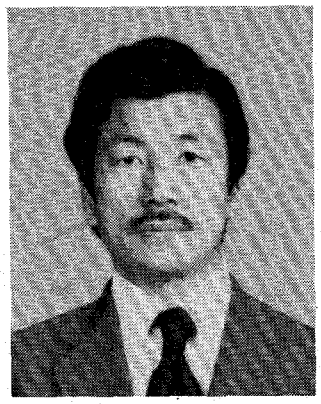

Prof. Eikichi Yamashita

"For contributions to the analysis and design of microstrip networks."

The following members of IEEE were elected Fellows with the support of MTT-S but were presented their Fellow Awards elsewhere.

Mr. Louis F. Moose, "For contributions to microwave relay communication systems."

Dr. Gunther U. Sorger, "For innovative contributions to the development of precision electronic measuring instruments and standards."

Dr. Kunihiro Suetake, "For contributions to the theory and techniques of microwave absorbers and the introduction of educational technology."

1984 IEEE MTT-S International Microwave Symposium Keynote Address

JOHN A. YOUNG

THE THEME of the 1984 MTT-S International Microwave Symposium was "Expanding Microwave Horizons." The conference theme was a most appropriate one. Today's working engineers need to stretch their thinking, but in some nontechnical directions, because the factors most crucial to their success—and their industry's future—are *not* solely or even primarily technical in nature.

Engineers today are players in a high-stakes game called international competition in high technology. It's a contest waged in a vast arena—a world marketplace that is growing in size and interdependence. The players are thousands of individual firms in the private sector. But to make things complicated, hundreds of national public policies influence what those private-sector firms can do. So this is a game where government helps formulate the rules.

To develop a strategy for winning in this competition, the President's Commission on Industrial Competitiveness was formed in the fall of 1983. Its 30 commissioners plus staff are grappling with the question of what makes an industry—and a nation—able to compete successfully in world markets. And while many of the details studied are purely American, the questions asked and factors examined are really quite universal.

Due to report in December of 1984, the Commission members have come to one, definitive conclusion: The only people who think that the competitive question has a simple answer are politicians running for office. A nation's ability to compete is a complex subject. It's determined by many elements—all interrelated.

Since complexity doesn't scare engineers, they should find some value in going through the following factor analysis of competitiveness. Such an exercise will help them better understand what trends and forces affect nations and their ability to compete in high-technology markets. Better yet, perhaps it will spur them to consider some issues to which they haven't yet given much time.

Factor One: The "Givens"

The first factor can be labelled as "givens." They're things that already exist, like natural resources, infrastructure—roads and communications networks—and the size of the national market. When these are present in abundance, they become advantages that have a good-news–bad-news character. Their existence is a positive. But the competitive ease afforded can make a country somewhat wasteful and slow to respond to change.

Today, both America and Europe face strong challenges from nations that have a severe scarcity of natural resources—Japan and all the "new Japans" in the Pacific Rim. *All* their energy has to be imported. And just a few decades ago, these same nations had little in the way of roads or communication systems either. Now they're giving us a run for the money in technology.

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Factor Two: The Cost and Quality of Our People

Human resources—people—represent a second national factor affecting competitiveness. Here there are two issues to consider—first, the cost of those human resources and, secondly, their quality. The data cited here will have a purely U.S. perspective, but they have implications no matter where we may live.

For human resources, America's cost is a real competitive disadvantage. We get paid more than people elsewhere, no matter what job classification we may have. Hopefully, we're worth that much more. But no matter where we live, we must remember that our high standard of living has to be earned; the marketplace doesn't bestow it upon us as a right.

Earning it may not be as easy as it sounds, when you compare wage rates around the world. For every dollar in wages and benefits paid to a U.S. production worker, a French worker gets 68 cents, a Japanese gets 49 cents, a Mexican gets 23 cents, and a Korean gets 11 cents.

That's quite a comparison. Consider products that require equal labor. When you have wage costs that are so much higher in some countries than in others, you build in a productivity improvement challenge of overwhelming proportions.

Please note that the wage-rate comparison cited was for production workers, not professionals or managers. The same probably holds true for other job classifications, and costs will vary widely from country to country. Wherever we are, we need to be aware of those cost differentials and make productivity—whether in R&D, or manufacturing, or sales and administration—a goal for every activity we pursue.

The second element of the human resource factor is the quality or skill level of the workforce. Too often, there's a mismatch between skills needed and skills available. Microwave technology is a case in point. Demand worldwide for communications equipment is booming, but in the United States, the number of people trained in this highly technical field is not keeping pace. Engineering availability will be a critical factor in the future strength of any nation's ability to compete in technological markets.

The scope and seriousness of America's engineering shortage are open to debate. But no one will argue with the statement that many engineering schools are constrained by outdated equipment and too many vacancies in key faculty engineering disciplines. And few will question the proposition that technology and world markets are changing so rapidly that we must create more vehicles where people can get trained—or retrained—at various times throughout their lives.

The shortage of technically trained people and our lack of mechanisms for helping them acquire new professional information are not the only challenges we face. Often, management needs to rethink its assumptions and methods.

First, it needs more of an international perspective—a better view of world markets and international data needs. Here it must be admitted that the Japanese and Europeans have kept a broader view than Americans. Secondly, management's view needs to be not only broader, but more long-term. Too often, business leaders focus on short-term gains rather than the long haul, too much on the manipulation of paper assets than on the creation of real value.

The final area of human resource skills is one for which there is no curriculum. It's one that everyone in business needs. It's so *simple* that it isn't taught, but it's so *difficult* that it isn't often accomplished. It's called getting along together—creating a consensus among everyone in an organization about where it's going and why. There are many ways of creating that sense of shared purpose—profit-sharing, stock purchase plans, or participative management. We should pursue them all, because the ability to compete depends on how well we function as a team.

Factor Three: Capital

The third competitive factor is an area that engineers don't tend to think about very much—capital. Investment is what fuels economic growth. Countries that invest more have better manufacturing productivity growth. The statistical correlation is strong.

Take the top six industrialized countries and rank them according to investment rates for the past ten years. From top to bottom, that ranking will exactly mirror how they stack up in regard to productivity growth. By the way, you'll find Japan at the top of that list with about 20 percent of GNP invested, and the U.S. at the bottom with under 7 percent. The difference between the two countries in productivity growth was also about 3 to 1.

The President's Commission on Industrial Competitiveness decided that those were disturbing rankings. It asked a wide range of economists why it was happening. A lot of testimony was heard and, marvel of all marvels, a wide spectrum of economists actually agreed!

There's a logical reason American industry hasn't invested as much as its foreign competitors. Capital costs more here than it does abroad. Using Japan as the yardstick, the experts pin U.S. capital costs as between one-and-a-half to four times higher—a real competitive disadvantage for American firms. As a result of higher capital costs, U.S. firms have to price their products higher to make a comparable profit.

There are many reasons capital costs vary so much from country to country—the inflation rate, the source of the capital (whether it's debt or equity), or the way the capital is used. Let me just discuss two key causes that vary widely around the world—the neutrality or nonneutrality of a nation's tax code and the question of supply and demand for capital.

National tax codes can have a significant impact on the competitiveness of an industry. Some countries have tax codes that favor one industry over another. Some do it quite explicitly, with definite competitive goals in mind.

Others are more ad hoc, and it's appropriate to place the U.S. in that latter category. Here, different tax allowances and depreciation rates combine to create a situation where the effective tax rate on industry ranges from a plus 48 percent to a negative 14. The U.S. electronics industry falls toward the high end of that range.

The cost of capital is even more troubling for industries like electronics because of its high growth rate, short equipment life, and high levels of investment in R&D. Many scholars have attributed the Japanese success in the American semiconductor market to their ability to borrow more easily and at a lower cost.

The U.S. now has real cause for concern. We're now contemplating government deficits that will absorb more than half of the total private sector savings. And what capital remains will be even more expensive than it is now.

Here's an example of where a nontechnological issue—capital demand, supply, and cost—has very direct effects on our industry, its ability to compete, and on our jobs.

Factor Four: Technology

A fourth national factor affecting competitiveness is technology, and it represents the most powerful and dynamic of any strength a nation can bring to bear. Technology can be thought of in two different ways. First, it can be product technology whose very uniqueness calls for a premium price. This is how we usually think of technology.

Maintenance of this innovative strength requires investment in a nation's universities, strong government support for basic research, the ability to couple that research with the needs of the market, and mechanisms to transfer advances in basic knowledge to the commercial sector. That last point—the commercialization of research—is something this country has been slow in doing.

There's a second aspect of technology that deserves greater attention, because it's something engineers can directly affect. Product technology is only half the coin. The other side is process technology. Applied to the manufacturing function, it can make products that are more attractive in terms of cost and quality.

Please think about those last two words—cost and quality—because those are the two elements that ultimately determine *any* industry's success in world markets. Even in the world of microwave technology, where so much of the procurement is done by government, buying decisions are most often made on the basis of how much quality performance a piece of equipment can deliver at a given price.

Anyone who has studied the Japanese success story knows that a large part of their success derives from the attention they've given to the process of manufacturing. One of their greatest strengths has been in applying technology—much of it imported—to the production of products that are superior in both cost and quality.

So engineers must do more than develop advanced technology for use in products. It does little good to develop an innovative product if, within a short time, someone can replicate and offer it for half the price. Engineers must recognize that the systematic *application* of technology to the manufacture of products is a most important but neglected part of the profession.

Besides contributing directly to better quality and lower costs, process technology is easier to protect. We export the product, not the process used to make it. Who knows the recipe for Colonel Sanders chicken?

There's one final thought worth pursuing while on the subject of how process technology can improve the cost and quality of our products. It's been said before in some circles, but it's important enough to repeat: Cost and quality are *not* mutually exclusive goals. In fact, improving quality is the best way of reducing costs. HP has seen these results in case after case.

When quality and cost become design criteria, some new relationships develop among members of the team. Our designers and process people now work closely together from day one. R&D engineers think about manufacturability. The result has been elegant equipment that's easier to build. And production engineers now realize that the solutions they develop can contribute the competitive edge we need.

Factor Five: Institutional Conditions

The fifth and last factor influencing our ability to compete can be termed institutional conditions. This means how we organize and govern ourselves.

Starting with the global perspective, let's look for a moment at the rules of international trade. The high-stakes game of international competition in high technology should be played on a level playing field. There must be open and equal access to all national markets. That way, when anyone wins, he knows he's done so fair and square.

Protected and subsidized industries are not, by definition, competitive. Any nation has the right to decide what industries it would like to encourage, but it must do so within the boundaries of international trade laws.

On a national level, increased competition in high technology calls for a re-examination of a whole range of public policies. We need to ask ourselves some hard questions.

Have we asked the competitive consequences of our actions?

Or do we just take competitiveness for granted, ignoring the trends or actions that may weaken our position?

Do our policies just concentrate on distributing wealth, rather than creating it?

Are the goals of government and business, labor and management really so divergent?

Do we have mechanisms for creating consensus on goals?

Or do our laws (like anti-trust) and our historical attitudes (the division between management and labor) prevent us from working together?

Lastly, if we were to formulate a strategy to meet international competition, what would it be?

Any nation can formulate such a strategy, one that's consistent with its own social, economic, and political

heritage. Here's a brief sketch of the directions it might take.

First, after the factor analysis, decide whether your country has a competitive advantage or disadvantage in each area.

Next, build on your strengths. For the U.S., its competitive advantages are skilled human resources, technology, and a vast domestic market. All of those strengths could be better developed and deployed.

Then look at your competitive disadvantages. Decide whether you want to improve them or accept them as givens. If you're from a country with a high standard of living, you'll probably have to live with a high cost for human resources. Other disadvantages may be at least neutralized. The U.S. will never have low capital costs, but they *can* be improved.

The next step is to decide in whose court the ball lies. Some weaknesses must be addressed in the private sector, such as the management of human resources and technology. Other factors get you into the realm of public policy —things like capital costs, exchange rates, tax policy, or the administration of international trade law.

So there's a wealth of targets and arenas to choose from. Hopefully, engineers will select at least one. There are plenty of reasons for them to get out of the lab and add to the public dialogue. To expand their microwave horizons, so to speak.

So thank you for entitling your conference "Expanding Microwave Horizons." It provided an opportunity to remind us all that engineers have a very broad stake in the outcome of international competition. And that we can and should play a very broad role in formulating our nation's response—no matter where we live. Engineers have a lot to offer here. We're used to complexities. We're pragmatic. We're problem-solvers.

That call to action—for engineers to get involved in solving the broad societal issues that surround them—is an appropriate note to leave you with. It's also the same theme that has run through IEEE since its inception one hundred years ago. That's because it's a message worth repeating, worth hearing, and worth acting upon.

John A. Young is president and chief executive officer of Hewlett-Packard Company, located in Palo Alto, CA.

He has served as HP's chief executive officer since May 1978 and as chairman of the executive committee of HP's board of directors since March 1983. He had served as the company's chief operating officer and president since September 1977.

He joined Hewlett-Packard's marketing planning staff in 1958 after receiving a master's degree in business administration from Stanford University. He subsequently served as a regional sales manager, a member of the corporate finance staff, and marketing manager of the former Microwave Division. In 1963, he was appointed Microwave Division general manager.

In 1968, he was named vice president of the company and assumed responsibility for the newly formed Electronic Products Group, which included the instruments, components, and measuring systems produced by Hewlett-Packard.

He was appointed executive vice president and elected to the company's board of directors in September 1974. At the same time, he was named to the executive committee, established to coordinate all phases of the company's operations. As executive vice president, Young was responsible for HP's Instrument, Computer Systems, and Components Groups.

Born in Nampa, Idaho, on April 24, 1932, he was graduated from Oregon State University with a bachelor's degree in electrical engineering. There he was a member of two honorary fraternities, Eta Kappa Nu (electrical engineering) and Sigma Tau (engineering), served as president of Alpha Tau Omega social fraternity, and received the Air Force ROTC communication award.

From 1954 to 1956, Young was an officer in the Air Force Research and Development Command at Holloman Air Development Center in New Mexico.

He is very active in Stanford University affairs and is currently serving as a member of the Board of Trustees. He also has devoted considerable time over the past several years to the University's fund-raising activities, having served as National Corporation Chairman for the $300 million Compaign for Stanford program. Additionally, he serves on the Business Council for the College of Idaho.

On June 28, 1983, he was appointed by President Ronald Reagan to be chairman of the President's Commission on Industrial Competitiveness, which is chartered to explore means of improving the competitive posture of U.S. industry at home and abroad. The same year, he was named national chairman of Junior Achievement, Inc.

He is a director of the Wells Fargo Bank, Wells Fargo & Company, and SRI International. He is co-chairman of the Western Technical Manpower Council, a member of the Business Council, the Business Roundtable, the Executive Committee of Machinery & Allied Products Institute, and is a member of the National Industrial Advisory Council of the Opportunities Industrialization Center (OIC). He also serves on the Board of Governors for the San Francisco Symphony Association, and is a member of the board of directors of the Bay Area Council. His professional affiliations include membership in the American Electronics Association (formerly WEMA).