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Workforce Development Issues in the Aluminum Industry: Human Resource Management, Technology, and Trends in the Marketplace

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I. Introduction and Executive Summary

This paper summarizes a number of important human resources issues that have emerged in the U.S. economy in general and in the aluminum industry in particular. They have to do largely with human resource (HR) management policies and how they have interacted with technology to alter the efficient way to organize production. Important trends information technology advance, in globalization, and in demographic change that affect the optimal HR policies also are discussed. The overriding goal is to better understand the HR policies that lead to improved productivity in the aluminum industry, under what conditions they will and will not work, and how major trends alter the desired HR strategy that firms will wish to follow.

Section II of the paper gives an overview of “new” HR policies adopted by many manufacturing firms. Important differences between new and traditional HR are discussed, as are the logic behind the use of new HR methods, the evidence on their effectiveness, and reasons why they are not universally adopted. Section III discusses the important trends of information technology advance, increased globalization, and demographic change and how aluminum producers may need to change their HR policies in response to them. Section IV summarizes and makes recommendations concerning regarding a research agenda in this regard.

A summary of conclusions and recommendation is as follows.

Newer HR practices are policies that involve line workers more in decision making and problem solving, in the flow of information in the organization, and generally blur the line between supervisor and worker. Evidence shows that these practices are typically very effective in raising productivity for plants that have adopted them, which tend to be those more technologically advanced and have additional characteristics making worker discretion and decision making more important.

Recommendation 1. Assess which segments in the aluminum industry are most likely to experience substantial productivity gains with new HR.

As noted above the aluminum industry is quite diverse, with producers making a variety of products ranging from smelted products and to sheet stock, tubing and automobile parts. Not all have the technological and market environments that lead to success of new HR so it is important to make this assessment individually for each segment.

The introduction of new HR practices has been problematic for firms with entrenched management and workers and a history of antagonistic union-management relations, making the transitional from traditional to new HR costly.

Recommendation 2. Among segments of the aluminum industry where new HR would increase productivity, assess the degree of management and worker cooperation, labor relations conflict, and other factors that can raise strong impediments to adoption of new HR methods.

The combined effects of technological advance and increased globalization make it so that firms with traditional technologies and HR will face increased pressure from foreign competition. These firms will need to adopt newer technologies and HR practices (if feasible) or engage in further outsourcing or offshoring to survive. Also, as technology and globalization evolved, the optimal outsourcing/offshoring policies will evolve.

Recommendation 3. Assess the nature of foreign competition for aluminum producers and the character of offshored production. Determine which market segments have the greatest foreign competition. Determine if these are the settings where changes in technology and HR practices can increase international competitiveness. Examine the likely changes in the optimal outsourcing/offshoring policies as technology and globalization evolve.

Aging baby boomers will generate a substantial decline of workers in the peak productivity age range of 35 to 54, with an increase in older workers and retirements. High-tech firms with a highly trained labor force in this age group will suffer sizable productivity losses, necessitating adjustments to training and promotion of younger workers. These will be disproportionately firms with new HR practices. For firms with a labor force resistant to change, the retirement of older workers may present an

opportunity to adopt new HR methods with less opposition. Also, the changing composition of the labor force will alter the prices of labor services and other inputs. The industry will desire to adjust its training, compensation, and input usage.

Recommendation 4. Assess the demographic structure of the labor force of firms in each segment of the aluminum industry. Determine which firms will be most affected by demographic changes, whether the firm is a high-tech, new HR firm that is likely to be adversely affected, or whether the firm is a potential candidate for adopting new HR that will be helped by this trend. Determine how the prices of various inputs will change (on an economy-wide basis), how the aluminum industry will be affected by this, and how the industry can adjust regarding its input usage, training, and compensation policies.

II. Human Resource Management Practices

There has been a marked change in human resources (HR) management in many manufacturing firms over the past two decades and these practices are often given credit for substantial improvements in productivity and efficiency of firms that adopt them. Part A of this section discusses these practices and contrasts them with older HR practices. We also discuss the conditions that usually accompany adoption of the newer practices and the evidence on how effective they are. Though purported to be highly effective, not all firms adopt the newer HR practices. Part B discusses this more thoroughly, explaining the obstacles and impediments to use of these practices.

A. “New” Human Resource Practices

(i) “New” Versus Traditional HR

Typically, newer HR practices are policies that involve line workers more in decision making, the flow of information in the organization, in resolving problems, and generally blur the line between supervisor and worker. Authority relationships are altered, frequently there is decentralization of decision-making power, there are changes in the task content of various jobs, and the reward systems is

more outcome based. The new HR policies frequently are associated with a set of specific practices, including the following.

- (a) Team-based work organization, such as self-managed teams, employee involvement and problem-solving groups, quality circles and use of TQM, benchmarking, and various team-building activities.
- (b) More information flow involving regular meetings of workers and supervisors and greater information sharing.
- (c) Greater decision making by workers, e.g., workers deciding on the pace of work, the method of work, and repair schedules.
- (d) More broadly defined jobs and job rotation.
- (e) Compensation with payment for skills learned and profit sharing or pay tied to quantity and quality of work.
- (f) More extensive worker recruitment and training, with careful screening of workers hired, high amounts of training and cross training.
- (g) Though not formally part of HR, these new practices are often adopted in workplaces that are more heavily computerized and more technologically advanced.

These practices are in contrast to the more traditional HR. Traditional HR is characterized by narrowly defined jobs, seniority-based pay promotion rules, and strict supervision by foreman. Jobs and pay categories are tightly defined, there are clear lines of demarcation separating duties and rights of workers and supervisors, with decision-making powers retained by management, and communications and conflicts channeled through formal chains of command and grievance procedures.

(ii) Decision-Making Authority and New HR Practices

A critical difference between the newer and traditional HR management is the assignment of decision-making authority. Generally speaking, it is desirable to have decision-making power in the

hands of those who have the best information and the best incentives to use the information.¹ If an employee is given decision-making rights but does not gain from good decisions, s/he is less likely to make good decisions. Also, if the party making decisions has incentives, but not the information, wrong decisions are more likely to be made.

Organizations differ in where the knowledge and information lies. Upper management frequently has better information on the financial status of the organization, and the broad picture of which units are having difficulty, overall downtime problems, bottlenecks, quantity of production, quality issues, and inventory. Workers on the shop floor typically have much more specific knowledge and intangible (difficult to quantify) information about particular equipment, people, customers, and situations.

Organizations differ in which type of information is more important and also how difficult it is to inform the persons with decision-making power. For example, the needs of a particular customer in a particular week are likely to be known to those deep in the organization and meeting those needs may require deviation from the usual production routine. However, decision-making power might be held high in the organization and it may take too much time conveying the information there in order to do anything about it. Organizations also differ in where the strongest incentives are and in the difficulty of giving others in the organization more incentives.

With traditional HR practices, top managers have strong performance incentives, but not workers. Decision-making power is held at or near the top and there is little discretion at the bottom. Narrow job definitions and close supervision are ways to limit unwanted behavior among those at the bottom with little incentive. Newer HR pushes decision making deeper into the organization. This makes better use of shop-floor information held by workers. Profit sharing, team-based pay, and other performance pay methods are devised to provide incentives.

The literature argues that market and technological trends over the past two decades often have made it more desirable to decentralize decision-making authority into the hands of workers.

¹ Jensen and Meckling (1992) originally developed the basic line of analysis that this section relies on.

Computerization and information technology have enabled firms to produce goods with higher quality and closer tolerances. They also have enabled easier customization of products and rapid changes in product mix. Greater competition and adoption of just-in-time inventory by customers has heightened the importance of minimizing defective batches and “getting it right” the first time. Activities to meet these types of standards generally rely more heavily on shop-floor information and initiative. More discretion and decision-making authority at this level is desirable.

Often, discretion at this level is in the form of self-managed teams and employee problem-solving teams. In solving shop-floor problems, it is sensible to have workers knowledgeable in a variety of things since the problems could come from anywhere. Therefore, adopting cross training, job rotation, broader job definitions, and information sharing practices is complementary to the decentralization of decision making. Here, it is easier to move general information about the organization into the hands of those with specific, shop-floor information than to move the specific, shop-floor information to upper management. Adopting stronger incentive pay – profit sharing, bonuses for meeting unit goals on quantity and quality – completes the package by bundling incentives with information and decision authority.

(iii) The Use and Effects of New HR Practices

According to large scale studies done in the 1990s, many U.S. businesses have adopted some form of new HR work practices, but only a small number have adopted the full system.² By now, use of these practices is even more widespread. A variety of careful studies have shown positive productivity effects on those firms that adopt these practices, though the effects are stronger for firms that use a large fraction of the new HR methods.

Perhaps the studies closest and most relevant to the aluminum industry are those regarding the steel industry. The Sloan Steel Industry Center, housed jointly at Carnegie Mellon University and the University of Pittsburg, conducted intense, on-site studies of a number of segments of the steel industry,

² See Ichniowski, Kochan, Levine, Olson, and Strauss (1996) and Osterman (1997). The “full system” means enhanced worker participation, flexibility in work design, decentralization of managerial tasks, and incentive pay.

including steel finishing lines and minimills. Based on the data and information collected, statistical analysis shows a strong, positive effect on productivity of adoption of new HR management practices.³ The effect is stronger for plants that use a fuller set of the new HR methods.

Note that a simple comparison of plants with new HR and those without could lead to illusory estimated productivity effects. If plants that were already more productive are the ones that adopt newer HR practices, the higher productivity might be erroneously attributed to the new HR. However, the findings in the steel industry studies are not illusory. The studies compare productivity before and after the adoption of new HR methods at the same plant, with control for anything else that might have changed, such as the amount of capital. It is clear that these plants experienced an increase in efficiency due to adoption of newer HR management.

It is still an open question, though, whether this finding applies to all plants. In other words, is there a special set of conditions where adoption of newer HR methods raises productivity and it does no good in other conditions? If the plants where they have been adopted met these conditions, we expect to find positive productivity effects. But the findings only apply to plants meeting these conditions and not to all plants. We discuss this more below in the next subsection.

Studies of other industries are broadly consistent with the steel industry studies. For example, MacDuffie (1995) studies automobile assembly, Bartel (2004) examines retail banking, and Batt (1999) investigates customer service call centers. Each finds positive effects on productivity after the adoption of new HR practices in the samples they study. Using large, broad-based samples of manufacturing industries, the studies of Black and Lynch (2001, 2004) and Cappelli and Neumark (2001) find very similar results.

B. Will It Work For Everyone?

The consistently strong, large, and positive effects of new HR practices found in studies have led many to ask why they are not more broadly adopted. Are firms missing out on something good or are the

³ See, for example, Ichniowski, Shaw, and Prennushi (1997) and Boning, Ichniowski, and Shaw (2001).

studies missing something that firms know about? There is some research that touches on these questions and suggests two types of answers. The first is that newer HR practices are only suited to plants in certain types of competitive and technological environments. Newer HR raises productivity in these settings but not in others. The second is that new HR raises productivity in a broad set of firms beyond those that have tried it, but the costs of transition from traditional HR to newer HR are prohibitive.

The studies of Bresnahan, Brynjolfson, and Hitt (2000, 2002) are consistent with the first type of answer. They find that cheaper and more powerful information technology naturally has led to more of its use. This, in turn, has made feasible many new products, higher quality, and many service innovations. These authors find that these settings are where worker discretion and use of shop-floor information is most critical, leading to organizational change with decentralization of decision authority, increasing the breadth of jobs, use of self-managed teams and employee involvement groups, and more incentive-based reward systems. In other words, this is the setting where new HR pays off.

A related paper is that of Boning, Ichniowski, and Shaw (2001) regarding steel minimills. They investigate productivity and the adoption of new HR practices for 34 production lines over the course of the mid 1990s. One aspect of their study focuses on the complexity of the production process. Even though all plants are minimills, there is still substantial heterogeneity. The least complex plants are where billets are reduced to smaller sizes and the most complex are where intricate steel shapes with tight tolerances are produced. In general, the more intricate mill products require demanding tolerances and are made on lines with advanced, computerized technologies. A strong finding of the study is that plants with more complex production processes are much more likely to adopt newer HR practices. Evidently, it just does not pay off for plants using less complex technologies.

The evidence on minimills is consistent with that above. More advanced, computer-intense production methods tend to lend themselves to situations where greater worker discretion is needed, making adoption of new HR practices more profitable. This suggests that new HR is not for everyone, but only for firms in certain environments.

Are aluminum producers in these environments? While all aluminum producers share some commonalities, there is a substantial heterogeneity. Aluminum plants include smelters, producers of rolled sheet stock, tubing, die castings, ingots, extrusions, billets, foil, die-cast automotive parts, coils, containers, gutters, windows, and a variety of products for automobiles. It remains an open question whether each of these types of aluminum producers are suited for new HR management policies.

The difficulties in making the transition from traditional to new HR is the subject of Gant, Ichniowski, and Shaw (2002) and Ichniowski and Shaw (1995). Both papers discuss the large, positive effects of the adoption of new HR found in studies of steel finishing lines and investigate why many plants have not adopted these methods. Gant, Ichniowski, and Shaw (2002) emphasize the vast differences in communication networks and training for workers with new versus traditional HR systems and that moving from the traditional to the new system is difficult. Their study examines communications between workers in similar jobs, across jobs, with supervisors and management, and with customers. All types of communications are much greater with new HR practices.

For this to be effective, workers must acquire a broader range of knowledge that enables them to effectively communicate more widely. This involves substantially greater training costs, or retraining costs for a plant intending to switch over to newer HR. Additionally, there will be more training required in communications, problem-solving, and teamwork skills. Further, there must be “buy in” of both workers and management to cooperatively engage in the new training and HR system. Obtaining the latter may be more of an impediment than the direct (re)training costs.

In a plant with traditional HR practices, both management and workers have developed sets of skills suited to the traditional HR system. Neither side wants to risk the potential loss of compensation and position in the firm if these skills become obsolete under the new HR system. Additionally, adoption of newer HR calls for reorganization of responsibilities in a firm, and some managers may lose power. For unionized plants, the newer HR changes worker-management relations and union leaders in positions of power may lose influence. Each of these generates resistance to changing from traditional HR.

Also, among the steel plants studied, some are plagued with antagonistic union-management relations with a great deal of mistrust. Gaining cooperative effort to retrain is especially problematic in this setting. For example, pre-shift informational meetings among workers may be misinterpreted by management as union strategy meetings, worker-management problem-solving sessions may turn adversarial, and changes by management in compensation methods may be viewed by workers as a way to cut pay. This makes switching over to newer HR much more difficult and much less likely.

The statistical analysis of steel finishing lines' use of new HR methods by Ichniowski and Shaw (1995) is quite revealing. Most plants that use newer HR are greenfield sites or reconstituted sites. Neither type of site has a standing workforce (or a union), so all training starts from scratch. There are no lines of communication or training to be undone and no entrenched interests to overcome. Also, workers and managers in these plants tend to be younger and with less industry experience, suggesting fewer obsolete skills at risk. Among those that changed over from traditional HR practices to newer HR, several factors seemed to play the strongest roles in influencing the change. The first was threat of closure of the plant. Plants where there had been partial closure or that had a strong likelihood of future closure were much more likely to switch over to new HR methods. The threat of job loss evidently is a powerful incentive to induce cooperative change.⁴ Also, plants where management and union leadership had been recently changed were more likely to adopt new HR. As above, this implies fewer entrenched interests to overcome.

Existing aluminum producers vary in their degree of unionization, of entrenchment of management and labor, and in the threat of plant downsizing and closure. Thus, they will vary in the difficulty in switching to newer HR practices.

III. Market Trends, Human Resource Management, and the Aluminum Industry

This section discusses three important economic and social trends and their connection to HR management. The three trends are well known: continued technological advance, increased

⁴ This is true in a number of other industries. For a recent, careful analysis, see Schmitz (2005) examination of large productivity gains in the face of potential mine closures in the heavily unionized iron ore mining industry.

globalization, and large changes in the demographics of the labor force. At question here is how they interact with HR management and affect the type of human resource policies that firms (including aluminum firms) ought to adopt.

Technology. Computer and communication technologies have revolutionized many production processes and marketing and management methods. Continued technological advance is expected. Recent changes in technology have enabled increased customization, better quality with tighter tolerances, and rapid adaptation to customer needs. These have induced the redesign of firms' workplace organization and compensation systems, with more employee training, more worker discretion and involvement in decision making, and greater reliance on performance pay. In other words, adoption of new HR methods. The technology advance has been complementary to worker discretion and thus has led to the new HR methods that are suited to it.

Is it expected that technology advance will continue to be complementary to worker discretion or it is likely that this will reverse with future technologies? The study of Autor, Levy, and Murnane (2003) is insightful in this regard. These authors find strong evidence that computers are substitutes for workers performing rote, repetitive tasks that can be accomplished by explicit rules and are complements for workers in performing nonroutine problem solving and complex communication tasks. This is likely to remain the case for the foreseeable future.

However, the pace of technological advance will not be the same for the variety of aluminum producers in the marketplace now. Those that experience higher rates of technical change will continue to be called on to adopt new HR practices to suit their evolving technology. Others will not be under this type of pressure.

Globalization. The future will bring continued ease of international transactions – trade, outsourcing, foreign direct investment – and with it increased foreign competition. This is interrelated to technological advance in a number of ways. Perhaps most important to the aluminum industry is the nature of work that is offshored and/or for which foreign competition is the most intense. Casual

observation strongly suggests that it is the traditional manufacturing enterprise that faces more intense foreign competition and it is high-tech manufacturing that is more likely to survive in the U.S.

Traditional manufacturing relies more on routine tasks and semiskilled workers to carry them out. Many, many workers in Asia and other parts of the world have the level of skill needed to do these types of jobs. Additionally, their wages are much lower. Growth in trade essentially puts these workers and their firms into competition with similar U.S. workers and firms. The continued integration of China and India into world trade has added hundreds of millions of workers that compete with semiskilled U.S. workers and the firms that employ them. As a result, foreign competition will be more intense for goods relying on traditional manufacturing methods. U.S. firms relying on those methods will face continuing pressure. U.S. workers with only a modest level of skill will see their wages and employment prospects stagnate.

Though foreign competition exists for high-tech manufacturing, much of the workforce in less developed part of the world is not ready for the jobs in this type of workplace. U.S. firms and workers in this setting are expected to continue to do well. These are the types of firms that use new HR practices and employ workers with a higher level of skill and capacity for intense training.

The upshot is that the combination of technology and international trade will make it much more difficult for the traditional manufacturer to survive in the U.S. but high-technology/new HR workplaces are expected to thrive.

Also, the nature of technology and the skills and training of workers may affect the decisions on outsourcing and offshoring. For example, highly specialized manufacturing processes may require specialized components and skilled, specialized labor. In this setting, it often makes sense to produce the components in-house. Whether this is done by a domestic plant or one overseas depends on whether the

skill level is available overseas and on the foreign legal environment regarding protection of proprietary information.⁵

Demographics. The aging and retirement of the baby boom generation will have a substantial impact on all types of firms and the HR strategies that will lead to success. The U.S. Department of Labor forecasts that the fraction of those in the labor force aged 35 to 54 will decline from 47% to 44% by the year 2010 and to 41% by the year 2020. This is largely due to baby boomers aging past this age group. The 35 to 54 age group is considered the most productive in the labor force (due to the combination of stability, good health, experience, and skill), thus the labor force will lose a sizable fraction of its most productive and skilled people. At first this will be accompanied by a rise in the pre-retirement age group (55 to 64) as the baby boom generation ages to these years when worker productivity often declines. It will be followed by a decrease in this age group as this generation retires. Also, there is expected to be a small increase in younger workers aged 25 to 34 over this time period.

The coming decline in the number of workers in their prime years of productivity will make particular difficulties for firms that rely on the high-tech/new HR workplace. This type of workplace is one with a high amount of training and where fully-trained, senior workers are especially valuable. Loss of large numbers of these workers will cut productivity much more than in a workplace where little training and skill acquisition occur. Firms in this situation may need to take steps to retain older workers and/or to intensify the training of less experienced workers to move them into higher-level jobs more quickly.

The large scale retirement of older workers may be advantageous to producers who are contemplating a switch from traditional manufacture and HR methods to high-tech/new HR. As discussed above, one of the impediments to adopting new HR is entrenched interests in the old way of doing things. It is likely that more senior workers have these entrenched interests. A substantial

⁵ See Spencer (2005) for a survey of literature that examines these and related issues.

reduction in the number of this type of worker removes an obstacle to modernizing the workplace and HR system.

Also, the coming change in workforce composition will induce changes in the prices of the labor services of experienced workers, of younger workers, and of the required return on capital. Naturally, the price of experienced labor will rise due to its reduced supply. The nature of the adjustments of the other input prices depends on the substitutability/ complementarity of the other inputs with experienced labor for the economy as a whole. How the aluminum industry fares will depend on its needs of the inputs whose relative prices rise.

IV. Summary and Recommendations

New HR practices are typically very effective in raising productivity for plants that have adopted them. Plants that have adopted these practices tend to be heavily computerized, are technologically advanced, and have additional characteristics making worker discretion and decision making more important.

Recommendation 1. Assess which segments in the aluminum industry are most likely to experience substantial productivity gains with new HR.

As noted above the aluminum industry is quite varied. Some will most likely have the technological and market environments that lead to success of new HR and others will not. An environment in die castings production that lends itself to new HR does not necessarily mean that the same is true of smelters. It is important to make this assessment individually for each segment.

The introduction of new HR practices has been problematic for firms with more senior and entrenched management and workers, those that have a history of antagonistic union-management relations, and where jobs are not threatened. The costs of making the transitional from traditional to new HR are likely to be prohibitively high in this type of setting.

Recommendation 2. Among segments of the aluminum industry where new HR would increase productivity, assess the degree of management and worker cooperation, labor relations conflict, and other factors that can raise strong impediments to adoption of new HR methods.

The combined effects of technological advance and increased globalization make it likely that firms using technologies suited to traditional HR will face increased pressure from foreign competition. To survive, these firms will need to adopt newer technologies and HR practices (if feasible) or it may be necessary for them to engage in further outsourcing or offshoring. Further, evolving technologies and skill/training requirements for worker means that the optimal outsourcing/offshoring policy will evolve.

Recommendation 3. Assess the nature of foreign competition for aluminum producers and the character of offshored production. Determine which market segments have the greatest foreign competition. Determine if these are the settings where changes in technology and HR practices can increase international competitiveness. Examine the likely changes in the optimal outsourcing/offshoring policies as technology and globalization evolve.

Substantial changes in the demographic structure of the labor force are coming due to the aging of the baby boom generation. Firms will gradually lose a significant share of workers in the peak productivity age range of 35 to 54, with an increase in older workers and retirements. This will cause sizable productivity losses for firms with a highly trained labor force, necessitating adjustments to training and promotion of younger workers. These will likely be firms with new technologies and new HR practices. For firms with a labor force resistant to change, the retirement of older workers may present an opportunity to adopt new HR methods with less opposition. Also, the changing labor force composition will imply changing input prices that the industry will need to adjust to.

Recommendation 4. Assess the demographic structure of the labor force of firms in each segment of the aluminum industry. Determine which firms will be most affected by demographic changes, whether the firm is a high-tech, new HR firm that is likely to be adversely affected, or whether the firm is a potential candidate for adopting new HR that will be helped by this trend.

Determine how the prices of various inputs will change (on an economy-wide basis), how the aluminum industry will be affected by this, and how the industry can adjust regarding its input usage, training, and compensation policies.

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