MATRIX COMPILATIONS

This is the ninth issue of Compilations. Your letters and phone calls tell me that you appreciate the news and analyses that are contained on its pages. One friend says "embedded" would be a better descriptor. The format, he says, is intimidating, and that a newsletter with punchy headlines and graphics would make it more readable. Others have said that they would like to read more hard facts and statistics, that this would lend a greater degree of credibility to my assertions and help to validate my opinions. Put in more summaries and include a table of contents, I'm told, so that readers can pick the articles which interest them without having to read the entire issue.

This is all good advice, but before I make any changes, I'd like to hear from more of you. What issues would you like to see covered in more depth? How can I make Compilations more relevant to your business or production efforts, and help to make you more profitable and productive?

The past year was a busy one for Matrix Consultants. Work on several articles for **Computer Graphics World** gave me the opportunity to broaden my base of experience in computer-aided dispatching, multi-purpose geographic databases, and optical disk technology. The DRUPA'90 Cartographic Report, which many of you ordered, was well received. I was part of a team that created a publishable map from a routing and navigation geographic database, and helped to implement electronic book publishing systems that integrate text, graphics, and maps. In between were a number of executive briefings and technical seminars on both sides of the Atlantic.

As you will see by reading this issue of Compilations, some of the concerns that Matrix Consultants will be addressing with clients in 1991 include minimizing the damage to sales and profitability during the recession, how to organize for higher productivity, how to take advantage of emerging standards in digital geographic database, and how to use optical disk technology for efficient storage and distribution of those databases. We'll also be working on multi-purpose database applications, testing and evaluating map publishing systems, from the desktop variety to the larger format systems. And we'll be taking a hard look at integrating satellite image analysis techniques with digital data capture methods, including raster-to-vector conversion, automated line following, and text and symbol character recognition.

Give me a call. This is Matrix Consultants. How can I help you?

THE MATRIX PERSPECTIVE

The opening bell for nineteen ninety-one had a slightly less uncertain ring to it than it did last year. The political horizon may appear more ominous, but the dense fog has lifted from the global economic landscape and it is clear that the world is in a recessionary period. This isn't necessarily good news, but it's information we can use to get on with the job of planning our business strategies.

Businesses have been bracing for a slowdown for the past few years. It was not a question of whether there would be a recession--the longest economic expansion since post-World War II could not go on forever--but when it would start; how long it would last; whether it would be mild or severe; and whether it would affect the major world economic groups (North America, Europe, and the Far East) equally. The invasion of Kuwait and the subsequent doubling of the price of oil didn't cause the recession, but the event helped to push up the timetable for its start.

Except for when it would begin--it's here--the other questions remain unanswered. The Allied response to Iraq's aggression commenced on January 16th. The immediate reaction on the oil markets was to lower the price of oil. But if oil prices do jump to $60 a barrel as a result of some action in this regrettable war, we could all be in for hard times on planet earth. In addition to already causing a significant and unnecessary loss of precious lives, the war will probably, by all accounts, lengthen the recession's duration, increase its severity, and broaden its global effects.

What does all this mean for the map publishing and tourist publication industry? Negative economic indicators on both sides of the Atlantic might suggest that sales of maps and map-related products for tourist purposes will slow or even decline. Sales of new cars are well below what they were one year ago. The U.S. auto industry reported a $2 billion loss for the third quarter. Airline travel, already down in the third and fourth quarters, is suffering badly because of the threats of terrorist acts. Profits for U.S. carriers were off 99% compared to the same period last year. The hotel and motel industry also report more empty rooms and profits are almost 50% below last year's rates.

Higher air fares and higher prices at the fuel pump, combined with consumers and business who feel that they have, or will have soon, less discretionary income, are resulting in large reductions in travel for non-essential purposes. People are staying close to home watching TV (broadcasting is up 28%), going to the movies (entertainment is up 95%), or fixing up their houses (machinery and hand tools was up 69%).

My view is that prospects for the mapping industry as a whole to weather this recession are not as gloomy as they might seem. Although I don't necessarily believe that all companies will maintain the levels of growth they had during the previous, prosperous eight years, I see excellent opportunities for those organizations which have understood the power of geographic information and the flexibility of maps to be educational and entertaining, as well as utilitarian.

Having worked through four recessions, two of them as an urban planner and two as a map producer, my experience has been the following:

1. When businesses and individuals cannot act, they plan. Businesses plan for increased capacity and improved distribution; individuals plan for doing in the future those things they cannot do in the present.

2. Governments at all levels that don't help to spend their economies out of recession are not likely to be voted back into office. Capital intensive governmental projects which help restart sagging economies begin with planning intensive projects.

3. Recessions eventually end. Those who are prepared for the upturn in economic activity and who can meet renewed demand for their products or services will enjoy the time until the next recession hits.

Map producers in both the private and public sectors who provide consumers and businesses with products that are truly useful for planning purposes will not only survive this recession, they will thrive. When the last recession took hold almost a decade ago, paper maps and color magic markers were the planner's primary tools for analyzing and presenting geographic and demographic data. Today, the planner is armed with strategic decision making tools running on personal computers and color output devices that can produce one hundred maps in the time it took to manually color one.

It is my belief that map producers who can offer a variety of media to consumers and business will fare best in this recession. Organizations that automated during the boom times and were careful to organize their databases for multi-purpose use (i.e., not just using computers to draw maps) will have more opportunities to adapt their data to paper, digital, video products. These organizations will also be in a better position to take advantage of increased demand when the recession ends.

The next several months are crucial. You need to look at your own product mix, determine which products did best during the previous

economic downturns, and decide where to concentrate your resources for the most effective return on your potentially limited resources. For some, it may be time to circle the wagons, wait for the attack, and hope for the best. For others, it is a time for action, a time to target your products and services at those consumer and business buyers who want and need them in these difficult times.

TRANSFORMATIONS

A $10 million contract being performed by ESRI will, in all probability, affect the way that geographic databases are designed and used in the future, and will strengthen ESRI's already strong position within the GIS software, systems, and services industry. Environmental Systems Research Institute (ESRI, Redlands, CA), along with subcontractors Loral Defense Systems, Akron Defense Systems Division, and Geovision (Norcross, GA) have finished the first year of the two-year contract with the U.S. Defense Mapping Agency (DMA). The contract, called the Digital Chart of the World (DCW) Project, has two primary objectives:

1. To provide a standard vector data format for preparing, processing, and distributing geographic data; and,

2. To create a detailed global database, and a method for distributing this database, that can be used for logistic support, environmental planning, resource management, or any application requiring geographic analytical capability.

Jack Dangermond, founder, owner, and president of ESRI, says the real impact of the project is that "it will provide the basis for global science in the future. It will provide a strong foundation for building numerous kinds of thematic overlays. This is one of the most significant GIS projects ever done...and will form the basis of not only automated cartography, but for geographic information modeling on a global scale." Make no small plans.

The project team is creating a 1:1 million base map of the world using the DMA Operational Navigational Charts (ONC) as source material. ESRI's responsibilities are to prepare the standards, convert the ONC map series into digital form, put the resulting database on CD-ROM, and provide users with the means to access and review the data. Loral is providing systems engineering and project logistics support. Geovision will pre-master the CD-ROM disks, is helping establish CD-ROM production techniques, developing CD-ROM quality assurance procedures, and, with ESRI, is designing new techniques for logically indexing the data stored on the disks.

ESRI has developed a production process to convert the ONC series into the final DCW product. To complete the conversion, it is using a combination of its own ARC/INFO system, a scanner with raster-to-vector software, and a raster editing system. After the data is structured, classified, and attributed with the ARC/INFO system, it is processed through the DCW conversion program and stored in what is termed the Vector Product Format, the generic model for the GIS. Within the DCW project, the VPF will serve as the basis for direct access of digital vector data for multiple mapping applications.

VPF is not intended as a vector data exchange model, like the Initial Graphics Exchange Specification (IGES), AutoCAD's Drawing Exchange Format (DXF), or Intergraph's Standard Interchange Format (ISIF). VPF will be neither hardware nor software specific. As a direct access format, it is meant to be usable, without conversion, in systems that are designed to work with it. For the present, only the DCW CD-ROM software operates with VPF data. However, if the DMA has its way, the VPF model will be adopted by hardware vendors and geographic database developers so that digital base maps at all scales from any source will be readable and usable on any hardware platform running any GIS or mapping application software. They expect that GIS software vendors will adapt their systems to work directly with the VPF format, and also that database producers will use the format for storing digital geographic data.

The DMA fully intends to distribute the DCW database, packaged together with map access and display software, on CD-ROM disks. The Agency is analyzing different distribution channels and pricing for the product, and hopes that it will be used by a wide audience. I visited ESRI and viewed a prototype of the product which runs on a standard '286-based computer with 1 megabyte of memory and an EGA monitor. Although it is not a full-fledged GIS, nor a true desktop mapping system, it contains enough functionality to allow users to select and view data sets so they can order printed maps or digital products from the DMA's primary data sources.

Why was ESRI selected as the prime contractor on this project? More to the point, if the database does have cartographic applications, why isn't there at least some representation on the project team of a map publisher with digital cartographic experience? What is ESRI? Is it a GIS software and system integration vendor; a GIS consulting and contract database production firm; or, a company that does now, or will in the future, compete with geographic database producers for a share of the digital cartographic market?

The DCW Project is an appropriate context for analyzing the breadth and depth of ESRI because if the objectives of the Project are to be

satisfied, ESRI must, to some extent, possess all of the above qualifications.

Many of you are aware of ESRI's reputation as one of the world's leading suppliers of geographic information systems software. As a tightly held, private company controlled primarily by Jack Dangermond, it is difficult to know for certain ESRI's annual sales or level of profitability. Daratech (Cambridge, MA) recently gave them a 17% share of the GIS software market and ranked them second to Intergraph in total GIS hardware, software and service revenues with an 8.6% market share. That would put them in the range of approximately $52 million per year in sales. According to data released by ESRI through its periodic newsletter, ARC News, the company had growth rates of over 40% over the past few years, and ESRI maintains that its two primary products, ARC/INFO for mainframes, minicomputers, and workstations, and PC ARC/INFO outsell all other GIS software products by a ratio of almost two-to-one.

Whether it holds 8%, 17% of 40% market share, ESRI is a major force in the automated mapping and GIS industry. Jack Dangermond, with his college professor demeanor and business acumen, along with S.J. Camarata, Jr., one of the industry's most unassuming marketing directors, together practically created the GIS market sector. After leaving the Harvard Graduate School of Design in the late 1960's, Jack returned to his hometown in Redlands and founded ESRI. It began life as an environmental engineering consulting company. He and his staff automated Ian McCarg's principles of environmental overlay analysis, and helped to transform environmental planning into a computerized science.

Through persistent proselytizing about the virtues of an integrated geographic and relational database, the ESRI team pieced together a constituency for their computerized methods. In their consulting work by constructing examples of GIS databases with their own home-made systems, they created a supply of willing buyers for both the databases and the systems on which these databases could be processed. Only then, after almost fifteen years of laying the foundation, did ESRI become a bonafide vendor of systems software. ARC/INFO GIS quickly became a standard by which all mapping systems were measured.

What helped ESRI make those early sales was their ability to deliver a system complete with a database, one produced by their own staff of cartographers and technicians who compiled and digitized the geographic data according to ARC/INFO principles. Eventual users of ARC/INFO could focus on their application, rather than on the technical--and difficult--details of constructing a topologically

structured database. As the number of users grew, the ARC/INFO GIS standard spread.

When looking for assistance in developing a standard and creating a database according to that standard, who might be better suited to this task than a group like ESRI who had already done it and who had a proven track record?

Fine. ESRI has the qualifications to define a GIS standard and the ability to create a geographic database. But why should they be entrusted with producing a database that will have potential cartographic applications? Topological structure and integrated graphic and attribute data are neither necessary nor sufficient for a cartographic quality database. While it is possible for a cartographic quality database to also be topologically structured and usable for GIS applications, it is not at all feasible to use a GIS for publishing maps unless the database has been designed for this application from the outset.

ESRI is not a map publisher, but it has gained a respectable amount of experience in digital cartographic production through its contacts with the cartographic community, both from the growing list of map publishing clients who use its system, and from the prospects it lost to competitors. ESRI employs cartographers, some of whom are quite knowledgeable about the cartographic requirements of a digital geographic database.

ESRI has not undergone a transformation from a system vendor to a geographic database producer. Neither does ESRI appear to be headed in the direction of competing with its ARC/INFO map publishing clients by creating cartographic quality databases. However, the experience gained by the company on the DCW Project will help to make the ARC/INFO system and ESRI's services more attractive to map publishers, particularly those who are interested in packaging their data on CD-ROM and who are interested in working with the DCW Project's VPF standard.

PIXEL POINTS

Optical Disk Technology

Is CD-ROM a map publisher's nightmare, or is it a dream come true? Will CD-ROM or some other form of optical disk technology replace paper maps and travel guides, or will it be the next great idea to find a place in the digital dustbin? Finding the answers to these and other questions about optical disk prompted me to research the technology. I prepared two articles on the subject for **Computer Graphics World** which appeared in the August '90 and September '90 issues. In this

section, I've summarized the contents of the first of these articles to describe what optical disk technology is. Let me know if you'd like to learn more about what the technology can mean to map users, map publishers, and mapping and geographic database developers.

Optical disk technology is a method of storing and retrieving massive amounts of digital data. It includes the media on which the data is stored, the methods used to store the data, and the mechanisms for gaining access to that data.

CD-ROM (the shortened version of Compact Disk-Read Only Memory) is one form of optical disk technology. The other two major classifications are WORM (Write Once, Read Many) and erasable optical (also called magneto-optical disks). CD-ROM lets a user read data, but not make changes or add data to the disk. WORM lets a user read and add data, but not change or erase the data once it's on the disk. Erasable optical disks allow a user read, add and delete data at will.

If you have seen an audio Compact Disk, you know what optical medial looks like. It consists of a glass or plastic substrate coated with a thin metallic film. Data is stored as a sequence of 1s and 0s, just like on magnetic media (i.e., all forms of magnetic tape, floppy disks, and fixed and removable magnetic, or so-called hard disks). However, instead of using magnetic fields, data on an optical disk is recorded on grooves or pits formed on the metallic coating with precision optics and focusing systems using a beam of light from a low-powered laser. A laser beam is used to read the data as well. When the disk is read, the laser beam is reflected back from the surface to a detector with light sensing diodes. Voltage changes caused by the reflected light meeting or not meeting a 1 or a 0 are converted to computer-readable on-off bits.

CD-ROM drives--the mechanisms which allow users to read data stored on the disk--are similar to CD audio players: The audio players do not have computer interfaces and driver software (they're made for playing music, not data); CD-ROM drives can read data and, if equipped with analog audio circuitry, they can be used to play music as well. The other difference between the two is cost, with CD-ROM drives priced from $500-$1,000, versus $200-$300 for portable CD audio players. Like audio CD players, CD-ROM drives can only read data that has been pre-recorded on the disk. No additional data (or music) can be stored on the disk, nor can the data be erased. When the drive is connected to a computer system, it is treated like any other logical drive, except that it is read-only.

The standard 4 3/4 inch CD-ROM can hold up to 660 megabytes of data. That's equivalent to the capacity of around 550 high density

floppy disks. They're small, durable, portable, and, because they are non-magnetic, more stable than tapes or floppy disks. They can't be erased by machinery or X-ray devices. They're also relatively inexpensive to manufacture. The first master disk costs about $2,000, but each copy made from the master costs only a few dollars. A standard data format for CD-ROM, known as ISO 9660, has evolved so that CD_ROM data disks are compatible and interoperable with different manufacturer's disk drives of the same size. (Some systems use 3 inch disks which can store up to 200 megabytes, and these disks cannot be used on the more common 4 3/4 inch drives.)

WORM disks and drives allow users to write data once to the disks. There currently is no single, standard data format for WORM, and disk sizes vary by manufacturer. WORM optical disk technology has been used primarily for archival storage of data in place of magnetic tape. They offer the advantages of being more compact and providing greater storage capacity than tape, with a single 5 1/4 inch disk holding over one thousand megabytes (that's one gigabyte) of data. By linking a series of WORM drives together (called daisy chaining), or with a multi-disk player (called a jukebox), it is possible to have an almost limitless capacity of data available for reading and writing.

Erasable optical disks can be compared to a floppy disk, but with a thousand times the floppy's storage capacity. The erasable disk looks like other optical media, but an ultra-thin magnetic layer covers the platter. Data storage spots, where the 1s and 0s will be recorded, are placed on the blank disk under the magnetic layer. I think of these spots as gates at a railroad crossing: open or up for 0s, and closed or down for 1s. All the spots initially face in the same direction (the gates are open and there are only 0s on the disk). To write data, an infrared laser heats selected data storage spots and a magnetic coil switches the direction of the heated spots (closes the designated gates), signifying 1s.

When reading the data, laser light is reflected back from the spots and polarized clockwise or counterclockwise, depending on whether the spot is a 1 or a 0. To erase data, the laser heats all data spots on a selected sector of the disk and reorients the spots in the same direction (opens all the gates again).

Erasable optical disk drives function like an internal hard drive except that the storage medium is removable. The drives are slower by one-third than a Winchester fixed drive, but they're 15 to 35 times faster than CD-ROM drives. Like WORM, there are as yet no standards controlling size and data formats.

There are variations within these three basic optical disk technology categories. NV. Philips of The Netherlands, along with Sony

Corporation of Japan, the originators of Compact Disk technology, are working on CD-I (Compact Disk-Interactive). CD-I is a self-contained CD-ROM system with a built-in computer and a real-time operating system. CD-I is intended as a consumer product for interactive video applications. It offers the possibility of combining graphics, audio, text, and possibly animation in a single device that can be connected to a TV or slip into the dashboard of a vehicle.

Competing with CD-I for a portion of the consumer market is DVI (Digital Video Interactive) developed by General Electric and RCA. This technology is aimed at full-motion video, allowing up to 72 minutes of full-screen, full-motion video at a resolution of 256 by 240 pixels with 16 million colors to be packed on a single standard CD-ROM disk. A user can literally wander around a video image, overlay the video with photographic still shots, drawings or illustrations, and 3-D CADD images, and build a simulated reality or enhance the experience of viewing virtual reality.

Optical disk technology is what I would describe as an enabling technology, providing the bridge between increasingly available, but very large geographic databases, and relatively inexpensive computer platforms running powerful mapping application software. The technology is helping to remove the two major barriers to widespread use of geographic data and mapping systems: distributing the data contained on maps from primary producers and geographic data integrators to end users, and storing this data by end users for use in their applications.

PROJECTIONS

The recession is not the only challenge facing map publishers today. Competition will increase in the coming year from companies outside the cartographic mainstream (see **Compilations**, September 1990, Etak is a map publisher), as well as from the global media giants (e.g., Bertelsmann, News Corp., Mondadori) who have identified the powerful potential of geographically linked data. Meeting these challenges will require that map publishers develop new ways of thinking about which products to bring to market and how to get these products in the hands of consumers for the right price, at the right level of quality, and in the right quantities.

Traditional cartographic organizations have difficulty coping with the development of new products and with the introduction of new techniques and technologies that are often necessary to create new products. The problem for most map publishers is not lack of imagination, but an intransigent organizational structure which prevents new ideas from taking root. In this section I will outline what I see as inhibiting agents built into the current hierarchical

management model prevalent in many map publishing firms. I will also present an alternative model which may open new possibilities for your organization.

Most map producers, including those who have automated, are organized around printing cycle tasks. Once a map base is created, periodic updates are applied to stored masters, plate-making film is re-used whenever possible, and enlargements or reductions and re-screening of the bases are made to generate new map products. The objective is to maximize the substantial investment made in the original map base through reprints and multiple usage. The degree to which a base can be reused--and, of course, sold--determines the profitability of a map producer.

Assembly line cartographic production is now the norm. In the post-World War II era, military mapping techniques, such as scribing, type stick-up, and peel coat stripping, were transferred to the private sector. These techniques required special training and, once learned, it was found to be more efficient to have cartographic staff perform their specialized functions, rather than allowing them to create a complete map from design and compilation through printer-ready film. Each skill group reports to a supervisor, supervisors report to a manager responsible for groups of tasks, like research, cartographic production, photographic production, or quality control, and managers, in turn, report to departmental directors. The number of management layers above the directors is generally dependent on the size of the organization: The bigger the company, the heavier the upper management layer.

Ever since the Industrial Revolution, the division of labor by task has resulted in hierarchical management structures. Specialization in cartographic production has resulted in the hierarchical model becoming the prevalent model in the map publishing industry. In the simplest form of the model, manufacturing, marketing, and administration comprise three sides of the organizational pyramid leading up to the president at the top. Overseeing all from above with a watchful eye is the board of directors.

The introduction of computer-aided map publishing technologies into many of the traditional mapping companies has had little effect on the companies' organizational structures, nor on their abilities to explore new possibilities offered by digital map bases. Often, a new group with its own supervisor works in parallel to the "manual" production flow. This group performs tasks which are similar to those used by non-computer-equipped fellow staff. The objectives for automation have typically been limited to converting the company's original base material to digital form as quickly and economically as possible so that a digital database can be used for cartographic products, or to make an

immediate substitution for scribing and type placement without consideration of database issues.

If a digital base is properly prepared for cartographic purposes, and the correct systems are used, it is faster and less expensive to create a range of products from a single digital base than from several manually prepared bases. Although the initial investment in equipment, training and conversion remains relatively high, and the payback period remains long, companies that have automated are experiencing the advantages over manual production techniques. However, substituting digital for manual cartographic techniques is like a bank keeping computerized records of all client accounts and using the records only for sending out monthly account reports. It may be an improvement over handwritten ledger sheets, but so much more can be done.

Map publishers need to move beyond a digital-for-manual substitution of technique; they must find ways to respond more quickly to market conditions with new products; and they need to find ways to gain access to a fair portion of the emerging market for geographically linked data. You can make a start toward accomplishing these goals by changing the way you think about your organization because, to a large extent, it is the way we manage that determines what and how we produce.

Hierarchical organizations leave little room for introducing new ideas and processes. Assuming that everyone in an organization is gainfully employed in performing his or her specialized task, there should be no idle time available for these employees to pick up a new skill or start creating a new product. What often happens is that someone in the organization presents a new idea, it is studied by a committee, reviewed by upper management, approved or rejected. If approved, a struggle ensues between supervisors who must donate staff to the effort and managers who are charged with implementing the decision with no negative effects on productivity. In order to keep productivity levels at current rates during the period of transition, new staff must be hired to replace those lost to the "new process" team. Alternatively, existing staff must work overtime. Employee morale suffers, profits probably suffer, and a successful implementation, if achieved, may take much more time than originally estimated.

Hierarchical organizations focus on managing functions: producing, selling, administering. Over time, the functions begin to have a life of their own beyond the life of the company as a whole or beyond the vision of the company's founders. The tug of war that takes place between production (desire for higher salaries and higher quality), marketing (demand for lower production costs and more variety), and administration (demand for more reports that take more time, reduce

productivity and increase costs) exemplifies the struggle inherent in most organizations, particularly those in the mature stage of existence.

Companies locked into hierarchical management often lose track of the maxim for success in a market economy: Optimize profits, people, and products. Companies exist because of these three ingredients and continue in existence based on the optimization of all three components. A company can maximize profitability at the expense of its people and the quality of its products, but it cannot do so for very long. A company's employees can be very pleased with their salaries and with their product's level of quality, but if profits are not optimized, the company will slowly cease to exist.

There is nothing sacred about hierarchical management. It is a model built for accountability, not necessarily for productivity or personnel development. It may have been necessary at one time to facilitate the flow of information up from the shop floor to top management, and to get the message down through the chain of command. However, in today's world of seemingly unlimited communications possibilities, it is possible for everyone to have immediate access to required information. Many of the largest corporations have come to understand that multiple reporting layers are unnecessary and, in most cases, counter productive.

For a model of an organization that would optimize profits, people, and products, I suggest building an organizational structure--physically--around these three components, plus a communications component. Rather than an hierarchical concentration on task, such a structure would permit a focus on product horizontally across the organization with support and participation of process resources vertically through all product groups. In this model, which is best described as a distributed management structure, any number of product groups would be staffed by appropriate process specialists for every phase of a product's life cycle, including idea, proof of concept, implementation, full production, and retirement.

The difference between a process specialist in a distributed management structure and a task specialist in an hierarchical structure is that the process specialist contributes knowledge and skills to any number of products. It is no longer possible to consider training generalists. It is possible, however, to develop holistic (the whole is greater than the sum of its parts) understanding in individuals with specialized skills.

The profit--or money management--component includes collections, disbursements, and asset management. This grouping is similar to that of a financial department in an hierarchical organization, but the way it is used is substantially different. As participating members in each

product group, the money people are able to integrate financial planning into product planning. The amount and cost of money, space, people, materials, sales and marketing, can be built into each product from the earliest stage. Individuals with financial management skills, rather than production or marketing skills, have the responsibility for ensuring that a product is financially viable, for preparing budgets, and for monitoring a product's costs and profitability.

The people component is comprised of recruitment, training, and personnel management. The degree to which these functions are connected to product and profit issues determines the level of productivity and job satisfaction. The result is a proper match between staff skills and expected performance. Recruiting personnel and training staff must have a definite stake in the successful selection of staff. To be able to do this, they must have a knowledge of the product and its eventual method of production and distribution.

Personnel management, often called "human resources," is a detached and isolated function in large, hierarchical organizations. It rarely exists in small companies where its functions of addressing employee complaints and seeing to the well-being of staff are usually performed by one member of the management team. People management is not an inconsequential issue, particularly in small organizations. The loss of a single, important staff member in whom the company has invested substantial time and financial resources to train, can be disastrous. People management skills are not necessarily the strong points of product- or profit-oriented individuals. Adding this dimension to a product team will go a long way toward avoiding personnel conflicts before they occur and solving problems as they arise.

Design for Manufacturability; Produce for Profitability

In a distributed management organization, the product component involves more than just production. What products to produce, how to produce, and how to sell them are as important as actual production. Elements of the product grouping include technique--product design, selection and adaptation of tools, and the preparation of procedures; production--materials selection and acquisition, materials conversion into product, and process control; and distribution--product marketing, sales, and inventory control.

Combining technique, production, and distribution into product groups is becoming standard practice in the manufacturing sector. In its best form, the three cooperate as equals partners designing products and procedures which are manufacturable and marketable. In its worst form, one of the three assumes the position of leadership (i.e., creates a hierarchy) and determines the direction and success or failure of the product. A distributed management structure in which

all participants in the product component cooperate and communicate with each other, as well as with members of the financial and people components, will help to ensure that products are designed for manufacturability and produced for profitability.

A fourth component, communication, makes distributed management possible. Internal communications involves the installation and oversight of telecommunications and computer equipment. The members of this group have the responsibility of ensuring that voice, written, and digital data are stored in such a way that the data can be retrieved and turned into useful information. It is not necessary for this group to have product-specific knowledge, but as participating members in each product group, they can translate product requirements into communications requirements. They can also help to guide the selection of production techniques toward those technologies which enhance the entire organization's ability to communicate.

External communication, that is, the processing of data to and from points outside the organization, and the integration of internal and external systems, is becoming essential for every business. It is no longer a matter of sending and receiving telephone messages or distributing the mail. Facsimile and digital data communications with clients, branch offices, and field staff requires considerable thought and specialized expertise. Successful implementation of external communications can add measurably to the success of a product.

Where is the leadership, the executive management, in a distributed organizational structure? There is no obvious pinnacle as there is in an hierarchical structure. Shared leadership by the most capable individuals in profit, product, people and communication is one alternative. Shared leadership is common in start-up companies when a group of like-minded individuals form a partnership and make group decisions. As the company grows and as hierarchical management takes hold, one of the individuals usually emerges as the leader, the president, with ultimate responsibility for all decisions.

Another alternative for leadership in a distributed management structure, one that is particularly suited to sole a proprietorship which has expanded, or to a large company with an established president making the transition to distributed management, it for the leader to participate with his or her special expertise in some or all product groups. Everyone has strengths, and a president or company founder generally attains a position of leadership because of strengths, skills and qualifications with either people, products, or money.

Some of you will read these words, recognize the problems and frustrations of hierarchical management, agree in principle with the

suggested solution, but draw back from the thought of organizational change. I'd like you to contact me to discuss how you can make the change evolutionary, not revolutionary. There are steps you can take to set the stage for an eventual shift to distributed management without disrupting current production and marketing efforts or reducing your company's profitability. We can start with the following:

1. One of the first and most important steps you can take is to improve internal communications. Decide what information you and all your staff need to be able to do your current jobs effectively. Determine how you can get the information you need more quickly, in a more understandable form.

2. Start building capital planning and asset management into product development. Categorize you products and determine both the resources required to produce and distribute them and the return on those resources.

3. Start hiring the best people you can find with specialized skill. Determine who in the current organization can make the transition to distributed management and begin to develop their specialized skills while encouraging team commitment.

4. Begin to compile and analyze market and product development intelligence on a continuous basis. Select individuals within your organization who cover the people, profit, product, and communications components and assign to them the task of regularly reporting on developments.

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