SAMI data, another month to confirm a trend, and two months to analyze the data and implement action. After five months, the competitor is gone and it's too late! (5)

> The information doesn't give me a good enough sense of regional differences in sales. (5)

The data doesn't give any information about promotion effectiveness at the store level. Did the outlets reduce the price like they were supposed to? Did the promotion spur buying? (5)

Information Use. The PMs used the available information to carry out performance, promotion, and competitor analyses. They limited their use of quantitative data to looking primarily at national trends. SAMI data and shipment reports were the primary information sources for tracking performance. Custom reports were used to examine key markets (e.g., a market in which Alpha was introducing a new product). A member of the liaison group would extract SAMI data for those markets using the MDSS. If more information was needed, PMs would usually contact the trade promotion group or sales force for their interpretation of the quantitative data. Since promotion cost and redemption reports were not accurate or timely, PMs relied on the trade promotion group and sales force for promotion evaluation. Many decisions, such as changes in product formulation or packaging, were subjective and made without analysis of quantitative data.

Product managers commented on their analysis of quantitative data:

> There is not enough time to do analysis. We're a lean organization and we're constrained by time. We only do [analyze] the big stuff. (6)

> I'm not comfortable with the computer. It's time consuming and difficult to use. (10)

> There is not a lot of analysis being done right now. We are close to operating totally in the dark. This is due in part to limited people resources. It's still better than in the 1960s when just gathering data took all the time. Now it takes one day instead of two weeks, but that's still not good enough. (11)

Knowledge. Most participants indicated that their lack of data and analytic tools limited the amount of knowledge they had or could develop about their products, markets, competitors, and promotions. Some commented:

> With more information I'd have a better understanding of may brand. (10)

> Having more information would raise my comfort level. Now we operate more based on experience and feel. (6)

> Here the approach is "if the information is not actionable, why spend money acquiring it?" We therefore acquire less information. Much of the information acquired by my previous employer was

actionable at some future point or was great background, but was not actionable immediately. (9)

We don't have a general and relatively current understanding of purchasing dynamics. We don't know how much cross purchasing there is or the proportion of people who are deal-responsive or brand loyal. We don't know the demographics of our purchasers and how they might be changing. (13)

The lack of historical information and the inability to relate outcomes with actions limited the amount of knowledge in some specific areas, such as designing promotions and analyzing competitor behavior. Some PMs commented:

We're finding it difficult to plan any promotions in many areas of the country. I need to know what the hot buttons are to get people to eat the product. I need to know what works well, where. There is little information to help me figure this out. We're missing the causal dimension. We've been in the business for a year and the promotions have not been effective. (9)

In developing new promotions, ideally we would look at previous ones. We don't do enough of it. We should go back to SAMI and examine the promotion, looking at the numbers before, during and after the promotion to evaluate its effectiveness. (6)

I'd like to know how effective promotions are by chain, so I can change them next time around, and so I can ask the sales force why it didn't work. (9)

I'd like to know what works for trade and consumer promotions, advertising, packaging changes, and shelving changes. (5)

We are especially lax in knowing the strengths and weaknesses of competitors' new products and how they fit into the who buying scenario. How will it affect us? How should we respond? None of that analysis tends to be done here. (13)

We do not look at the impact of competitors' actions on our volume and spending. There is no place to store it on the system and no analytical tools. This is very important for forecasting. It will become more important as we enter competitive businesses. We have been isolated from the competition. (15)

I have a feeling for trade deals but I don't have the facts. (5)

One PM commented that the kind of information he had was different than the type he had in his previous job:

I have more exposure [than at my previous employer] to top management and sales, to get their thinking and viewpoints. I don't have the amount of information that I had before, but I don't know whether information would provide the key points to determine where to go with the brand. (6)

4.2 Company Beta

Company Beta had sales of over $1 billion. The market for its oldest product was stable after several years of decline. The product was extremely price competitive. Its other products were growing and faced less competition. The company was the market leader in all of its product categories. It had two national and several regional competitors. Consumer purchasing and consumption patterns differed significantly by region for most of Beta's products. The cost of raw ingredients was a significant factor and strongly influenced product profitability and marketing spending. A recent supply shortage caused the price of Beta's primary ingredient, and thus competition on price, to become quite volatile.

Social factors. Beta considered itself to be an information-driven organization. It embraced the notion of creating competitive advantage from information resources. It had made several changes to its organization within the last few years "to commit to the long term growth of the information infrastructure," according to a senior executive. The marketing and information systems divisions were combined to "integrate the experts on external information (market research) with the experts on internal information (MIS)." The company had worked with third party data vendors to learn how to use the data they provided.

Product managers considered the division to be analytically oriented. They "earned their stripes" by learning to perform tasks requiring quantitative analysis. Some commented:

We're very fact-oriented and we're very analytical. We make our decisions based on facts, combined with history and experience. We depend on data. That's the way we manage our business. (8)

There is more confidence in the results if they come from a computer. (3)

Product managers at Beta were considered "the focal point of the brand." They had responsibility for setting volume and share targets and for making marketing decisions for their products. However, the sales force was gaining power and was increasingly being relied on to analyze marketing information.

Information Supply and Distribution. Individual training about the available data and analytic tools was provided

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by the information systems support group. A minicomputer housed both SAMI and MAJERS data, as well as an integrated database which combined and standardized SAMI and MAJERS data by geographic areas and time periods. Data was kept by product for each of the 52 markets, 19 districts, and five regions into which Beta divided the country. Shelf price and promotion data, reported by the sales force, was stored at the account and market level. Since it was one to two months out-of-date by the time it was put on the computer, PMs keyed the data into their PCs directly from source documents.

Every PM was authorized to have a PC. They were used constantly by assistants and associates (the "number crunchers"), but infrequently by the senior PM staff. All PMs were trained to use Lotus. Because of the computational limits of the MDSS, Lotus was heavily used. A linear regression package was available, but was used by only a few PMs. Most relied on market research for statistical analysis.

Preformatted market share and volume reports were produced monthly from SAMI data. PMs used the MDSS primarily to extract data and to aggregate information by ad hoc geographic areas and time periods. The systems group provided assistance for extracting data and structuring reports. Ad hoc extracts of data from the mainframe could be done overnight on request. Data could be downloaded directly from the minicomputer to the PC. This was cumbersome and most PMs extracted and then rekeyed the data.

One member of the information systems support group commented on his role:

> If I notice that PMs seem to be doing a lot of typing in of data or that they are using calculators, I'll question them and maybe I can help them do it on the mini. I like to get as much support time in as I can on a flexible basis. I try to make myself available based on their time constraints. (10)

Some PMs actively sought additional data sources. Two were using scanner data that were purchased for a few markets and were being tested by the sales force. Others were attempting to integrate mainframe and minicomputer data, with support from the systems group.

PMs worked closely with market research and considered them a high quality source of both quantitative and qualitative information. The advertising group and the sales force provided less information to the PMs. The trade promotions group was an important source of quantitative data about promotions and competitor activity. They tracked planned and actual promotion results by brand, package size, market, district, region, and event. In addition, they evaluated promotion effectiveness and maintained an historical database of previous promotions. One member of the group commented:

We track competitor promotions all the time because price is such an important part of our business. Promotional spending data for us and the competitors is available up to the hour. Things change rapidly. We can evaluate the impact of competitors' actions on our total spending in minutes and react immediately. (2)

Information use. The PMs used the available information to analyze performance, promotion, and competitor activity. SAMI reports provided an overview of share and volume. Most PMs performed additional analysis of the data using their PCs. For example, every assistant PM was responsible for creating and using a spreadsheet model to track customer inventory and actual versus planned consumption. The model was used to forecast volume and share for the next period. Forecasts were supplied to the production unit and were broken down into local goals for the sales force.

Most PMs used their PCs to track promotions, including verifying that the trade offered the proper promotional price, comparing their price to competitors' prices, and tracking the impact of the promotion on share and volume. In addition, many used their PCs to perform ad hoc analyses and special projects. These included creating models of the effectiveness of features by market or customer, modeling customer inventory levels to insure and anticipate adequate supply of product during promotions, and analyzing relationships and trends using graphics. PCs were used to track planned versus actual media spending by market and to monitor the impact of changes, such as new packaging or product reformulation, on share and volume. One PM used scanner data to track market share for the previous week, avoiding the two month SAMI time lag. Another used it to analyze promotion results at a more detailed level than could be done using SAMI.

Some PMs commented on their use of information technology:

> Now we can do more detailed, accurate and effective analysis, for example, by tracking average shelf price for us and our competitors in 52 markets rather than averaging at the level of 19 districts. (3)

> It's easier to aggregate data by specific [ad hoc] geographies. (8)

> In the past, gathering competitive information took so long that it wasn't worth the effort. Now I can sit here and talk to you about any business problem with all the facts. They come automatically to me at my fingertips. I don't have to run around to get the data. (8)

> Even though my use [of information technology] is fairly limited, I can be more responsive to my

management, I can pull up stuff and present it in a usable way. (9)

We can do a lot of "what if" costing, forecasting and budgeting scenarios. (4)

Use of information technology at senior PM levels was limited. One senior manager who did use the technology saw benefits to its use but potential problems for managers not familiar with the technology. He commented:

Because I'm a responsible for an entire product group, I'm the only one who thinks about it (as an integrated group). So there are a number of projects that you really can't give to an assistant.

It's now to the point where this stuff (technology) is very dangerous because all these PMs who don't know how to use it don't have access to the basic data. They just cannot get output. At six o'clock in the morning or at night, they may be the only person around. (9)

Knowledge. Company Beta had been actively attempting to increase the information, knowledge, and skills of its PMs. For example, it had worked directly with outside data vendors to better learn how to use the data they provided. Several PMs compared the current information environment to the one that existed a few years earlier:

Before, we could not easily access historical data. It was easier to use current information, rather than using someone else's experience to make a better decision. Now, I can do it easily. For example, say we wanted to lower the price of product X by $1.00 in a market. If someone told me that we did that two years ago and it was the best thing we ever did, I can quickly look back at the price and share data for that time period to confirm the results. Now I can go into a meeting with some perspective. (8)

You can correlate more things with the PC. You can use more information and put it together more effectively. (3)

We certainly have a much better managed database now than we did five years ago, in terms of knowing things. (9)

One PM, however, felt a need for analyzing more information in greater detail:

We have a lot of data on promotion spending level *versus* volume impact, but what we haven't included is the *customer* level results. We need to link customer results to share of market and promotion spending level. (2)

Right now we're using a lot of judgement in making trade-off decisions about whether to spend money in one market or another. If we could do sensitivity analyses on different strength franchises in all of our markets in different parts of the country, we would know how to spend our money more effectively. Now we do this only on an exception basis. (2)

The PMs felt that the need for more information would be answered by access to point-of-sale scanner data:

Traditionally we use SAMI data to reflect the shipments made from the customer's warehouse to the store. To the extent that SAMI correlates with consumer purchases it gives us an idea of how much product is being consumed. Scanner data represents the relatively new dimension of what is actually leaving the supermarket. The scanner data will tell us on a weekly basis how much we're moving through the cash register. This is the closest we can get to the consumer without going into their house. The closer we are to the consumer, the easier it is to correlate product movement with consumption. Currently there is a lot of judgment (rather than analysis) behind spending decisions. We really need that information. (2)

Others had mixed feelings about the data and skills required to effectively use scanner data:

It could be terrific and it could be a disaster. It could be a disaster if we treat it the same way as we have treated our data up to now. That would probably reduce effectiveness because we would be so inundated that we would truly lose sight of the forest for the trees. If we can be selective, this can help us really understand what makes *a* ... [unit of product] move off *a* shelf, which is what it's all about. It's a whole new level of understanding. But what you have to do is to look at that in one place or maybe two places for general conclusions. You must learn your business from those individual movements and not try to analyze 50,000 individual movements. We need to learn how the thing works and once we understand that I think it has potential. (9)

A senior marketing manager had concerns about missing opportunities:

Product managers are more effective because of information technology, but the use of those data is still the same as it was five years ago. They don't do anything different on the computer than I did with my old calculator, they just do it faster. There has not been that "great leap forward" from speeding up clerical tasks to really improving decision making. We will probably need some other impetus, some creative light to think about how we make that leap because it's not

going to come by itself. It's not going to happen just because they have these PCs sitting in their offices.

We still do very basic things very poorly. We do very poor trend analysis, very little regression analysis, very little causal analysis or even non-causal black box trend analysis. We plot the trends on the graph, and that's about it. A way in which it could probably become truly more effective is if we could make good projections of what is about to happen rather than looking back at what has already happened, somehow use this data to make a base projection and to build in additional assumptions to make them better. (9)

The PM also saw benefits to networking the various levels of the hierarchy to more effectively combine his knowledge and experience with their analysis:

I'd like to do more forward planning, and if I had electronic access to my assistants' files it would be a lot of help. Now it is a pain in the neck to get data, massage them, and build trends into them to project something. The assistants rewrite the databases for their own purposes, and they would be much more usable for me than the mini databases. There are some things I want to be able to look at. They do analysis, but after so many years, I could look at something and probably pick out that there is something funny here, something really strange. (9)

Some PMs felt that there was a trade-off to focusing on quantitative analysis:

Access to more data allows us to get closer to the facts and act faster, but too much detail also encourages short term tactical analysis rather than strategic analysis. People can get caught up in the numbers and not look at the strategic issues. (8)

5. DISCUSSION AND CONCLUSIONS

Although the small sample size (N=2) does not allow us to statistically analyze the propositions, the richness of the case data and the detailed description of the process by which each company uses information and analytic tools and produces knowledge provides a basis for testing the propositions. Yin (1984) suggests that each case site should be viewed as an experiment and not as a data point. Just as when conducting two experiments, the findings from the two sites provide insights which can be examined to see how well they generalize.

Both companies had similar market environments and organizational contexts. Beta had experienced somewhat more price competition in one part of its product line, driving the need for promotion information. However,

the managers in both companies performed the same basic functions using the same types of information. We, therefore, can test the propositions by comparing the impact of level of information supply and distribution at the two companies, which have similar information requirements. Specifically, we would expect that information use and knowledge acquisition would be greater at the company with a higher level of information supply and distribution.

A comparison of the two companies provides evidence to support the research propositions. In general, PMs at Company Beta had more data and analytic tools available to them than PMs at Company Alpha. They used more information and acquired more knowledge. In addition, there is evidence that both cultural differences and differences in level of knowledge between the companies affected information supply, information use, and knowledge acquisition.

Information supply and distribution was greater at Beta than Alpha. Beta had a greater supply of both internal and external data. It received data on retail prices for its and competitors' products from the sales force; Alpha did not. Only Beta purchased features and scanner data. In addition, Beta integrated its external information sources, facilitating more sophisticated and extensive analysis. Alpha, in contrast, had developed and used qualitative sources of information more than Beta, relying primarily on the sales force and trade promotion group, and personal visits to the field.

With respect to information distribution, data were more accessible at Beta and more analytic tools were available. Alpha discouraged ad hoc access to internal information. Report modifications and requests took months to receive. Hardware constraints limited direct access to internal data. PMs at Alpha felt that information was inconvenient to access or retrieve. PCs were not readily accessible at Alpha, nor was training provided in their use. Beta made a PC available to any PM wanting one. All junior PMs received individual PC training and created the standard "state-of-the-brand" spreadsheet as part of their training.

Information use was greater at Beta than Alpha, providing evidence to support proposition 1. PMs at Beta used spreadsheet software for several tasks including tracking customer inventory and media spending, budgeting, and forecasting volume and share. They analyzed the impact of their and competitors' promotions, of new packaging, and of product reformulations. In addition, they developed models of the impact of features. They tracked price and analyzed promotion data at a market level.

PMs in Alpha used quantitative data only for an overview of market activity and did little or no additional processing if nothing unusual occurred. They followed up

with qualitative information from the field if more detailed explanation or understanding was required. PMs at Beta also used their information to gain an overview. However, all assistant and associate PMs did more detailed, routine quantitative analysis and many did additional ad hoc analysis.

The differences between the two companies can be viewed in the context of information requirements. Beta better addressed the complexity of the environment than Alpha. It supplied information that PMs could more easily structure to match the structure of their markets, products, and competition. The greater amount and timeliness of information provided a better response to environmental uncertainty at Beta. Alpha, in contrast, was "close to operating totally in the dark" and had a lower "comfort level". Information overload was not a problem for either company. Scanner data could, however, pose problems for Beta.

Alpha was oriented more toward qualitative information exchange. Beta's infrastructure was geared primarily toward quantitative information processing and exchange. Alpha was operating with somewhat inefficient channels by using qualitative information where quantitative would have been more appropriate. However, rich channels might have better supported implementation, thus facilitating action. Beta was operating efficiently with quantitative information, having defined the world unequivocally in terms of price, volume, promotion spending, and market share. However, PMs might have had a less developed capability to reduce equivocality, if needed.

Product managers at Alpha knew less than their counterparts at Beta, providing evidence to support proposition 2. PMs at Alpha did not know the impact of previous promotions and found it difficult to plan promotions in many regions. PMs at Beta, in contrast, examined the impact of previous promotions and used this knowledge to plan new ones. PMs at Alpha were lacking causal data and hence did not know to what degree various factors influenced sales (e.g., features, coupons, or in-store displays). They also knew less about the actions of competitors and their impact.

Based on our analysis of the two companies, we propose that given some degree of fit between information supply and distribution, and demand, the greater the amount of technology and resources allocated to information supply, distribution, and use, the greater the knowledge about the information environment. By greater knowledge, we mean more facts and a better understanding of the relationships among variables (Jaikumar and Bohn 1986). We do not mean to imply that greater knowledge is always desirable. It must be evaluated within some context. In this case, having greater knowledge would probably increase Alpha's return on marketing investment. Beta had much greater knowledge about its environment and it

had the skills to analyze the environment. It made greater progress in tying outcomes to actions, thus providing analytical feedback for knowledge advancement. Beta was able to leverage its experiences by codifying and storing action results and providing access to that information. Alpha was less able to provide this support for learning and knowledge.

Perhaps the most important outcome was Beta's development of information and skills for analyzing competition. Since Alpha was just beginning to face increasing competition in its markets, it historically had not required this knowledge. Many participants considered this lack of knowledge to be Alpha's greatest weakness; information technology support could have its greatest benefit for Alpha by providing the means to develop this knowledge. The implications for management are that learning and information technology go hand-in-hand. Information systems not only supply facts, but allow the company to build a knowledge base, develop analytical skills, and provide analytical feedback to evaluate actions and increase knowledge.

Information technology was most useful in developing tactical, not strategic, knowledge. Tactical knowledge is rooted in unequivocal, quantitative analysis of analyzable information. Strategy is qualitative and equivocal. Alpha's PMs may have had a better strategic feel for their products and markets, while Beta's may have been better tacticians. Management must recognize the difference, understand when to promote one versus the other, and provide the information technology infrastructure which balances the two.

The level of knowledge at each company influenced its approach to information supply, information use, and knowledge acquisition, providing evidence to support proposition 3. At Alpha, PMs knew less about the factors that affected the marketing of their products. Their supply, use, and knowledge acquisition focused on gathering basic causal information at a national level and only focusing on regions on an exception basis. PMs at Beta knew more about the impact of specific marketing programs at a detailed geographic level. Their information use focused on building sophisticated models to gain incremental benefits in profits.

There is evidence that a relationship exists between culture and the approach company's take to supply information, use information, and acquire knowledge, providing evidence to support proposition 4. One of the most striking differences between the companies was their respective cultures. Each company's culture fit their approach to marketing: Alpha responsively creating and quickly implementing niche products, Beta competing head-on with other major producers frequently on price. At Alpha, the culture was described as action-oriented and entrepreneurial and less energy was expended on gathering and analyzing information and less emphasis

was placed on acquiring knowledge. PMs at Beta considered the company information-driven. Management valued data analysis and knowledge acquisition.

It is difficult, however, to conclude that either the culture or the level of knowledge was the primary influence on the approach to I/P. Similarly, it is not clear whether greater supply and use of quantitative information in Beta resulted from or was one cause of the cultural difference. We tentatively conclude that culture, level of knowledge, and information supply and use represent a self-reinforcing web of causal links (Weick 1979).

Moving a company to different levels of analytical/factual knowledge poses a challenge for management to break the loop. One potential approach is by managing or changing the culture (Schein 1985), another by investing in new (to the organization) information technologies and letting the organization experiment and learn (McFarlan and McKenney 1983). Ultimately, management must make the strategic decision of whether to manage the company as an information interpreter (Daft and Weick 1984) or an action generator (Brunsson 1985), and manage the information infrastructure accordingly.

This research identifies a limitation in the OIP framework. According to the framework, fit of I/P requirements and capabilities is a stationary and attainable objective. Because the use/knowledge relationship may be reciprocal, rather than causal, fit may become a moving target. Use of information is affected by (as well as affecting) level of knowledge, and supply and demand are not static. On one hand, what we know limits how we interpret and analyze information, reinforcing existing knowledge (Anderson 1985). The supply of information and the technology to analyze it, if limited to equivocal sources, further reinforces the current level of knowledge (Feldman 1986). On the other hand, knowledge drives demand. The more we know, the more we want to know. Information technology which supplies unequivocal feedback and the tools to analyze it can break the reinforcing loop and increase knowledge. Greater knowledge allowed Beta to be more directed in defining and meeting its information needs. As knowledge increases, more variables and relationships are identified and made explicit, and more facts are demanded. As more facts are gathered and analyzed, knowledge increases and the cycle repeats.

Demand, however, is never actually satisfied. Neither Alpha nor Beta were satisfied that they had enough information. The difference was in the type of information demanded, and reflected their level of knowledge. Alpha's PMs wanted access to basic quantitative data which could provide useful feedback; the type of information which Beta already had. Beta's PMs wanted more refined information to build on what they knew and to create new analytical models: promotion information by customer, scanner data to track actual product movement,

information to create "causal" marketing models. The technology at Beta was supporting learning. It was sustaining the PM's demand for information at a higher level of knowledge.

6. SUMMARY

Our use of field-based case research has allowed us to meaningfully explore a topic about which little is unequivocally known. The strength of the method lies in its ability to help us understand a complex process which takes place in a real-world setting. Our results provide the basis for future research in three areas. First, we are performing additional case research in several sites to learn more about how managers use information. Second, we are performing longitudinal case research in some of these sites to determine the impact of increasing the amount of data and analytic tools on knowledge and other outcome variables. Third, we are developing a survey, in which some of the concepts presented here will be quantified and the propositions will be empirically tested. The case study has been especially valuable in identifying areas in which to focus the quantitative data collection.

We proposed a model whereby information use was influenced by characteristics of the information supply and distribution, and whereby knowledge increased with increasing information use. We further proposed that these relationships would be subject to the social forces and the level of knowledge within the organization. Our observations supported our model. Meeting an organization's information needs requires supplying and distributing information appropriate to the problem and understanding and managing the culture in which the information technology will reside and the level of knowledge within the organization. Our results further suggest that unequivocal information, analytical use, and analyzable knowledge increase tactical but not strategic decision making capabilities. Finally, our results suggested that the notion of attainable fit may be a myth, and that once closed learning cycles (Hedberg 1981) are implemented, managers must be prepared to manage continual and changing demand for more refined information support.

7. REFERENCES

Aldefer, C. P. "An Intergroup Perspective on Group Dynamics," Chapter 13. In J. W. Lorsch (ed.), *Handbook of Organizational Behavior*. Englewood Cliffs, NJ: Prentice Hall, 1987.

Anderson, J. R. *Cognitive Psychology and its Implications*, Second Edition. San Francisco: W. H. Freeman, 1985.

Benbasat, I.; Goldstein, D. K.; and Mead, M. "The Case Research Strategy in Studies of Information Systems." *MIS Quarterly*, Vol. 11, No. 3, 1987, pp. 369-386.

Brunsson, N. *The Irrational Organization*. New York: John Wiley & Sons, Inc., 1985.

Daft, R. L., and Lengel, R. H. "Organizational Information Requirements, Media Richness, and Structural Design." *Management Science*, Vol. 32, No. 5, May, 1986, pp. 554-571.

Daft, R. L.; Lengel, R. H.; and Trevino, L. K. "Message Equivocality, Media Selection, and Manager Performance: Implications for Information Systems." *MIS Quarterly*, September 1987, pp. 355-366.

Daft, R. L., and Weick, K. E. "Toward a Model of Organizations as Interpretation Systems." *Academy of Management Review*, Vol. 9, No. 2, 1984, pp. 284-295.

Driver, M. J., and Streufert, S. "Integrative Complexity: An Approach to Individuals and Groups as Information-Processing Systems." *Administrative Science Quarterly*, Vol. 14, No. 2, 1969, pp. 272-285.

Duncan, R. B. "Characteristics of Organizational Environments and Perceived Environmental Uncertainty." *Administrative Science Quarterly*, Vol. 17, 1972, pp. 313-327.

Feldman, J. "On the Difficulty of Learning from Experience," Chapter 10. In H. P. Sims and D. A. Gioia (eds.), *The Thinking Organization*, Jossey-Bass, 1986, pp. 263-292.

Feldman, M. S., and March, J. G. "Information in Organizations as Signal and Symbol." *Administrative Science Quarterly*, Vol. 26, 1981, pp. 171-186.

Galbraith, J. R. *Designing Complex Organizations*. Reading, MA: Addison-Wesley Publishing Co., 1973.

George, A. L., and McKeown, T. J. "Case Studies and Theories of Organizational Decision Making." *Advances in Information Processing in Organizations*, Vol. 2, JAI Press, 1985, pp. 21-58.

Goldstein, D. K. "Factors Affecting the Demand for Information Among Marketing Managers: A Qualitative Analysis." *Marketing Information Management*, Innsbruck, Austria, 1988.

Hedberg, B. "How Organizations Learn and Unlearn," Chapter 1. In P. C. Nystrom and W. H. Starbuck (eds), *Handbook of Organization Design*, Oxford, England: Oxford University Press, 1981, pp. 8-27.

Hiltz, S. R., and Turoff, M. "Structuring Computer-Mediated Communication Systems to Avoid Information Overload." *Communications of the ACM*, July, 1985, Vol. 28, No. 7, pp. 680-689.

Huber, G. P. "The Nature and Design of Post-Industrial Organizations." *Management Science*, Vol. 30, No. 8, August, 1984, pp. 928-951.

Isenberg, D. J. "The Structure and Process of Understanding: Implications for Managerial Action." In H. Sims and P. Gioia (eds.), *The Thinking Organization*, Jossey-Bass, 1986, pp. 238-266.

Jaikumar, R., and Bohn, R. E. "The Development of Intelligent Systems for Industrial Use: A Conceptual Framework." *Research on Technological Innovation, Management and Policy*, Vol. 3, 1986, pp. 169-211.

Kahnemann, D., and Tversky, A. "Variants of Uncertainty." In D. Kahnemann, P. Slovic, and A. Tversky (eds.), *Judgement Under Uncertainty: Heuristics and Biases*, 1982.

Kiesler, S., and Sproull, L. "Managerial Response to Changing Environments: Perspectives on Problem Sensing from Social Cognition." *Administrative Science Quarterly*, Vol. 27, 1982, pp. 548-570.

Kmetz, J. L. "An Information Processing Study of a Complex Workflow in Aircraft Electronics Repair." *Administrative Science Quarterly*, Vol. 29, 1984, pp. 255-280.

March, J. G., and Simon, H. A, *Organizations*. New York: John Wiley & Sons, Inc., 1958.

Machlup, F. *Knowledge: Its Creation, Distribution and Economic Significance. Volume 1: Knowledge and Knowledge Production*. Princeton University Press, 1980.

McCann, J. M. *The Marketing Workbench: Using Computers for Better Performance*. Dow Jones-Irwin, 1986.

McFarlan, F. W., and McKenney, J. L. *Corporate Information Systems Management: The Issues Facing Senior Executives*. Homewood, IL: Richard D. Irwin, 1983.

McKenney, J. L. "The Influence of Computer-Communications on Organizational Information Processing." Division of Research, Harvard Business School, 1986.

Miller, J. G. *Living Systems*. New York: McGraw Hill, 1977.

Poole, M. S. "An Information-Task Approach to Organizational Communication." *Academy of Management Review*, July, 1978, pp. 493-504.

Quelch, J. A.; Farris, P. W.; and Olver, J. M. "The Product Management Audit." *Harvard Business Review*, Vol. 65, No. 2, March-April, 1987. pp. 30-33.

Salancik, G. R., and Pfeffer, J. "Who Gets Power - And How They Hold On To It: A Strategic Contingency

Model of Power." *Organizational Dynamics*, Vol. 2, No. 21, Winter, 1977.

Schein, E. H. *Organizational Culture and Leadership.* Jossey-Bass, 1985.

Swanson, E. B. "The Two Faces of Organizational Information." *Accounting, Organizations and Society*, Vol. 3, No. 3/4, 1978, pp. 237-246.

Tichy, N. M. "Networks in Organizations.," Chapter 10. In P. G. Nystrom and W. Starbuck (eds.), *Handbook of Organization Design*, Oxford, England: Oxford University Press, 1980, pp. 82-97.

Tushman, M. L., and Nadler, D. A. "Information Processing as an Integrating Concept in Organization Design." *Academy of Management Review*, July 1978, pp. 613-624.

Weick, K. E. *The Social Psychology of Organizing*, Second Edition. New York: Random House, 1979.

Weick, K. E., and Daft, R. L. "The Effectiveness of Interpretation Systems," Chapter 4. In *Organizational Effectiveness*, New York: Academic Press, 1983, pp. 77-93.

Yin, R. K. *Case Study Research: Design and Methods.* Sage Publications, 1984.

Zmud, R. W. "An Empirical Investigation of the Dimensionality of the Concept of Information." *Decision Sciences*, Vol. 9, 1978, pp. 187-195.

EXHIBIT 1

GUIDELINES FOR PRODUCT MANAGER INTERVIEWS

I.   Introduce self and project stressing confidentiality of the study

II.   What are the most important tasks that you perform?

    A. For each task:

        1. Describe it.

        2. What information do you use in carrying out the task?

        3. Where does the information come from? Probe to find out what information is coming from people and what is coming from systems.

        4. What analytic tools do you use (if any) in performing the task? What tools are used by others to provide you with the information that you use?

        5. What is the impact of having this information on the performance of the task? How would you do the task differently with less or more information?

III.   Are there other ways that you use information or analytic tools in your work? Gather information on the use of personal computers, PC software, mainframe computers and software, electronic mail, etc.

IV.   Is there other information that you receive from others that you use in your work?

V.   What factors influence your use of IT?

    A. What aspects of the company influence your use of IT? What aspects of your division (or business unit)? What aspects of your product? What aspects of yourself?

VI.   What, if any, changes have occurred in your work due to the increased availability of data and analytic tools?

VII.   What, if any, changes do you expect to occur in the next few years?

EXHIBIT 2

PRIMARY THIRD PARTY VENDOR DATA SOURCES USED BY RESEARCH SITES

SAMI: Supermarket warehouse withdrawals (dollars and units) and computed share-of-market by product, geographic area, and time period. SAMI was bought for a category of products and contained information for all competitors' products in that category. It was used as a proxy for retail sales. It includes only warehoused items and, therefore, does not include all goods sold in supermarkets (e.g., meat sold in the delicatessen section is not in SAMI). Reported monthly approximately four weeks after the end of the month. Purchased by both companies.

MAJERS: Supermarket promotions (e.g., coupons, give-aways), featured items (e.g., end-of-aisle display), and advertising type (e.g., newspaper ad size, in-store circular, etc.) by product, account, and time period. Reported monthly (although company Beta negotiated weekly reports). Purchased only by Beta.

SCANNER DATA: Actual point-of-sale purchase volume by product, account (customer), and week. Reported weekly about two weeks after the fact. Limited purchasing by Beta only, for experimentation and one special project.