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The biggest challenge to engineering and to the management of our company is that we diversify one basic product to meet three different markets. We did it by decentralizing and giving engineering managers full rein to run the three lines of business.

Our product is a microprocessor computer system that's based on the latest technology in semiconductors, logic and memory. Most companies our size—$5-million, 100 employees—that have one basic product usually concentrate on a single marketplace and sell to the OEM. We sell to the end-user, which means that we have to develop a lot more engineering insight about his problems than we ever did with the OEM.

We've taken our computer-based system into three vertical markets: (1) word processing, where we have a range of competitors from automatic typewriters all the way up to very sophisticated time-sharing word-processing systems; (2) intelligent terminals; and (3) business functions, such as data processing and accounting.

Learning to divide and conquer

To pursue three markets with the same basic product, we decided a year ago to apply the management that is characteristic of much larger companies. We formed three product-line departments—a word-processing department, an intelligent terminal department and a data-processing department—and an operations group that is responsible for manufacturing the product.

Managers of the product-line departments maintain their own software development, engineering and product marketing. Each is also responsible for his own profit and loss.

Giving product managers the profit and loss responsibility is done in many large companies, but in a small company that's only four years old it's unusual.

To motivate the manufacturing people—those in the operations group—we measure what they do on a cost basis rather than a profit-and-loss basis. We transfer the product at cost from the manufacturing area into the three product centers, where the markup of profit is taken.

Product engineering, which supports manufacturing, is also under the control of the operations manager. His biggest problem, of course, is keeping three different product managers happy at the same time.

We don't believe in having a centralized engineering staff in either hardware or software. We put our engineers with the other members of whatever program they're working on. I think that engineers enjoy the interaction of the marketplace. In larger companies I think that the engineer often gets too far away from the customer. If we centralized, the engineers would not be exposed to the day-to-day running of the business. I like to think that we're creating potential business managers out of these engineering managers.

All three of our product-line managers have

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Richard L. Petritz and Linolex

Dr. Petritz, President of Linolex Systems, Inc., came into the computer field via the semiconductor business. In 1969 he was a founder and the first president of Mostek Corporation, a successful semiconductor company. Both Mostek and Linolex received their initial capital from New Business Resources (NBR), a Dallas based venture capital company of which Dr. Petritz is a founder and general partner.

Prior to the formation of NBR, Dr. Petritz was Director of the Semiconductor Research and Development Laboratory at Texas Instruments, during which time he was an early forecaster and spokesman of the importance of Large Scale Integration. His keynote address

come up through engineering. A good engineering manager in this company has a good opportunity to run a total business. He has a career development path that is unlimited. This is another benefit of our decentralized system.

The right ratio of chiefs and Indians

Besides profit and loss, what else are the product-line managers responsible for?

In the word-processing department he's responsible for the design of the peripheral devices that make the basic computer system a word processor, such as printers and magnetic card readers.

The intelligent-terminal engineering manager concentrates on communications—emulating various other terminals on data entry, magnetic tapes and other peripheral devices that are used in the communications business.

Peripherals that are pertinent to data-process-

at the 1966 Fall Joint Computer Conference, "Technological Foundation and Future Diversions of Large Scale Integration," still stands as a landmark forecast of the direction and impact of LSI on electronics.

Holding a PhD degree in Physics and a Bachelor and Masters degree in Electrical Engineering from Northwestern University, Dr. Petritz has published more than 25 technical papers on the subject of transistors, integrated circuits, LSI, physics of photoconductors and information theory. Several of his papers have been cited by professional organizations including his original paper on the theory of noise in transistors which received the Browder J. Thompson Award of the IEEE.

Dr. Petritz presides over a five-year-old Massachusetts corporation that manufactures and sells a small computer system which contains a video display, a keyboard and three cassette magnetic tape drives integral with the central processor. This configuration of equipment combines a business-oriented computer with a flexible medium for local storage and an operator-oriented man/system interface to give stand-alone processing power.

The company also delivers asynchronous and synchronous communications adaptors, type-font and matrix printers, data processing magnetic tapes and card readers to adapt the system to the needs of several specific markets into which its products are sold. Disc storage is proposed to enhance the local storage characteristics of the system.

ing applications, including high-speed printers, floppy discs and hard discs, are the responsibility of the data-processing manager.

So the engineering talent is spread among these three departments, plus manufacturing. Coordinating the work of all four departments is the responsibility of the manager of operations, who must be a very solid engineer. He holds a council meeting with the engineering managers from his own group. This group is responsible for the computer system itself—its design and manufacture.

This engineering council has representation from the three other departments that are concerned with peripheral engineering. Through frequent meetings, the group is able to keep different people from working on the same problem and to make sure that someone is always working on vital problems.

Giving the basic product versatility

You may wonder how we make a single machine perform satisfactorily in three different markets. For example, in the word-processing market customers would like to have a very large CRT for a large screen. In the intelligent-terminal market, a large screen isn't needed; it would only add to the cost.

We've tried to arrange a compromise. We present a relatively large screen to both markets. We show a person a screen of 20 lines by 80 characters. We can also "fold" our line, so that the width can be extended to 158 characters, and we can scroll vertically in case they want to see a full page sequentially.

Our engineers are motivated to take this basic concept, that of the same machine, to three different markets and to try to turn the disadvantages into advantages.

Creative engineering has enabled us to come up with good solutions to customer's problems and to enlarge our markets. To do this, we need to have a close relationship with the customer. This is why we formed the product-line organizations. We have marketing people in each of the product lines who return daily with customer feedback.

Each of the three markets present very different competition. The competitors in word processing hard-wire their machines. These machines are designed to do a very specific function, and they get locked into the hard-wired approach.

From an engineering point of view, you might think that these machines could process words better, because the product is designed specifically to do that. We've countered that by programming our machine with software. Our software engineers are constantly looking for ways to improve our word processor. Every three months we ship software releases to our customers to enhance the use of our word processors. But there are drawbacks. Keeping track of the support for all these software releases is a major logistics problem.

A number of competitors also make hard-wired data-communications equipment in the intelligent-terminal area. Here again, our engineering counterthrust is to add power and flexibility to the machine through software. With advanced software, we can emulate many communications terminals. Occasionally we will update the hardware—for example, replace the communication adapter with one of a higher speed.

Making it universal and maintainable

We tried to figure out how to make a single keyboard that would function effectively in three markets.

For word processing, we had a keyboard that resembled the Selectric Typewriter. We had a teletypewriter layout for the intelligent-terminal area and a slight variation of that for the data-processor product. We decided on a universal keyboard, which combines the best features of the Selectric layout. The control is a shift-lock key.

If we hadn't decided to develop a universal keyboard for the three markets, it would have been impossible for a company our size to support the product in the field. It would have been too difficult and too expensive to produce the different programs and the different keyboards. It was far easier to make compromises with our customers.

To service this machine, we're using upgraded typewriter repairmen. This presents an interesting engineering problem: how to make a machine serviceable by relatively untrained people. We designed the machine for board replacement, making it diagnostic so the serviceman can determine the faulty board and replace it, rather than trying to repair any part of it.

The biggest problem that a company like ours has is trying to introduce new products at a rapid enough pace. As a small company, we can have a new product that's exciting for X number of years, but technology moves on, and we've got to compete with someone else who's using that new technology.

How do we do it quickly enough so we don't become obsolete?

Small companies are limited financially; it's hard enough for big companies. Modest-sized companies are not so apt to be blind to the need for these products, but they may not have the physical resources to do the job. Keeping our engineers closely coupled to our customers' needs or requirements is our best insurance against product obsolescence. ■■