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## **Canada-U.S. Aspects of People as a Renewable Resource in the World Competitive Context: Public and Private Job Training and Retraining: A Motorola Case Study**

*Susan P. Hooker\**

**F**irst, let me thank you for the opportunity to be with you this afternoon. I am going to be shifting the focus a little bit. I am not going to be speaking from a national perspective at all. Instead I will be speaking from a Motorola perspective since I tend to see things from a fairly "Motorolan" point of view, having been with the firm for the last ten years.

In reference to Les Horswill's point about the shortage of skilled machinists and tool and die makers in the United States, I would like to say that about a month ago, I met with the Education Committee of the Tooling and Manufacturers Association of Northern Illinois. It is a group of about 500 small firms, most of them with no more than fifty employees. In the last ten months, they raised a million dollars from only 100 of their firms to create an education fund. Their purpose in contributing that money is to promote among high school students the notion of entering the skilled trades and apprenticeship programs instead of going to college. They are having to pull their future employees from the same group of kids who typically pursue four-year degrees in college in the United States.

The second of Mr. Horswill's points I would like to address is on education spending. A recent study from the Economic Policy Institute in Washington showed that we have, in fact, been looking at our educational spending numbers in a way that skewed the results. In total education, the United States is out-spending the rest of the world, but in kindergarten through twelfth grade education, we ranked eighteenth out of the twenty most industrialized nations. So, our spending on education is in higher education where we, without a doubt, have the best system in the world. It is not in kindergarten through twelfth. And the curriculum in the kindergarten through twelfth system around the country is predisposed to training people for the college system. We need to look at a two-tier system so that we can focus resources on developing excellent vocational education programs for those students who will not be going to college.

I would like to begin my presentation by showing you the cover

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stories from several issues of *Business Week* from over the last couple of years. The first was in March of 1986: "The Hollow Corporation" talked about many companies who were moving jobs and factories outside of the United States in search of cheap labor. Then, in April of 1987, "Can the United States Compete?" appeared as the cover story. The article asked whether we have the resources and the will to do what needs to be done to be a successful global competitor.

September of 1988 indicated a recognition that "Human Capital" may, in fact, be the answer to that question. The authors stated that our education system and our human resource policies, both inside firms and in the nation as a whole, would need to be fundamentally changed in order for us to be competitive.

This next one was just added to my collection a few months ago. It is the November 1989 issue with a cover story, "Competing with Japan: How Motorola Does It." Motorola is the largest supplier of pagers to the Nippon Telephone and Telegraph Company in Japan. We also have recently been successful in winning the ability to sell car telephone systems in Japan. We have been supplying the subscriber equipment (the phone that goes in the car) to Nippon Telephone and Telegraph Company very successfully for several years. We feel our future in Japan will be successful based on market reaction to our pagers and car telephone products.

Motorola was founded in 1928, with some very simple electronic products. Today we manufacture a full line of electronic products, from semiconductors that are used in computers to electronic control devices, and governmental electronics. We also sell and manufacture a number of sophisticated systems for two-way radio communications.

The majority of ambulance, fire and police department systems in use in North America are made by Motorola. Motorola is a multinational or global company. We have twenty-three manufacturing facilities in the United States, but we have thirty manufacturing facilities outside of the United States. Of our 104,000 employees, 55,000 are employed in the United States, and the other 49,000 outside of the United States.

We have a very participative style of management. All of our employees work in teams. They do problem solving as teams, have team goals and earn bonuses based on the success of those teams. The team approach is used even in the office of the chief executive.

We have a number of policies that cover training and education. The most significant one is new. As of January 1990, all 104,000 employees of Motorola will attend five days of training every year. That includes not only professional and executive personnel, but all employees.

We spend about 2.5% of payroll on training and education. We have a policy that every department will spend at least 1.5% of its payroll on training and education. Approximately 1% of our workforce is involved in training and education careers. In 1989, Motorola's training

investment was over \$60 million, not including the cost of payroll while people are in class.

Why does Motorola have this emphasis on training and education? We estimate that every employee in our company will go through eight to ten complete sets of skill changes in their working career. That is not necessarily eight to ten changes in jobs, but it means that their skills sets will have gone through that many changes by the time they retire. The half life of knowledge is changing at such a fast pace, it is unbelievable. For a software engineer, half of everything he knows when he comes out of school is obsolete two years later. For the industrial and mechanical engineers, it is obsolete six or seven years later. So, even our employees with high skill levels are going to go through multiple complete sets of skill changes as technology and other job requirements change.

We use an analogy to describe this situation. We believe that keeping our workforce competent to do their jobs is like moving all 104,000 of us up an escalator that is going down. If we stand still, in terms of skills, we really fall behind because technology and competitive pressures are moving those escalator steps downward. To be the best in class, we have to be increasing the skills and knowledge of everyone at every level in the corporation on a continuous basis. We need a culture of continuous, life-long learning.

In the last three or four years, we have also discovered that a full half of our U.S. factory-level population, about 12,500 people, lack the basic reading and math skills necessary for us to give them the higher level training that they need to operate in our more sophisticated factories.

Factory jobs, in our company at least, are not going away. We have been quite successful in manufacturing and would like very much to be able to keep a good number of our factories in the United States. But if we are going to do that, we have to be able to continuously upskill the workforce. People have to learn to work with automated machinery. They have to be able to read digital read-outs and be able to make routine programming changes. They have to be able to interact with the keyboard and with a screen that tells them what is going on with the machine. They also have to learn to do some simple maintenance procedures and understand written specifications. Half the people we currently employ do not have the basic reading and math skills so that we can teach them to do those things.

The reason for that is two-fold. Half of the problem comes from the poor quality of the "products" produced by the U.S. kindergarten through twelfth grade educational system. We have to remember that a lot of students do not make it through school; they drop out. Of the seventy-five percent who remain in school and graduate, an alarming number do not have the skills necessary to be productive in the workplace. The other half of our problem comes from the fact that we employ a lot of people who were not born in this country, but who immigrated

here as adults. Their lack of English language skills prevents them from being able to participate in problem solving activities or in the training that they need to be able to perform their jobs more efficiently.

Because of this enormous skill gap in our own Motorola workforce, we have programs at every one of our U.S. factories in which we are teaching reading, math and English as a second language. This can be a very lengthy process. Some people acquire the necessary skill levels after only a few months with forty to fifty hours of instruction. Others will require years and hundreds of hours of instruction. We already have some people who have been attending classes for two years or more.

You might legitimately ask, "How were these people able to do their jobs in the past?" The answer is that the very nature of the work itself is changing. We used to employ people just to put things together. The production of electronic goods requires multiple assembly processes that used to be performed manually. People with limited language and math skills could be taught to do those assembly steps quite easily. These employees have been reliable and valued contributors in the past, but today, and in the future, their skills are not adequate.

In our modern factories, the routine assembly work is now performed by automated machines, not by individuals. These machines need to be "managed" by skilled individuals who can set them up accurately, run their programs, make programming changes, perform routine maintenance, and track the output of the machines for quality and quantity. These are greatly enriched jobs that provide much more interesting work and greater satisfaction than the traditional electronics assembly jobs, but they also require a higher level of skills. Our intention is to build these higher skills in our existing workforce.

The popular assumption is that the factories of the future will need only a small number of these highly skilled individuals. Let me now share with you a Motorola success story that challenges that assumption. It is the story of our cellular car telephone operation that currently employs about 5,000 people in Illinois and has recently announced an expansion that will add another 3,000 jobs. It is also the story of an operation that was in such trouble in 1985, that it was scheduled to be moved to Asia. There were some people at Motorola who believed that the manufacturing could be done in Asia with higher quality and lower cost.

Cellular telephone technology was invented as a joint project of Motorola and AT&T. By 1985, Motorola alone had invested over \$100 million in the research and development of the technology, in the phones themselves and in the base stations and switches needed to connect the cellular phones to the land line telephone systems. The Federal Communications Commission ("FCC") approved the concept, and the first licenses were to have been granted to phone system operators in early 1985. Motorola was ready with products for the systems, and AT&T was ready with license applications. However, the FCC encountered a

problem. It received scores of applications for each of the two licenses per market that were to be granted. Truckloads of applications were being delivered daily, and the application review process that had been established was woefully inadequate. The result was an eighteen month delay in the awarding of the first licenses. That delay created a window of opportunity for electronics manufacturers in Japan and Korea to develop and prepare to market competitive products.

When the market opened in 1986, Motorola products were the most sophisticated products available, with a wide variety of features and models. However, Motorola products had more field quality problems than the less glitzy Far Eastern made products which were priced lower. The market chose the more reliable, lower cost products, and Motorola faced a moment of truth.

Our choice was clear. We could move the factory to the Far East in search of lower cost labor and higher quality product, or we could adopt a transformational strategy throughout the entire cellular telephone development, manufacturing and distribution organizations that would allow us to build competitive products in the United States.

Fortunately, we had been in the process of researching best-in-class manufacturing capabilities around the world and had already established a Motorola Manufacturing Institute to teach our senior operations management better ways to organize and manage their factories.

What was needed was a complete socio-technical system redesign that would challenge most of the assumptions on which traditional factories had been built. Technical system changes included redesigns of the products and the manufacturing processes to ensure quality and manufacturability in every feature. Statistical process control techniques would be used throughout the manufacturing process. The separate inspection function was replaced by self inspection procedures where every operator became responsible for their own quality and the quality of all prior operations. Job grades were redesigned, and certification criteria were established so that compensation could be tied to knowledge and performance. Social system changes included establishing strong partnerships between development, engineering and manufacturing, with Motorola's suppliers and with the employees themselves. Information on the current predicament, the risks associated with this transformational strategy and the alternative of having the factory go offshore were freely shared. The primary driving factor in the organization became the pursuit of perfect quality. The existing five layers of factory management were collapsed into two layers, making communications and decision making faster and more efficient. Employees were cross trained and certified on a variety of jobs. They participated in daily problem identification and problem solving activities. They collected and analyzed quality data and performed much of the maintenance on their own equipment. All of these changes were designed to enable us to achieve competitive

parity on the manufacturing floor and to allow us to satisfy our customer's requirements for high quality products at competitive prices.

One unanticipated glitch in this strategy confronted us as we set out to staff our new factory with people from the old factory who could work in this new environment. We implemented what we thought was a simple math assessment to determine if people could work with numbers, particularly fractions, decimals and percents, well enough to learn to collect process control data. What we discovered was not only a math skill deficiency, but more fundamentally, a language skill deficiency. More than half of the people in that original factory lacked the reading, math and English skills we needed in the new environment.

The Motorola cellular telephone story has a very happy ending. We did staff that factory with people who had the necessary basic skills, and we have continued to train and educate them. We screened internal and external applicants to ensure that they had the skills. Employees who lacked the requisite skills went to in-house classes put in place to develop those skills. The result has been an extremely productive manufacturing capability that produces electronic products with world class quality and low cost. The most interesting outcome is the leverage that the social system changes had on the technical system's projected results.

Industrial engineers are very good at predicting the output of a system based on its technical components. They predicted the output of our redesigned factory system. With the system changes and skill upgrades in place, that factory is 500% as productive as the original predictions. The impact of that improvement on business performance is visible in the ongoing expansions of our Illinois telephone cellular operations and the establishment of similar factories in the United Kingdom to serve the European market. Today, Motorola is the worldwide market leader in both cellular telephones and base station and switching equipment.

Obviously this successful transformation of our cellular telephone operation has caused the corporation to examine all its other business. In fact, most of those examinations were going on concurrently with the cellular telephone changes. One compelling truth has emerged: Total Customer Satisfaction must be our one fundamental objective, and those customers expect virtual perfection in all of our products and service.

As you may know, Motorola won the *Malcolm Baldrige National Quality Award* in 1988. That was the first year the award was granted. This award is intended to be a "Nobel Prize" of sorts, similar to Japan's Demming Award. Our success in cellular telephones, as well as similar efforts in all our other businesses, won that recognition. The key for us has been what we call our Six Sigma Initiative. "Six sigma" is a statistical term that represents 99.99996% perfection. Another way to state it is 3.4 defects per million opportunities. That is our goal in everything we do, to achieve six sigma across the board by 1992.

For those of you who are a bit more technical, let me explain this

concept in terms of the bell shaped curve from statistics. Plus or minus six sigma from the mean of that curve represents all but 3.4 of a million opportunities, or 99.99996%. Products and services designed to a six sigma standard will be perfect quality 99.99996% of the time even when we allow for the normal variation which will inevitably occur in any process.

By way of comparison, four sigma is better than 95% good, but it represents 6,210 defects per million opportunities. We live in a four sigma world. We are not used to perfection. Restaurant bills, prescriptions written by doctors, orders being entered for goods or services are all four sigma processes. Commercial airline safety in terms of flights taking off and landing with no injuries or fatalities is a six sigma process. Why? Because none of us would fly if the record were any worse. And yet the process of designing, building and flying airplanes across the country is a much more complex process than any of the four sigma ones noted earlier. The difference is in the importance of the process and the way people pay attention to it. In contrast, the information distributed by the Internal Revenue Service in its phone-in service for tax return preparation is only correct about half of the time, and that makes it a two sigma process.

The reason for including this discussion of our Six Sigma quality initiative in a presentation on people as a renewable resource is that people are the key to achieving that goal. Quality improvements are dependent upon improving the skills and knowledge of the people responsible for the quality of products and services. At Motorola that means every employee. Those quality improvements, we have found, are the key to productivity and cost improvements as well. Most importantly, they are the key to achieving our fundamental objective, Total Customer Satisfaction. It is customer satisfaction that will ensure the ongoing success and viability of the enterprise.



