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The Reluctance to Implement New Technology: Industrial Engineering's Role

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ABSTRACT

Although the U.S. has been a leader in technological development, it has fallen behind some other countries in the industrial implementation of these new methods. Recently issues of Industrial Engineering have addressed such issues as a lack of management commitment to Computer Integrated Manufacturing Systems (CIMS)I factors limiting the growth of robotics in the U.S., and the reluctance of management to implement office automation. The paper will examine these issues and present some of the published hypotheses of why industrial management in the U.S. is reluctant to accept and apply the newer management concepts and technologies. the industrial engineers* responsibility in finding areas where new technologies will result in improvements, preparing the justification, presenting the plan to management to gain their commitment, and directing the implementation will be discussed.

INTRODUCTION

Economic indicators point to the fact that the United States is losing competitive strength in a world marketplace that is highly competitive now and will become even more so in the near future. The President's Commission on Industrial Competitiveness declares there are glaring deficiencies in America's technological capabilities, and in a large part these are due to failure to devote enough attention to the implementation of new technology into U.S. industry [I.E. 1985].

The technological advantage enjoyed by America in the 1950's and 1960's has disappeared. America's position of economic superiority is now rivaled by competitors who have matched many U.S. achievements and are moving ahead of the U.S. American economists predict slow growth in productivity for the nest decade, and if present trends continue, the American standard of living will continue to fall and the U.S. will be a good candidate to join the ranks of once dominant world powers.. To compound the problem of being forced to compete to survive in a world economy, America's relative economic strength is lower than it has been at any time since World War II [Thurow, 1984].

Targeting one area of the U.S. system as solely responsible for the current problems is to ignore the breadth of the problem. The U.S. system and its historical progression should be considered and understood before problem areas can be identified and effective solutions implemented. If U.S. products are to become more competitive through implementation of new technology, all facets that support U.S. industry, including education and government, should be properly aligned to produce competitive U.S. products.

HISTORY OF PRODUCTIVITY - U.S. AND JAPAN

The American industrial revolution occurred around the late nineteenth century, and many industrial practices of that time undercut the foundations of American culture, including the work ethics of farming and living off of the land. Early abuses of workers included low wages, long hours, and dangerous conditions. These practices stripped workers of their basic human dignity, and employees could hardly be expected to take pride in their work when they had no pride in themselves [Wolfe, 1983].

Just after the turn of the nineteenth century, American productivity was given a boost when Frederick Taylor implemented Scientific Management, or the application of the scientific method to managerial problems. These methods represented coherent but dehumanizing attempts to organize factory work. The results of this practice were to dramatically increase productivity through 1970 [Buffa, 1984]. This was accomplished by the substitution of machine power for man power. Scientific Management helped productivity, but also set the stage for a long history of labor relations problems that are with industry today, and have contributed to long term decline in U.S. productivity [Buffa, 1984].

After 1970, several periods of recession have plagued the U.S. economy. Even though the U.S. has recovered from these recessions, overall productivity has shown no significant improvements. During the period from 1960 to 1980, the rate of increase in U.S. productivity averaged 2.7 percent. During the same period, Japan had an average productivity increase of 9.4 percent, and France and West Germany had productivity increases of 5.6 percent and 5.4 percent respectively [Buffa, 1984]. This loss of productivity is but one indication of the effects that failure to compete in technology implementation has in the U.S. economy.

Other factors that contribute to the U.S. economic decrease can be seen in the history and direction U.S. management and Japanese management have taken regarding technology.

The Japanese have historically been fierce competitors, and this is evidenced in their long history of overcoming adversity. During the rebuilding years after World War II, Japan became known as a exporter of low quality products. To solve this problem, Japanese industry focused on quality control techniques, many of which were taken from U.S. industry [Wolfe, 1983].

Japan's rising economy is relected in a real rate of growth, which is a measure based on technological advance. Japan's real growth can be measured by annual rate of increase in gross domestic product, and has been consistently above other industrialized countries [Peck and Toto, 1982]. This consistent growth and sustained leadership is a good indication of how Japan has implemented technology better than other nations in the comparison, including the U.S. [Peck and To to, 1982]. Focusing on specific areas of Japan's strategy and policy may be helpful to identify problem areas in U.S. technology and industry.

Key areas in Japanese industry that directly effect application of technology include balance of trade, research and development (R&D) spending, technology importation and wage and management systems. A larger fraction of Japan's R&D effort is funded by the private sector of their economy than most industrialized nations, including the U.S. Also, in terms of pure spending, real levels of U.S. R&D spending have declined by 2% since 1970, compared to Japan's which has increased by 17% in the same period. Japanese R&D expenditures are allocated thru competitive private sector markets, and the nature of this competition is to produce a better product, in contrast to U.S. R&D spending which is mostly funded by the federal government (and unimproved by lack of competition). In Japan, the risk inherent in expensive R&D efforts is also eased by Business Groups, or groups of companies that have valuable technology distributed among them, and the risks are distributed as well.

Japan is uniquely suited to take advantage of imported technology with a highly skilled and flexible labor force, a good supply of managers, scientists, and engineers, and the ability to implement technology to their advantage. Through imported technology, Japan avoids the high risk and cost of initial development [Peck & Goto, 1982].

The steel industry provides a good example-of how Japan seized upon the latest technology and why the U.S. is having economic problems. Even though established U.S. producers of steel had much greater experience than the Japanese and Germans, and should have been unbeatable on a cost basis, approximately 200 U.S. steel firms have closed. A large portion of U.S. steel is made in open hearth furnaces. This differs from Japan and Europe, where they use primarily oxygen and electric furnaces (much improved over open hearth). U.S. steel makers have neglected to convert to continuous casting as the Japanese and Europeans have done. These processes improve product yield, cut energy use, and increase labor productivity. Twenty-six percent of U.S. steel is continuously cast, versus 86 percent in Japan and 61 percent in Europe. A clear disadvantage for the U.S. [Buffa, 1984] and questions arise as to why. This can be answered in the context of labor, management, government, and social structure differences.

CURRENT U.S. PRODUCTIVITY AND ECONOMIC EFFECTS

The U.S. no longer has a self sufficient economy where labor, management, and government can abuse each other and not feel the effects rather quickly. The U.S. is being forced to compete in world markets, and this open trade will not support the costs of inefficient productivity. As evidence, total imported goods now account for 19 percent of U.S. consumption, up from 9 percent in 1970. The U.S. imports 28 percent of its cars, 18 percent of its steel, 55 percent of its consumer electronics products, and 27 percent of its machine tools. Japan was the first country to challenge U.S. products, and now countries such as South Korea, Taiwan, and Singapore are beginning to impose on U.S. markets [Alexander, 1483].

Differential labor rates are a prime reason for imports. For example, average labor rates are less than two dollars in South Korea and Taiwan, compared to $7.53 in the U.S. (May 1983) [Alexander, 1983]. Why are U.S. workers paid more, yet productivity is lower? According to James Harbour, auto consultant in Detroit, a good example is that better factory layouts and more flexible use of workers enables Japanese automakers to assemble a car in 15 man hours versus 30 man hours in the U.S. [Buffa, 1984].The blame here seems to belong to American management.

To further emphasize that U.S. manufacturing and management are to blame for the lack of technology implementation, consider foreign cars produced in the U.S. These cars typically have manufacturing costs two thousand dollars higher than their foreign counterparts. Due to the inefficient technology used in production, these situations are typical of how American industry is being forced to, catch up with world industries [Buffa, 1984].

Over the past several decades, U.S. management has shifted its focus from the production function to a marketing and finance orientation. During and just after World War 11, and U.S. had no rivals in manufacturing capability and productivity. Due to this lack of global competition, American manufacturers put increasingly more emphasis on business functions and less on productivity. The marketing era produced unparalleled levels of sales in the U.S., and the finance era followed as firms began to manipulate their newly acquired wealth during the 1970's. The concepts of mergers and acquisitions were introduced during this period, and should bear much of the blame for effects of inefficient financing and poor management. The problems with "merger mania" are described in a quote by Reich, "...paper entreprenurialism has replaced product entrepreneuralism as the most dynamic and innovative occupation in the American Economy. Paper entrepreneurs produce nothing of tangible use. For an economy to maintain its health, entrepreneurial rewards should flow primarily to products, not paper." [Buffa, 1984]. Mergers often result in no net addition of economic output for corporations, and millions of dollars in stockholder's funds may be spent. Certainly the time and money spent could better be used on productivity improvements and technology.

Another area of consideration is U.S. government action and policy, and the effects these have on the American economy. Since the early 1960's, there have been extreme differences between Capital Hill and the business/industrial community. Much public respect and support has been robbed from large industry, evident in the sentiment that business was corrupt, crooked, and colluding to rob the public. U.S. government's answer to these problems was anti-trust legislation. The long term effects of these policies are an atmosphere of non-competition and inhibitions against corporate joint ventures. The world is a competitive arena, and these restrictions have handicapped U.S. industry [Manufacturing Engineering, 1985].

Some government policy is blamed for adversely affecting productivity for the sake of improvements in air quality, noise levels, and employee safety. However, the U.S. can claim no disadvantage here compared to European and Japanese steel makers who spend as much or more on pollution and safety equipment. Gaining a better perspective, capital expenditures in most U.S. industries for pollution and safety combined can be blamed for at most around one tenth of the slowdown in productivity [Buffa, 1984]. The blame once again comes to rest on U.S. manufacturers.

American management's short term mentality and refusal to accept its fair share of the blame have sent many traditional "smokestack" industries into decline. Industries such as autos, steel, rubber and shipbuilding that were once synonymous with American industrial power have rapidly declined. As evidence, 19 percent of industry's blue collar work force are on indefinite layoff. Even as many old line industries decline, new technology is creating many opportunities in fields such as microelectronics, lasers, fiber optics, and genetic engineering [Alexander, 1983]. While new technology creates work, it also destroys many jobs in outdated industries. It is also possible that new technology, if improperly implemented and mishandled as past technology has been, will not provide the foundation of economic recovery that is hoped for, and may even contribute to U.S. economic decline.

SOLUTIONS AND FUTURE DIRECTIONS

Most of the initial effort aimed at solving U.S. productivity problems is reflected in the American affinity for quick, easy, short term solutions to problems that require extended treatment. Application of Japanese management to American industry may not necessarily be the answer. The Japanese forte appears to be successful management of people. This has been achieved by successfully evaluating the best of other cultures within the context of their own social structure. Japanese philosophy is reflected in their cultural cohesion and commitment to common goals [Wolfe, 1983]. America does not have the level of cultural cohesion or commitment to common goals exhibited by Japan, and blind application of Japanese techniques by U.S., industry may plunge U.S. productivity into a worse position.

Careful consideration must be given to how new technology should be applied in the U.S., where labor is in surplus, as opposed to Japan with a labor shortage. American firms must take a hard look at the role of the work force in productivity. Specific areas of Japanese worker-industry relations that may be transferable include long term commitments to employment, simplified labor relations, and flexibility of work rules that allow workers to perform a wide variety of tasks, towards achievement of more efficient use of labor [Buffa, 1984].

Reich challenges the idea that flexible production systems in use by many of America's competitors can be successfully implemented into America's high volume, standardized industrial base, since most large U.S. enterprises are too fragmented and bureaucratic to accommodate the novel techniques used abroad [Wolfe, 1983].

The plea for protection of U.S. industry by Federal legislation is yet another example of how American firms pass on their share of responsibility for economic recovery. Since many U.S. products cannot compete with foreign products in a free market, the U.S. government is asked to remove the competition. Import quotas on cars, motorcycles, steel, textiles, and other products represent the protection, but these policies may backfire on the U.S. through slowed rates of foreign debt repayment by other countries. Also, the U.S. has become more dependent on world markets during the past decade, and these products could be a prime target for foreign competitors in cases of protectionism or trade wars [Alexander, 1983]. Protectionism also serves to directly drain the internal U.S. economy. An example is the steel industry. Shielding from foreign competition has allowed the industry to defer plant modification through new technology. The result is that U.S. steel industry has allowed its production facilities to become outmoded, and inefficient production can inhibit economic recovery.

Another proposed solution is a National Industrial Policy similar to Japan's. MIT economist Lester Thurow argues that these schemes would not be very effective. This strategy involves targeting government aid for new and promising firms. Thurow argues that the Japanese system has always had government aid, as opposed to the American economy based on individualism and entrepreneurialism. U.S. money would be better spent on massive retraining efforts required by high tech industry and improved science and engineering education programs [Thurow, 1984].

The educational system of the U.S. may have been one of the earliest contributors to America's current technological problems. According to Anderson [Anderson, 1983], Japan has a higher percentage of students enrolled in engineering courses. In Japan, approximately 20 percent of all bachelor degrees are in engineering, compared to 5 percent in the U.S. The total number of scientists and engineers increased by 62 percent in Japan between 1968 and 1978; the U.S. had a 13 percent decrease during the same period. The Soviet Union is also rivaling the U.S. in technical education [Anderson, 1983].

Addressing the needs of the American educational system in the area of science and math is a first step towards rebuilding a foundation for implementing future technologies. Instilling students with interest in science and engineering, and providing quality education at all levels must take place through action and funding by business, industrial, and public sectors at the American economy. By contrast with our foreign competitors, the U.S. government has no clear and coordinated national policy for development of future scientists and engineers. Japan and other industrial powers have had such a policy for several years [Anderson, 1983].

AUTOMATION AND NEW MANAGEMENT

U.S. management must lead the way in the reform of management philosophy toward better productivity through implementation of technology. This can be accomplished through new emphasis on manufacturing functions and new technologies that contribute to-productivity and quality improvement.

According the Anderson, America may be forced to rely more heavily on automation and other new technologies, if it hopes to operate as efficiently as foreign industries. For example, if Ford Motor Company were to continue operation with current technologies and become as efficient as Japanese auto industry, it would need to cut its work force of 256,000 employees in half [Anderson, 1983]. Plant automation requires large capital investments, product volumes to justify financial outlay, and heightened employee involvement and education, to name just a few requirements to make technology implementation in industry a success [Manufacturing Engineering, 1985].

To complement increased automation, U.S. manufacturers need to restrict their interest to basic product lines and concentrate on doing fewer things well. In a comprehensive study, Rumelt found that companies that stick to their basic core business consistently outperform those that spread their resources too far [Buffa, 1984]. Diversification should be restricted to businesses that share close relationships.

Change in the philosophy of U.S. production management is needed, but can be effective only if supported from the top of the organization. According to Buffa, Japanese management structure provides a good yardstick for U.S. industry. More than 65 percent of all seats on boards of Japanese manufacturing companies are occupied by people who are trained as engineers. Almost the same percentage of seats on American boards are taken by people trained in law, finance, or accounting.

In Japan many problems that arise in industry are viewed as problems of engineering or science with technical solutions. American business problems are likely to be viewed as problems of law or finance to be dodged (not solved) through clever manipulation of rules and numbers. This results in a failure of managerial competence as evidenced by poor manufacturing strategy and productivity [Buffa, 1984].

CONCLUSIONS

Several decades ago the United States did not truly believe that Japan or Germany could make automobiles, tractors, and machine tools as well as America could. U.S. industry "rested on its laurels" and did not push to improve productivity or maintain a quality image. As a result., the U.S. is currently behind foreign competition in the implementation of new technologies and automation. Efficiently produced foreign products have penetrated and captured large shares of U.S. markets, and the result has been a weakened U.S. economy. America's industrial and technological inferiority has implications relative to our living standards, education, and defense; really at the center of our national well being.

Effective solutions cannot be borrowed from Japan, but must come from the industrial heart of America where the problems had their beginnings. The mismanagement of U.S. firms must be resolved, or foreign competitors will continue to have the advantage. If current trends are any indication of the future, high productivity as a result of technology implementation will be even more critical to the economic survival of the U.S. in a world market.

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