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A Road Map for Human Resources Development to Meet the Requirements of the U.S. Manufacturing Industry by 2005

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A ROAD MAP FOR HUMAN RESOURCES DEVELOPMENT TO MEET THE REQUIREMENTS OF THE U.S. MANUFACTURING INDUSTRY BY 2005

By
Col Scoop Cooper and Lt Col Elaine Parker

While there are many industries important to our nation, the manufacturing industries are particularly critical. Today, they are being challenged because of the growth and success of international competitors. This paper focuses on related U.S. human resource implications. It addresses several crucial work force issues: What types of industrial jobs will exist in the future? What skills and training will be required in the manufacturing sector? Will our people have the skills needed to sustain the industries that underlie our nation's economic strength?

This paper begins by describing the 18 to 25 year old cohort as of 2005. We address trends in the skill levels of this group, along with an anticipated outlook of the manufacturing industry's work force requirements. Next, to show greater specificity, our research focuses on the aircraft industry. Examples and implications involving the loss of industrial international competitiveness are also included. Finally, as proof of fundamental U.S. education capabilities, we outline existing U.S. military training strategies.

To remedy the human resource deficiencies noted, we propose significant revisions to our country's education system. Our intent is to insure an adequately trained U.S. work force will exist in the 21st century.--Education is the key to the continued viability and competitiveness of the U. S. manufacturing industry in a global economy.

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"More than 20 million new jobs will be created before the new century unfolds and by then our economy should be able to provide a job for everyone who wants to work. We must enable our workers to adapt to the rapidly changing nature of the workplace. . ."[1]

President Ronald Regan
State of the Union Address
January 27, 1987

"What is the vision of our New Covenant?
An America with millions of new jobs in dozens of new industries moving confidently toward the twenty-first century. An America that says to entrepreneurs and business people: we will give you more incentives and more opportunity than ever before to develop the skills of your workers and create American jobs and American wealth in the new global economy. But you must do your part: you must be responsible."[2]

Gov. Bill Clinton
Democratic National Convention
16 Jul. 1992

These remarks are more than political rhetoric. They bring to the forefront a complex, continuing challenge that faces our nation. These issues involve both industrial productivity and work force opportunities in an era of rapid technological change.

While there are many industries important to our nation, the manufacturing industries are particularly critical. They produce the supplies and equipment necessary for our industrial base and are the cornerstones of our economic vigor and our defense capability. But the manufacturing industry is changing. Some industries are migrating beyond U.S. borders looking for labor savings. Others are being challenged financially because of the growth and success among international competitors. Technological advancements are also causing long-standing methods and processes to become outdated. Similarly, demand for some manufacturing products is diminishing as federal spending is reduced and redirected.

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[1]Johnston and Packer, *Workforce 2000*, vii.
[2]Clinton and Gore, "Putting People First," 227.

These issues generate human resource questions. What types of jobs will there be? What skills and training will be required? What level of income will they produce? On another level they bring into question elements of national security interest. Specifically, will our people have the skills needed to sustain the industries that form the basis of our nation's economic strength?

INTRODUCTION

The importance of the manufacturing industry coupled with it's on-going changes and challenges make it an appropriate area of study. More specifically, the issues affecting the industry's work force are particularly suited to review. Without a clear understanding of its labor pool, any industry runs a risk of being unprepared to meet its human resource requirements. Therefore, this paper will explore the education and training levels of the manufacturing industry's work force. We will use the aircraft industry as an example of how work force requirements are changing. On the basis of those changes, we will propose an education and training road map to improve the capabilities of the U.S. human resource by the 2005.

First, as a background, we will describe that portion of the U.S. population which is entering its prime working years as of 2005. This data will focus on the 18-25 year old cohort, those born between 1980 and 1987. Next, we will explore what the education and skill levels of those workers are expected to be. From there we will review the anticipated outlook of the manufacturing industry. Included next will be projections in the level of contributions this sector is expected to make to the nation's GDP. Also, this section will present a summary of the skills expected to be needed by workers entering the manufacturing industry in 2005.

Next, we focus on the aircraft industry and use it as an example within the manufacturing world. We explore its position in the global market, look at industry productivity, and assess the impact of the changing capabilities of it future work force. Following that we turn to an international perspective and look at the education and training programs used both in Japan and Germany. Coming back to the United States, we review our military's education and training program for potential applicability to the manufacturing industry.

The analysis leads us to a proposed road map for national education reform. It is our position that revisions must be made to our nation's education system if we are to insure the viability and competitiveness of the U.S. manufacturing industry in a global economy.

U.S. DEMOGRAPHICS – A PERSPECTIVE

A Changing Population

The U.S. population is neither of static size nor composition. Both of these characteristics have the potential to affect the nation's work force; and in turn to impact the manufacturing industry. Therefore, it is important to provide a perspective on the demographics we should anticipate into the year 2005.

Birth rates. According to the *Statistical Abstract of the United States 1990* the U.S. birth rates per 1000 over the 1980 to 1987 time frame have dropped noticeably compared to the 1960 period. Specifically, in 1960 the rate was 23.7 per thousand. Averaging 1980 to 1987, the rate decreased to 15.7. In raw numbers this is over four million fewer births over the interval. In effect, by 2005 all employers will be competing for an 18-25 year old cohort that will be substantially smaller than in previous times. In fact, according to data compiled in the *Workforce 2000*

study, the nation's population and work force will continue to grow through 2005 at the lowest rates since the 1930s.

Minorities. Also of note is the evolving make-up of the U.S. population. Birthrates among black and minorities continue to outstrip whites.[3] Similarly, the rate of immigration continues to grow at notable levels. (4.7% in 1970, 6.2% in 1980 and 8.0% in 1990)[4] These statistics are not of themselves a problem. However, extensive studies do provide clear indications of social disadvantage and poorer school performance among these groups.[5]

Women. A continuing element in the work force's demographic make-up is the presence of women. By the 21st century, 61% of the working age women will be employed outside the home. While the employment of significant numbers of women is already widely accepted, the continued implications of child care, two-career family concerns, and equality of pay will continue to impact all industries.

Aging. At the same time more workers will be reaching the end of their working years than in previous periods. "By 2005 one out of every seven workers will be 55 or older versus one out of eight in 1990. Moreover, the number of workers under age 35 will drop from 46% to 38% of the work force by the turn of the century."[6] Clearly, our 18 to 25 year olds will become a sought after resource. The cumulative impact of these demographic changes underlies the educational environment we will discuss next.

Expected Educational Capabilities

Young adults entering the work force today and children currently being educated in the American school system provide an excellent predictor of the caliber of worker we can expect by 2005. In fact, those students beginning school in 1993

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[3]Bureau of the Census, *Statistical Abstract of the United States 1990*, 65.
[4]Vernez and McCarthy, *Meeting the Economy's Labor Needs Through Immigration*, 17.
[5]Johnston and Packer, *Workforce 2000*, 90.
[6]Johnson and Linden, *Availability of a Quality Work Force*, 10.

will be 18 and should graduate from high school in 2005. Most of them will then begin their working career--certainly many will enter the manufacturing industry.

In fact, for the purpose of this paper we will use the premise that no major changes will occur in our country's primary and secondary education systems over the next ten years. This assumption permits a clearer picture of the educational credentials, strengths, and weaknesses to be presented. With all the 18-25 year old cohort of 2005 in our school systems by the end of 1993; it is obvious that they will be shaped by the current school environment.

Literacy. Over 80% of our 18 year olds finish high school. But employers continue to find technical job applicants lacking. For example, 57,000 hopefuls were tested to find 2,100 qualified for entry level technical jobs with New York Telephone.[8] In reality, traditional assembly line methodologies of American industry have become a real part of our education system. Children are passed along often without really learning the lessons and skills taught. They graduate, but they are not educated. The Department of Education estimates that 25 million adults in this country are functionally illiterate.[9] In fact, other experts calculate over 17% of American 17 year olds today are similarly limited.[10]

U.S. Students Anchor The Bottom On Most International Tests (Algebra Results for 17-Year-Olds)[7]

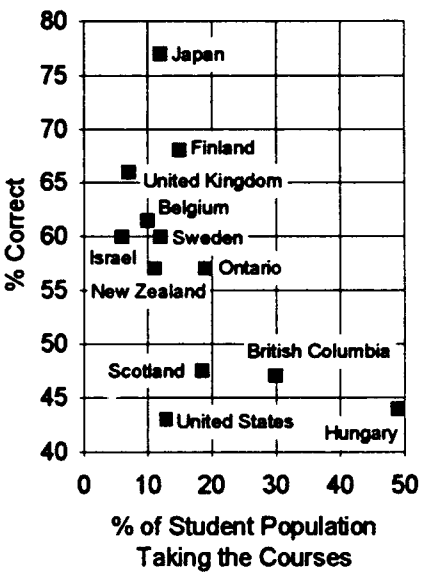

Figure 1

[7]National Center on Education and the Economy, *America's Choice: high skills or low wages!*, 43.
[8]Ibid., 23.
[9]Dept. of Education, *AMERICA 2000*, 16.
[10]Reich, *The Work of Nations*, 227.

Skills. Even those considered literate by today's standards are all too frequently found lacking in the industrial work place. Reading, writing, math skills, and problem solving inabilities are not uncommon. Researchers compiling the *Availability of a Quality Work Force* report surveyed 406 U.S. companies. Their responses indicate that 50% of all high school graduates applying for entry level positions cannot meet basic skill requirements.[12] By 2005, when the number of new work force entrants has declined (as previously discussed), this situation changes from simply a hiring complication to an actual problem. Even expected corporate downsizing will not preclude it. Bottom line: (We are assuming no significant changes are made in the U.S. education system.) Industry will face an incoming work force significantly unskilled in the basics and unprepared for the technologies of the 21st century.

Education Required for Today's Jobs[11]

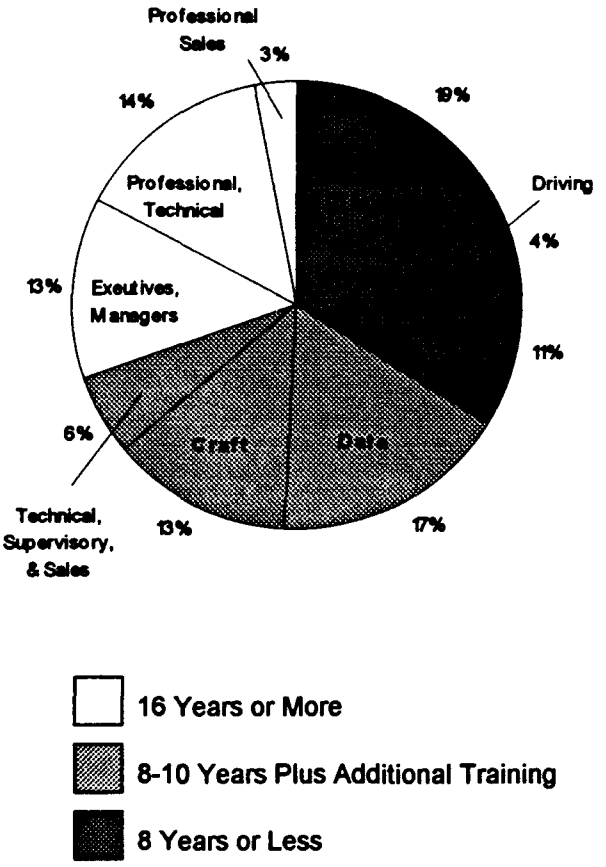

Figure 2

[11]National Center on Education and the Economy, *America's Choice: high skills or low wages!*, 27.
[12]Johnson and Linden, *Availability of a Quality Work Force*, 16.

MANUFACTURING INDUSTRY ANALYSIS

Post World War II Factors

Today this nation leads the world in total productivity. But other countries, most notably Germany and Japan, now enjoy a productivity growth rate that exceeds ours. Why? According to the MIT Commission on Industrial Productivity, this situation reflects the realities of a changing world. Global rebuilding after World War II gave the United States a phenomenal advantage; time permitted others to catch up. The commission identified five pillars for our post World War II global primacy.

- The American market was eight times larger than the next largest market.
- Technologically, America was superior. (We had not suffered the devastation that Japan and Europe had.)
- American workers were, on an average, more skilled than those of other nations. (In the post war years our veterans benefits provided unprecedented educational opportunities that resulted in a well-trained industrial work force.)
- The U.S. was far richer than other nations.
- American managers were considered the best in the world.[13]

By the mid 1950s these factors gave the U.S. manufacturing industry a dominance that seemed impenetrable. Unfortunately, recent history has shown the extent by which our World War II advantages have been diluted by a lack of planning, commitment, and investment.

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[13]Dertouzos, Lester and Solow, *Made in America*, 23-24.

Changes in the Manufacturing Sector

The U.S. manufacturing industry's position has diminished over the past 50 years. At its pinnacle in 1955, the U.S. dominated the world in the production of manufactured goods. Over the decades, the industry began to loose ground to global competitors who increased in number and productivity, and who gradually increased their international market shares. In fact, Japan and Germany are now two of the world's manufacturing powers.

From a U.S. perspective, the manufacturing industry's economic activity has declined. Over the last ten years, its GNP contribution has moved into the 20 to 25 percent range In addition, the *Workforce 2000* report projects continued reductions. It estimates only a 17 percent GNP contribution by the year 2000.[14]

Despite these changes, the U.S. manufacturing industry will continue to make viable contributions to our nation's economy. And it will still be a vital element of our country's national security picture. Its monetary contribution will continue to inject millions into our economy. Even at *Workforce 2000's* projected reduced rate, it will employ millions of skilled workers. Minimum productivity (output/worker in '82 dollars) is projected to be at least 71.4 thousand dollars per worker.[15] Further, the industrial base will remain the foundation of our country's military strength. Its production capabilities will provide the military hardware, supplies, and equipment critical to military power projections. Equally important, this manufacturing industry (if properly shaped) will be the building block of any mobilization or reconstitution if it should become necessary.

Consequences

Over the years, other industrialized countries observed our manufacturing prowess and the strengths that underlay them. While our industry was satisfied to

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[14]Johnston and Packer, *Workforce 2000*, xvii.
[15]Ibid., 54.

enjoy its advantages, their industries evaluated our strengths and emulated them. Today, many have reached a superior position over some sectors of our manufacturing industry.

There are many reasons for this change.

- In rebuilding a bombed out infrastructure Europe and Japan had the opportunity to build new, more modern and efficient plants and equipment.

- Of necessity they planned for long-term success while we were content to look at the near term and enjoy the status quo.

- Our manufacturing industry never developed a strategic plan. (They failed to analyze what it would take to sustain their world dominance. And therefore, they failed to adapt to meet the international challenges.)

- Finally, the re-industrializing nations recognized the long term value of an educated, skilled work force. (Today our country's elementary, secondary, and high schools rank low among those of the world's industrialized nations. They were once the best.)[16]

Obviously, the U.S. manufacturing industry had no control over some of the above occurrences. However, there are elements that developed largely because of U.S. manufacturing industry neglect. Still others can be moderated through involvement or corrective action in the near future.

Most importantly, our manufacturers need to develop long term industrial policies--goals or road maps for success in global competition. A critical element of this kind of plan must be to address the human resource issues. As plants grow increasingly sophisticated, workers must be capable of adapting to these changes. The education and entry level skills of today's young work force are not always up to that challenge. The demographics indicate the situation will only get worse as the current work force ages and retires. Clearly it will be in the manufacturing

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[16]National Center on Education and the Economy, *America's Choice: high skills or low wages!*, 43.

industry's interest to involve itself and ensure the that future work force has the necessary academic education, practical training, and general skills needed. This condition can be most readily recognized by evaluating one specific industry. For this reason, we have chosen aircraft manufacturing (Standard Industrial Code 3721).

AIRCRAFT INDUSTRY ANALYSIS

As shown above, manufacturing plays a key role in both the overall gross national product for the United States and in the overall productivity of our work force. We recognize that the U.S. aircraft industry is currently in a short-run or cyclical decline. However, it retains a potential for tremendous long-run expansion and growth through international competition. To insure its capability to expand, the aircraft industry must ensure that its human resources are fully able to handle the demands of the future work environment. In addition, the human resource challenge facing the aircraft industry is comparable to those of other manufacturing industries. Therefore, for our purpose, the aircraft industry serves as a viable example from which to examine work force education and training needs and from which to base proposed human resource improvements. These will follow in a later section of the paper.

In this section we will attempt to address key questions such as: What is the overall character and forecast for the industry? What will the impact of these changes be? Are there unique trends or developments that point out either strengths or deficiencies in the way human resources are trained and allocated in the industry?

Current Status

The U.S. aviation industry, still the global leader, is a critical part of this country's domestic and export economies. In 1991, aerospace ranked sixth in value of shipments and fourteenth in employment among all U.S. industries. It contributed about one percent of the GDP net balance of trade--the largest of any manufacturing industry. As stated in the MIT manufacturing industry study, *Made in America,* the aircraft industry now contributes over 3.6 percent of our overall national manufacturing value added and 3.3 percent of our overall manufacturing employment.[17] More importantly, the aircraft industry is the nation's leading exporter of manufactured goods, sending abroad products worth $43 billion in 1991 to 135 countries around the world. The industry produces the largest trade surplus of any U.S. industry ($30 billion in 1991). It accounts for more than 25 percent of all the nation's research and development expenditures, making it the country's leader in R&D spending on new technologies[18]

Background

It is important to note that (in the post World War II period) our aircraft industry grew up out of a close relationship with government. Military aircraft development financed research and development that could often be carried over into commercial products; for example the Boeing 707 began as a military transport. Another inherent advantage of the industry was that the market for commercial aircraft was largely located in the United States so suppliers and users worked together as though they were in the same industrial group. Competition took the form of technological leadership and during the '50s and '60s commercial aircraft became the nation's single most important export. This expert status actually continued throughout the '70s and into the '80s.

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[17]Dertouzos, Lester and Solow, *Made in America*, 8.
[18]Dept. of Commerce, *U.S. Industrial Outlook*, 20-1.

Future Trends

The industry is undergoing dramatic changes. As a result of a weak global economy, increasing international competition, and defense industry cuts, shipments (in constant dollars) will decline in 1993 for the third year in a row. In the past, significant growth in the civil sector sustained the aerospace industry during periodic downturns in defense spending. Between 1985 and 1991, while defense aerospace shipments were declining at a rate of approximately two percent per year, commercial aerospace shipments increased more than 11 percent per year. In 1991 civil orders represented 65 percent of the industry's total order backlog, up dramatically from 37 percent in 1985.[19] Steady sales of large commercial transport aircraft led this growth.

In spite of that, throughout the past decade, the financial performance of the industry lagged behind that of other U.S. industries. In 1991, the industry as a whole exhibited an overall decrease in its percent of equity from an all time high of 16.0 in 1981 to 11.5 in 1990.[20] According to the Aerospace Industries Association (AIA), the profitability of aerospace companies involved in the defense sector fell by more than half in five years--from a return on sales of five percent in 1985 to just two percent in 1990.[21]

The decline in shipments and profitability have already been reflected in the workplace. Between 1989 and 1992, total aerospace industry employment declined at an average rate of almost 6,200 jobs per month. Production workers employment dropped four percent in 1992.[22] Capacity utilization for the industry, as calculated by the Federal Reserve, fell from 85 percent in mid-1990 to only 69 percent by July 1992. As long as capacity utilization remains low, prospects for employment trends

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[19]Ibid., 20-2.
[20]*Aerospace Facts and Figures*, 157.
[21]Dept. of Commerce, *U.S. Industrial Outlook*, 20-2.
[22]Ibid., 20-2.

to stabilize or improve are poor.[23] However, when recovery occurs (long-range) the work force must be capable of handling the increasing technological mandates of the work place.

Human Resources Impacts in the Aircraft Industry

Industry assessment. Our research has made it clear that the aircraft industry is not using industrial assessments, or long-term plans, that address human resource issues. Instead, they are focusing on the near term people problems--cutbacks, health care costs, and the like. This is understandable given the current downturns being experienced throughout the industry. However, this lack of a long-term strategy could seriously impact competitiveness by the year 2005. Aircraft industries may not be able to get enough of the right (educated and trained) people to accommodate a growth cycle.

Lack of skills planning. Currently, there is a lack of fundamental understanding of the aircraft manufacturing process and skills requirements. Of the major aircraft producers polled by this research team (including Boeing, McDonnell Douglas, General Dynamics, and Northrop) not one single personnel or human resources department stated that they had a comprehensive document or plan for the skill development of their work force on the manufacturing floor. Interestingly, of the so-called non-major or second tier manufacturers only one firm, Vought Aviation, demonstrated any expertise and interest in a dialogue on the future skill requirements of the aviation industry.

To insure that no specific contractor was left out, we also contacted representatives from the Aerospace Industry Association (AIA). In a recent interview with Mr. Dan Naver, Vice President for Human Resources at AIA, he stated that currently no firm has documented skill requirements definitions. He

[23]Ibid., 20-3.

cited several reasons for the shortfall in this area. These included adverse legislation and regulations that require manufacturers to only request information from employees that directly relates to skill requirements. (Anything more cannot be defended in court.) He claims that this outside limitation serves to further "dilute the skills of the work force" and imposes further limits on aircraft industry management. An additional factor, he stated, was that a high school diploma is almost meaningless. It provides no clear gauge of the knowledge or skill levels possessed by job applicants.

The education crisis. The plight of our educational system is now widely recognized as a threat not only to the status of the aircraft industry, but to our nation overall. Lester Thurow, in his book, *The Zero-Sum Solution,* states that, "In a national assessment of mathematics abilities only 17 percent of the thirteen-year-olds and 29 percent of the seventeen-year olds could correctly answer the question 'George had 3/4 of a pie. He ate 3/5 of that. How much pie did he eat?' In an international study of mathematics ability for eighth and twelfth graders, . . .the eight graders ranked in the bottom tenth internationally and the twelfth graders were 'markedly lower' than the international average in all seven of the areas tested."[24] He goes on to say, "Comparison with students from underdeveloped countries were even more shocking. Iranian students passed Americans in vocabulary at age fourteen; students from Chile did so at age eighteen."[25]

The impact of deficiencies in formal education is staggering. Examples abound of how the "just-in-time" inventory system works better abroad because the assembly line workers can be taught the simple operation research techniques to learn what must be done. Foreign numerically controlled machine tools can be programmed by blue-collar workers. The same cannot be said for most American

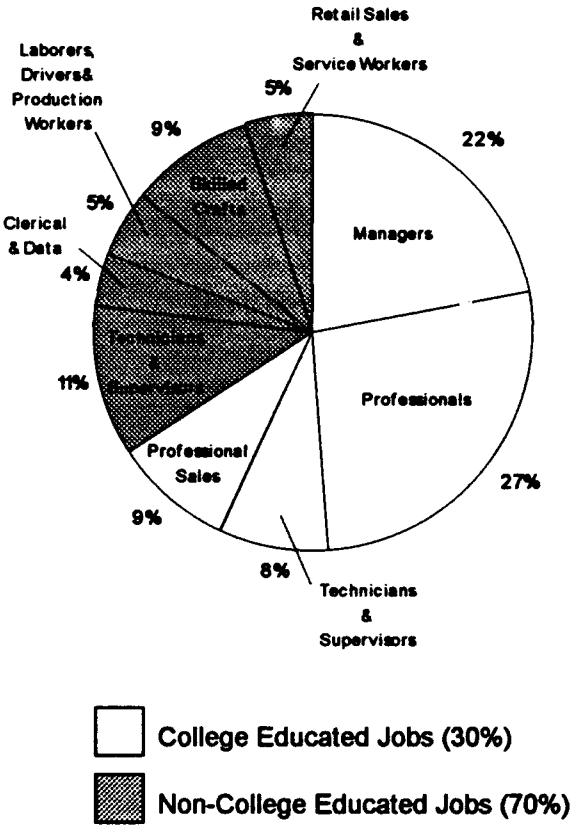
[24]Thurow, *The Zero-Sum Solution*, 184.
[25]Ibid., 185.

workers. In his paper on the "Aircraft Manufacturing Work Force 2005," Mr. Harris, Vice President for Fabrication and Controls at Vought Aircraft, outlined a training program to get his people up to speed. It encompasses teaching them the fundamentals needed to handle the programs associated with some of his more critical numerical process control machinery.[26] Experts estimate the implementation and supplemental training required to fill the basic skills gap left by our formal education system could take as much as three years. Three years of productivity loss will put us even further behind in the competitive race of global economies.

Continuing education. The formal school system is only part of the problem. American firms do not invest as much in training their work forces as firms abroad, and what they do invest is much more heavily concentrated on professional and managerial workers (see figure 3). This trend will need to be reversed to enhance possibilities for on-the-job skill training.

In addition, aviation industry officials state that one of the major problems on their planning horizon is

Two Thirds of Company Training Dollars Go To The College Educated[27]



Distribution of $30 Billion
Formal Training Expenditures

Figure 3

[26]Harris,, "Aircraft Manufacturing Work Force 2005," 2.
[27]National Center on Education and the Economy, *America's Choice: high skills or low wages!* 49.

that of the increasing age of employees vs. their skills levels. They see a "skills" gap approaching that is indicated by a large chasm of age differential on the manufacturing floor. For example, current data from Vought Aircraft division shows over 60% of their work force at age 55 or greater.[28] Based on this data, in 7 to 10 years over half of the experienced workers will be gone from the work force and there will be no chance for junior, inexperienced workers to learn by "following Joe around"--because Joe just won't exist anymore![29] Therefore, these new employees will be more dependent on formal education and training.

In summary, the aircraft industry exhibits problems common to the overall manufacturing industry. Specific suggestions to alleviate these problems will be presented in a subsequent section of this paper as a proposed road map for human resources development in the manufacturing industry.

INTERNATIONAL PERSPECTIVES ON HUMAN RESOURCE DEVELOPMENT

As previously stated, our research revealed that other nations' productivity is growing at a faster rate than ours. Assuming that they must be doing something right, in this section we will examine some of their strategies that improve competitiveness and the productivity of the work force. To aid in this process we have adopted a term from the authors of *Thinking for a Living*. The term is benchmarking: "a device that forces its users to learn constantly from the competition, from the very best in the world."[30]

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[28]Ibid., Fig. 6, 8.
[29]Thurow, *Head to Head*, 275.
[30]Marshall and Tucker, *Thinking for a Living*, 101.

Job Skill Planning - the Japanese Approach

In the years following World War II, Japan strengthened her industry base and heightened her competitive position in the world marketplace. High quality products and high productivity were the inevitable results of long-term, consistent efforts to improve product quality and production technology.

Because of their growing shortage of educated and skilled work force, the Japanese have proceeded on a course of numerical process control and automation to alleviate their shortages. In contrast to the U.S. aircraft industry, (which is largely indifferent to the skill requirements needed to perform given manufacturing tasks) the Japanese have proceeded to catalog and analyze all job skill requirements. This has been completed not only within each company, such as Mitsubishi, but also in an industry-wide basis. In the preface of the book *The Robotics Industry of Japan*, the author acknowledges the help of the Japanese Ministry of International Trade and Industry (MITI) in providing specific job descriptions and skill definitions. For example, in the book all major job categories are listed with specific task descriptions and even specific feedback loops. Because they know with a high degree of detail what their individual workers need to do (to manufacture certain items); the next step, to automation and robotics, (and therefore to higher productivity) will be easy.

Not only do the Japanese do a credible job on the Taylor-esque side of the equation (in understanding the scientific tasks and specific skill requirements of the labor force), they also have programs to educate and nurture the human side. This means that the Japanese employer is primarily concerned that the new worker be able to learn how to do a long succession of new jobs easily and well. Therefore, large Japanese employers expect to provide virtually all the vocational education that recruits need after they are hired. An example in the book *Thinking for a Living* states, "By 1992, for example, Toyota plans to put every new high school

graduate it hires for the front line through a two-year full-time course in digital electronics and mechatronics before they ever see the assembly line." According to the author, the most desirable vocational qualification is the highest possible level of "general intelligence." How students perform in school makes all the difference when it comes time to looking for a job. In a 1990 interview with the President of Mitsubishi Aircraft Division, in Nagoya Japan, he noted that the company actively hosted teachers from the local high schools and educational institutions.[31] The company wanted to know how each applicant performed in school; and they listened to the recommendations they got from teachers and principles.

So here we have two very significant benchmarks--first of all, Japanese skill training is based on industrial standards and planning. That plan, laid out and updated by the Japanese Ministry of International Trade and Cooperation (MITI) includes the human resources needs and forecasts for the upcoming century. The second significant observation is that the skill requirements and needs of the industry are always fed-back to the local educational authorities. They know what industry and society needs, and they insure it is integrated in the academic curriculum. Let us now look at another significant benchmark--one of the most diverse and excellent educational systems in the world.

An Education Alternative - The German Model

Germany has one of the most successful educational systems in the world. The average German starts school at a very young age, usually 5 years old. They begin normally in state supported Kindergartens or pre-schools that are geared to the academic fundamentals of basic reading and principles of mathematics. This is in contrast to our system in which early education consists of organized play. Thereafter, our system parallels the German model until age 10. Then the teacher,

[31]President of Mitsubishi Aircraft Division, Interview with author (Cooper), Nagoya, Japan, June 1990.

parents, and the students make a collective decision on which of many educational paths the child will proceed. One way leads to what is called the "Gymnasium" and is culminated in a series of day long oral exams administered by a panel of local and state instructors in the subject area tested. Successful completion of these exams results in an "Abitur" or certificate of accomplishment and graduation at age 19-20 after 13 years in school. The "Abitur" is roughly equivalent to an associate degree in the United States. This path is pre-university in the German system. Admission to German University or "Universitat" is based solely on high school GPAs that are ranked throughout the nation. Those with high GPAs and interests in an advanced degree in aeronautical engineering will have the option to attend Stadt-Universitat Freiburg, for example.

There are however, many other paths available for the typical German student. For example, the parents and teachers may elect to place "Johann" in the technical work skill path that will result in attendance in the "Berufsschule" or "Realschule." The key factor to note is that in each case these paths require private sector involvement in some form of apprentice or part-time education or work-school program.

These programs, although sponsored by local governments and "Staats" are directed toward national goals and requirements. Currently, Germany's joint government-industry apprenticeship program trains 65 percent of the country's work force in 375 occupations. In addition, businesses pump two percent of their payroll into this apprenticeship program, although there is no guarantee that any specific apprentice will work for that firm after completion of training. German companies put up about 40 percent of the cost of training schools; the government pays the rest.[32]

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[32]Fisher, "German Job Training," A33.

Another interesting factor is that even though a decision is made very early in a child's career, the education system is very responsive to student needs and changes in aptitudes. Transfers from one track to the other are both frequent and expected. In addition, students in "Gymnasium" are expected to fail or be put back at least one grade in the course of their high school education. There is no stigma attached to this event and the student only progresses after successful demonstration of the competencies required for the next grade level. The result is a much more diverse and highly trained work force ready to command higher level wages in a much more globally competitive environment.

PERSONNEL PLANNING – A MILITARY VIEW

It is not uncommon to hear that the basic American culture (characterized by impatience, the need for immediate gratification, and a self-serving mentality) inhibits the commitments needed for improved education and training. We are convinced that's not true. The U.S. military has extensive and highly successful education and training programs. Their effectiveness is proof Americans can handle this type of challenge and it's another example to draw on.

Personnel management in the military infrastructure is almost a "cradle to grave" undertaking. It is a completely integrated, long-standing element of military work force management. It encompasses traditional education and skills training activities. Plus, it includes on-going, environmentally unique, professional development programs. This long standing effectiveness also can serve as a baseline for our manufacturing industries to consider as they face the human resource challenges of the 21st century.

Academic Environment

High School. Beginning in high school the military sponsors or assists with Junior Reserve Officer Training Corps (Jr. ROTC) Programs. Though no military commitment is involved, the basic military orientation these youngsters receive begins their understanding of the military world. If they later choose to enter the military, this program can earn the young man or woman a going-in promotion over other recruits.

Collegiate. College ROTC and general scholarship programs permit graduates to enter the military as commissioned officers. Similarly, the various service academies graduate young men and women with strong academic and military training to serve as newly commissioned officers. Whether as physicians, pilots, or scientists (among others), graduates then reimburse the government by serving as commissioned officers in the military.

Other programs also exist. The various services operate Officer Training or Officer Candidate Schools. Here college graduates apply for approximately three months of military training. Upon completion, they, too, then enter the commissioned force of the military services.

The keys behind the effectiveness of these diverse programs are two fold. The first is to meet the needs of the military service. Applicants are sought and selected to meet expertise requirements of the military. Second, it is a competitive process because there are more applicants than requirements. Only the most promising are selected.

Skills Training

The military's need for a skilled work force is at least as great as that of industry. The ability to drive a private automobile doesn't mean someone can operate or maintain an M-1 tank. In fact, virtually all entry-level positions within the military's work force require initial formal training. Supplemental, advanced,

and refresher training are equally vital and are specifically programmed to occur through a military member's career.

The services conduct skills training both in specialized, formal schools (akin to vocational programs) and in on-the-job training programs. Initial skill level proficiency is normally earned in a resident, full-time training program Supplemental and advanced skill levels are attained subsequently either through on-the-job training or at formal schools. Regardless of the completion method, military personnel receive refresher/update training on a recurring basis.

First line supervisors are held accountable for their subordinates' progression and timely completion of qualification training. If a technician or specialist is found deficient in a skills area certified by the supervisor--it is the supervisor who is first called to task. As a result, skill levels are credible and are awarded only as proof of complete task mastery in areas of active responsibility.

The importance placed in the military's skills qualifications can best be seen in its promotion systems. Enlisted personnel cannot advance in rank until specific skill levels are attained. Officer competency is measured as a part of overall career field performance and professionalism.

Professional Development

The services want their career work forces to become more knowledgeable of the overall military environments and infrastructures. So they've created schools to expand military member's knowledge beyond their skill specialty. They begin after initial enlistment or contract obligations are completed. In addition, since leadership and supervisory roles grow as one moves up in seniority, these professional development programs incorporate significant material in these areas. Fundamentally, the overall professional development effort exists to assimilate trained personnel into the "corporate environment." In effect, its purpose is to develop informed, committed, career "team players."

Perspective

The military's commitment to training is fundamentally self-serving. It ensures that the services have consistently trained, competent workers. In turn, they form the building blocks for the military war fighting and war sustaining capabilities. Without this human resource base, the services could not fulfill their role in national security requirements. In addition, military personnel returning to civilian life create a spill over effect. These workers are more educated and better prepared to contribute to society.--It's reasonable to say they will add to our nation's GDP.

On a different level, the same perspective should exist within the manufacturing industry. Whether growing or shrinking, they must have a competent, reliable work force. Otherwise industry's ability to produce (and, in turn, to economically survive) could be jeopardized. This equates to planning.

Competent employees must be sought and, if not available, must be trained. Once employed, workers, and supervisors need to continue to expand their skills--or at least be prepared to adapt to changing, often more technical, work environments. This could be refresher training or even retraining to meet evolving industrial work force needs. The specific requirements are as varied as the industries operating throughout our country and must be tailored to meet the specific industrial needs. This means industries should out-reach to our country's educators and identify their expected work force educational requirements.

There are innumerable possibilities. From consultation to actual program operation, small and large industries should help shape the capabilities of the 21st century's work force. In addition, educators must be responsive and responsible for insuring our children are educated not just passed along. These concepts form the basis of our plan to improve the work force expected to exist in 2005. We call it a road map for human resources development.

A ROAD MAP FOR HUMAN RESOURCES DEVELOPMENT

> *"No nation can achieve greatness unless it believes in something--and unless that something has the moral dimensions to sustain a great civilization. The release of human potential, the enhancement of individual dignity, the liberation of the human spirit--those are the deepest and truest goals to be conceived by the hearts and minds of the American people. And those are ideas that can sustain and strengthen a great civilization--if we believe in them, if we are honest about them, if we have the courage and stamina to live for them.*[33]
>
> --John Gardner

Based on the aircraft industry example, clearly the manufacturing industries are facing growing challenges with the competency and productivity of their work force. Human resource planning needs renewed emphasis and commitment. As Mr. John Gardner so eloquently stated, greatness takes effort--effort to develop and enhance the individual's worth. That premise forms the linchpin of our proposal. For, if our people are not well prepared and well trained, they will not have the confidence or capability to handle the technical challenges of the 21st century.

Therefore, we submit that if the U.S. intends to remain a first rate nation in manufacturing, then key areas, such as nation-wide education and on-the-job work skills need to be revitalized. We are convinced that achieving these goals is a two-stage, public and private process. Accordingly, we have developed a proposed strategy. If followed, it should, by 2005, put the nation well on its way to ensuring the effectiveness and preparation of the work force. Our proposed strategy focuses in two main categories: education and on-the-job training.

Educational change and reform will require effort along the entire spectrum of our work forces' life span from infant to adult. Its fundamental premise is a lifetime of education provided by government and by industry. The on-the-job training portion of the strategy will address what the trained and skilled worker

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[33]Marshall and Tucker, *Thinking for a Living*, i.

can expect both in and out of the work environment. Overall, we believe this strategy should include the following five basic elements:

1. A periodic assessment and forecast of the status of the manufacturing industry should be performed.

2. Broad skill requirements for key manufacturing industries should be identified.

3. Those skill requirements and manufacturing industry needs should serve as one of the foundations of a new educational policy.

4. The U.S. government should work with industry to create and implement active worker training plans.

5. American manufacturing industries should provide feedback to these planning and policy areas in terms of work skill requirements and changes.

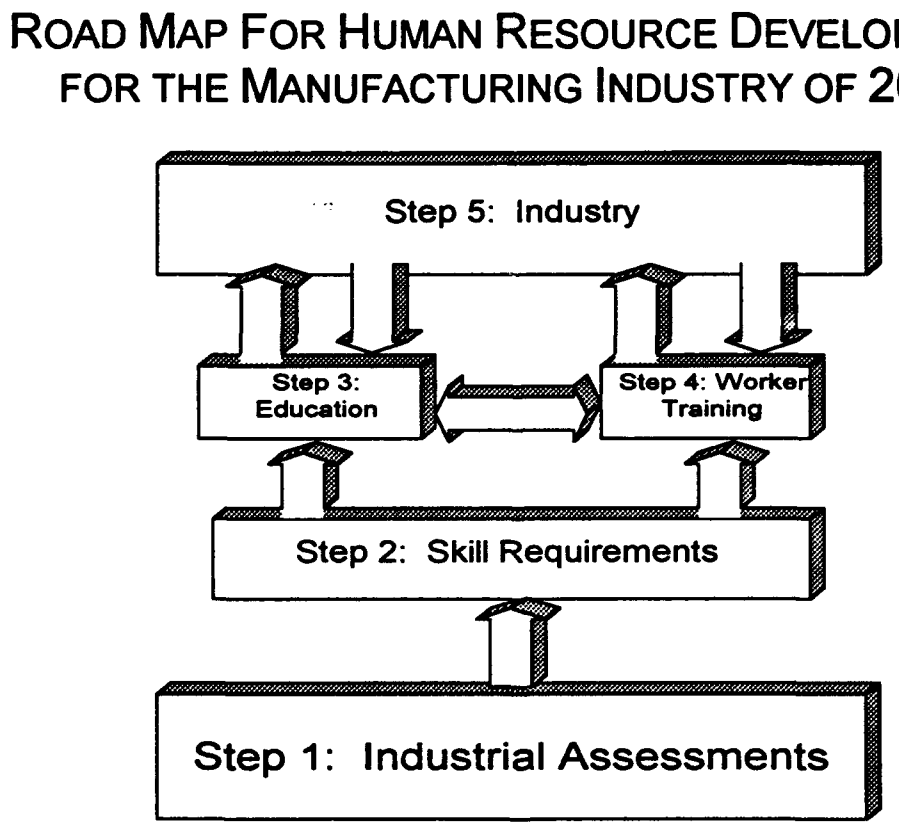

Figure 4.

Step 1–National Industrial Assessments and Forecasts

Before we can solve our productivity shortfalls and increase our competitive position in the global marketplace, we first need to assess the state of our industries and the health of the workforce. We already have the mechanism in place that accomplishes these prerequisites. The Bureau of Labor Statistics (BLS) has worked for considerable time to accumulate not only basic unemployment figures, but also the demographic profiles and forecasts of the national work force. Presented in documents such as *Outlook 1990-2005*, their data includes comprehensive information on the current status and trends evident in the manufacturing industry. Every other year the BLS develops three alternative industrial forecast projections based on the U.S. economy.

Using low, moderate, and high economic growth assumptions, the BLS examines the important implications flowing from these projections. They include (1) education and training needed for the projected jobs, (2) variation in job opportunities for those with different levels of education (3) the range of the three alternatives prepared by BLS to include employment and other implications, and (4) the changing race, age, and sex mix of the labor force.[34]

This data and the assessments provided are very powerful tools for the government and industry to use in developing policies, goals, and decisions for the coming century. They could fuel a broad spectrum of government and industry actions. In a "hands-off" environment, the assessments would provide private and public sector managers in industry and education with future trends and tools to assist their decisonmaking. In a more "hands-on" environment, these assessments could help government decisionmakers create a coherent and cohesive national economic and education strategies. From either perspective, using the BLS

[34]Bureau of Labor Statistics, Outlook: 1990-2005, 1

assessments offer a sound departure point on which to build a revitalized education system.

The credibility of using the BLS assessments to begin our road map is reinforced in their current findings. Their data shows that the areas of fastest job growth favor those with the highest amount of post-secondary training and education. The risk of unemployment for high school dropouts and the undereducated is growing and will continue to grow.[35]

Step 2–Establish Broad Skill Requirements for Key Manufacturing Industries

Based on the results of the assessments described above, the next step should be the establishment of industrial standards and skill requirements. Before we can embark on a redesign of the education system we need industries' involvement to articulate the specific skills needed to compete in the coming century. Based on the example presented previously, the aviation industry is pre-occupied with its current draw down and is therefore caught in the trap of "shooting behind the rabbit." While most of their human resource and personnel departments are focused on the immediate task of massive layoffs, some forward looking manufacturing firms have begun to look to the future and the effects of their decisions in the year 2005. In effect, they are already planning for the cyclical effects of industrial change.--They are planning for growth.

Motorola Corporation is a good example. They embarked on a program of industry-job cooperation that now is a $120 million annual investment.[36] To empower this program, Motorola went all the way back to basics: Where are we and what is it we want to do? (i.e., step 1 in our road map applied in a micro scale). Armed with that information, they then proceeded to determine what skills they

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[35]U.S. Bureau of Labor Statistics, *Outlook 1990-2005*, 1.
[36]Marshall and Tucker, *Thinking for a Living*, 100.

currently demanded of their work force, and what expectations they had of the future demands on their work force. They then took the next critical step and asked the question: From now until 2005, what is the delta between the forecast (in terms of human resources) and what will be needed? By looking at the work force in the way that a business looks at any resource--as a supply or raw materials problem--they could see that delta widening. Phrased this way, this was a problem that Motorola could understand and even more importantly, could do something about. They instituted a comprehensive program to support and work with selected educational suppliers (the schools) to get the kind of resources they need to be competitive.

There are other examples of this kind of industry specific activity. One is the Corning Glass Works in Virginia. A recent article in the Washington Post, noted that a Corning interior audit of its skills requirements for the "new manufacturing worker" identified a totally different human resources requirement than what is currently being produced. When Corning selected for their new factory they picked only 150 out of a pool of over 8,000 applicants[37]. What were their selection criteria?--Increasingly, they are the same "general education" ingredients that the Japanese benchmarks have been using over the last decade!

From these examples and from the benchmarks established by our competitive neighbors, Germany and Japan, we see that the isolated successes of some U.S. firms need to be expanded across the country. Competitiveness in the global market place will only be achieved by integrating the supply side of the human resource challenge (our educational system) with the product side of technological demands in industry. In fact, by involving local education experts and teaching them what the human resource needs are, it is possible they can take

[37]Swoboda, "Corning Manufacturing Industry", H4.

the lead in improving their product--generally intelligent graduates ready for the demands of a "high tech" world.

Step 3–A New Educational Policy

Whether educators take the lead or not, our research has clearly found that there is a growing shortfall in the caliber of graduates produced in our nation's education system. (Note: We acknowledge that many bright, intelligent young men and women graduate from our schools. These are predominately our college bound students. However, the number of marginally-educated young adults is growing. The trend is in the wrong direction.) Where once we were the world's leaders in education, now we rank behind most of the industrialized world. Other nations have improved their education systems; we let ours go stagnant.

Some industries have already begun to address their work force challenges. However, we feel the only way to remedy the overall situation is a reform of our nation's education system. We see several fundamental elements in this effort.

Education testing. This is the crux of our proposal. Standards must be established that are on a par with the rest of the industrialized world. And students should be evaluated periodically. Progression (at key phase points) to the next grade or level must be predicated on demonstrated adequate knowledge in all standardized areas.

The frequency of testing is open for discussion. However, we believe evaluation at the fourth, eighth, and twelfth grades could be appropriate. These benchmarks would allow parents to make informed decisions and to plan for their children's future--much like the German system. Successful testing after the twelfth grade would serve as the qualifying criteria for what we now call a high school diploma. More importantly, it would give employers a clear reference of the knowledge level and academic base of potential workers.

Teacher accountability. Teachers must also prove their capabilities--for they shape the minds of our nation's most precious resource. Some type of general, and where warranted, specific tests should be mandated to verify teacher competency.

But compensation must accompany this undertaking. At a minimum the wages of our teachers need to be brought up to parity with that of other industrialized nations. In fact, by the mid 1980s the salary of Japanese and German teachers far outstripped the American mean ($40-50,000 vs. $30,000).[38]-- In Japanese and German society, teachers are at the top of the professional strata. They are among the most highly paid and respected professional class.

Structural changes. Simultaneously, other changes will need to be incorporated. The school day should be lengthened. And we need to follow the lead of many of our global competitors. We should increase the number of school days per year. (Currently we average 180 days per years. Other countries average 220-240.)[39] In addition, a careful review of the administrator to teacher ratios should be undertaken (in military parlance, tooth to tail) to insure we are optimizing our education investment.

Educational diversity. We currently have a fundamentally one track system. Our educators need to give as much priority to the non-college bound students as they do for those going to college. It is in this area where industry can make the greatest impact. Work study or apprenticeship type programs could be created either at the high school, community college, or vo-tech levels. Perhaps corporate employees could serve as volunteer (on-loan) faculty. Or maybe industry experts can help educators shape curriculum to ensure students learn critical skills and concepts. Tailored to specific area industries, such a program could benefit

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[38]Thurow, *Zero Sum Solution*, 195.
[39]Ibid., 193.

employers while at the same time helping make the students more competitive in the workplace.

Government involvement. From Head Start to a variety of federally sponsored programs, there is much that our government can do to enhance the academic capability of our children. Federal investments in our young would continue to have the potential for a multiplier effect. The ability to learn can be enhance by targeting assistance to the disadvantaged. And this investment can continue to pay itself back (into society) with adults who are more capable, educated, and ready to be productive members of the community. Other possibilities include school subsidies or bonuses for particularly effective school systems. Regardless of the specific action, the bottom line remains the same: Government has a significant role to play in improving the education system of this nation.

If these proposals were adopted, even gradually, the result could be an interactive relationship between industry, educators and the government. The impact would be clear--a better educated work force, one capable of taking its place in a technologically based society. It would also put us well on our way toward improved global competitiveness.

Step 4--Continuing Education in the Workplace

The other dimension in our road map that needs specific emphasis and innovation is that of skills training or continuing education. As discussed previously, we have several good examples. Our nation's challenge is to identify those benchmarks that we would want to target or emulate.

While continuing appears to address on-the-job training, the current realities of industrial downsizing necessitate a retraining aspect. There are some jobs that won't exist in ten years. For those workers they must be taught new skills (retraining) or face the prospect of unskilled, minimum wage employment.

Retraining. Retraining has several facets. First, current employees may need to update basic education skills. The valuable employee must possess sound thinking and problem solving skills. They must be able to communicate, verbally and in written form. Also, they will need strong mathematical abilities--for much of the mechanized world will be computer dominated. (By 2005, if our education reforms are introduced, young workers will possess these skills--as verified by their high school diplomas.) This refresher could be completed on company time or perhaps through corporate sponsorship.

Second, some skills will grow antiquated. To sustain productivity, even healthy businesses will need to offer retraining opportunities. In addition, those industries downsizing or even leaving business will need similar programs, but on a larger scale. Out-reach or placement opportunities can be significantly enhanced through retraining.

The scope of retraining in some industries is so large that today federal and state governments are involved. In fact, we already offer substantial retraining opportunities to displaced federal workers (caused by base closures). And these same opportunities exist for a variety of out-of-work Americans. Perhaps some thought could be given to using closed military installations as retraining centers. Coupled with existing community colleges and vo-tech programs, many displaced workers could be retrained. Another alternative, tax credits or subsidies could be made available to industries who aggressively pursue retraining rather than lay-offs.

Continuing and on-the-job education. These are largely industry initiatives since they take place during working hours. Unfortunately, it is one that many businesses have avoided because of their long-standing Taylor-esque approach to work. However, if the German or Japanese examples demonstrate anything, they show the criticality and productivity value of well-trained workers.

So the first step will involve obtaining the support and commitment of industry. Many employers have dismissed extensive on-the-job training or undertaken only narrowly focused initiatives. Why? Because they felt that investment would only be lost due to high turnovers. How can this dilemma be solved? It will take time. Initially employers will have to accept the reality of some losses. But those persons, even working for another firm, are not a loss to our economy. Employment actions will eventually "even out" as trained resources move between firms or perhaps enter the work force from the military (or other federal, state, and local trained resources)--i.e., It is not a one way street! Fundamentally, there needs to be collective interest in ensuring private (on-the-job or continuing training) takes place, where appropriate. It is the only way to sustain the overall work force during on-going, technological change.

Again, government could make a difference. By tax incentives or perhaps in developing some type of national support structure, government could encourage industry to expand these continuing education endeavors.

Benchmarks. The manufacturing environment will need a work force with reliable, consistent skills and capabilities. In the short term investment in continuing education and retraining are the best available options. (In the long run, a reformed education system is the key.) More than anything else, industry needs thinking workers. Lester Thurow captured it best. Workers must "have a conceptual grasp of the work, be able to fix problems as the need arises, rather than merely reporting them to a superior, and contribute to the continuous improvement of both the product that they manufacture and process by which it was produced."[40]

This is the benchmark, the baseline work force, that the manufacturing industry needs. The change will, for many industries, require cultural

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[40]Thurow, *Thinking for a Living*, 101.

adjustments. The expectations of non-committed (almost non-creative, non-thinking) workers must be reevaluated. Concepts such as Total Quality Management (TQM) and other employee empowering perspectives must be explored and institutionalized.

Step 5–Feedback from the industrial sector

Our proposed road map would be incomplete without a feedback process. The idea of incorporating TQM into the industrial work place is predicated on empowered employees.--Similarly, our road map is predicated on empowered industries. Our concept can succeed, only through joint effort. Industry must share the burdens of planning and executing the programs--if they are to enjoy the rewards. By working with our education systems and with federal, state, and local governments, the net result can be a productive and trained work force--one tailored to manufacturing needs. More significantly, this approach can evolve as industrial needs change. It can ensure workers are able to produce competitively in the global market well into the 21st century.

CONCLUSION

During the course of this paper we presented the demographics and future projections of the human resource base of the United States. Based on current trends and projections we explored the education and skill levels of those workers. We then narrowed the analysis to the manufacturing industry where we looked at current and future work requirements. To provide specific examples and data to support our analysis, we focused on the aircraft industry. And to compare our human resource posture, we benchmarked our analysis against the best practices of the industries in Japan, Germany and the U.S. military. This led to a proposed road map for national education reform.

The news is sobering and of high national exigency. This nation's manufacturing industry is at a cross roads. It can no longer rely on the traditional assembly-line methods. Computers and high technology have become a way of life. But to use them effectively means employees must be capable of handling them. It means the work force must be educated more technically and to higher standards. It also means that education and training are a life-time undertaking because updates, new methods, and new innovations will continue and perhaps even accelerate.

As we have attempted to show in the preceding pages--the need for skills development is no longer a narrowly localized problem that rests with the individual company or even the industry. It is a national problem that is fundamental to our society and our future lifestyles.

We are convinced that to succeed the American education system must be overhauled. High standards must be set for students as well as for their teachers. Simultaneously, industry must get involved in shaping the education process and in developing on-the-job training, continuing education and retraining. Government, at all levels, must be the conduit connecting the elements and facilitating the educational reforms critical to this undertaking.

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