



WHAT IS ADVANCED MANUFACTURING?

May 2011

Definition

Advanced manufacturing is high productivity, high profit, high wage, technology rich, relatively high value added fabrication of globally competitive products that creates wealth and builds and sustains communities. Of course not every plant meets every criteria embedded in this definition. Advanced manufacturing can best be seen as a set of interrelated practices that naturally go together and support each other. Advanced manufacturers are firms that embrace many, if not all, of these practices.

High productivity, high wages, competitive prices and high profits go together in advanced manufacturing. What are some of the practices that yield these results?

A long-term vision and commitment. This means an emphasis on long-term shareholder value, not short-term speculative profits. Companies are, and should be, in business to make profits. But in almost every case firms have a choice between maximizing either short-term or long-term profits. Advanced manufacturing firms choose the maximization of long-term profits. While this long-term view generally is more beneficial to stakeholders such as workers, communities, suppliers and customers, it isn't the only reason high performance firms focus on the long term. A steady stream of profits over time generally offers a better total return to owners, or in financial language managing for the long term generally has a higher total return expressed as net present value.¹

Genuine worker consultation and influence over the production process. There is a large and compelling body of evidence supporting the substantial contribution of genuine worker involvement to profits.¹ Its fundamental insight is that employees who actually do the work know most about it and are best positioned to know how to improve performance. Successful

¹Long and short term thinking also relate to the decision to offshore production. "For any individual company, it is often better, in the short or intermediate term, to outsource production to an overseas supplier. The company can buy manufacturing services at a much lower rate if it goes to China or elsewhere, depending on the industry. But if everybody is doing that, you get a general erosion of the economy, which could lead to a decline in the standard of living. An individual company, though, can move assets anywhere. So companies can reward their shareholders regardless of what happens to the national economy. As a result, the interest of companies and the country have diverged... managers [should] take away a more thoughtful approach about manufacturing and think about the longer-term implications of their actions for their companies as well as for the countries in which they operate," according to Willy C. Shih. See Endnote ____ for citation.

employee involvement gives workers the ability, motivation, and authority to continuously improve operations. At the same time, employee involvement may be the advanced manufacturing practice with the single greatest impact on the well being of communities, as will be discussed presently. Workers who have more control at work are happierⁱⁱ and healthier.ⁱⁱⁱ

Investment in product research, development, and innovation. At the very heart of a advanced manufacturing strategy is a commitment to innovation, such as developing new niches and markets, adding value to existing products, and investing in research and development. These lead to an expanding market share and improvements in the efficiency of the productive process and the productivity of employees.

Investment and reinvestment in productive capacity. In addition to product innovation advanced manufacturing companies continually strive to be more efficient and productive while cutting waste. High productivity requires adequate capital per worker. In this competitive world there is always someone thinking of a product with superior benefits, a manufacturing process that slashes costs and a method to deliver products faster by reducing time to market and production cycle time.

Investment in and commitment to the continual enhancement of employees' skills and career development. Earlier we noted that educated, well trained workers were a prerequisite for most high value added manufacturing. While the public sector has a role in providing workers with foundation skills, firms must provide the firm specific training required. Companies also must continuously facilitate the updating of their incumbent workers' skills.

Providing strong material incentives for high performance, as well as providing decent wages, benefits, and security. In addition to the obvious benefits of good compensation to workers and communities, there are a number of studies demonstrating the direct benefits and importance of adequate worker compensation to firms' profits. Higher wages are associated with higher skills and higher skills with higher productivity. Better paid workers are less likely to quit.^{iv} Better paid workers buy and consume more goods and services.

Building useful, genuine partnerships within the firm, in the sector, and in the community. This includes relating to suppliers as partners and strong relationships with and superior service to customers. This requires being transparent, straightforward and fair.

The Link between Advanced Manufacturing and Community

Primary jobs are required to produce wealth. Increasing productivity is the only way to increase aggregate living standards. Advanced manufacturing offers primary jobs and increasing productivity therefore advanced manufacturing is a fundamental – perhaps *the most* fundamental – ingredient in community economic development.

Sometimes those who are deeply concerned about the part of the population that has a disproportionately small share of society's wealth question why we should focus on manufacturing. They often concern themselves with distribution or redistribution of wealth rather than its creation. The relatively high pay and benefits that accrue to manufacturing employees inherently helps address the equitable distribution issue to some extent. Of far greater importance

is advanced manufacturing's ability to create the wealth that provides the resources necessary for equitable distribution. From a practical point of view it is generally more widely acceptable to equitably distribute newly created wealth than to redistribute preexisting wealth. Economically sustainable communities need advanced manufacturing.

Tangible wealth creation is important but is only part of the story. The contemporary advanced manufacturing worker also is accustomed to working in teams and applying knowledge and skills to real problems. This increased worker participation or employee involvement has an important spin off effect.

When workers participate more they obviously interact more with each other and with management. This interaction builds interaction skills, habits and trust. Employees develop this "connective capital," that is, the stock of human capital that employees can access through their connections to other workers, through communications links with other employees in order to tap into the knowledge of their co-workers as they seek to solve problems together. Employees in plants with employee involvement practices are working in environments with higher levels of connective capital, because the richer set of inter-worker linkages in these plants give workers access to the knowledge, ideas, and experience of a wide array of co-workers. The high levels of connective capital appear to be an important reason for ... productivity gains realized.^v

Connective capital is one type of social capital. When workers learn a skill they can transfer that skill to another situation. The skills, habits and trust acquired in building connective capital at work are the same skills used in building social capital in any setting. "Social capital refers to connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them."^{vi}

Social capital can be acquired and possessed by an individual. Social capital can also be acquired and possessed by a group or society. In this case social capital refers to "features of social organizations, such as trust, norms, and networks." This kind of collective social capital is a public good that can be drawn upon to solve problems of collective action.^{vii}

Social capital acquired by individuals in one domain of their life can be utilized in another. The social capital (in the form of connective capital) acquired at work as a result of employee involvement can be transferred to civil society and civic participation. Workers who actively participate and have a relatively high degree of control at work find this to be satisfying and will therefore be more likely to seek the same rewards in civil society. Employee involvement thereby provides a motivation for involvement in civil society and democratic politics. This motivation is reciprocal: citizens who are actively involved in civil society and/or politics will be more motivated to participate at work.

Does the fact that an individual has the skills and motivation to participate mean that he will do so? It turns out that the motivation provided by needs satisfaction and the skills acquired at work are necessary but not sufficient for participation in civil society and formal politics. The final element is a willingness to participate. Willingness to participate is provided by the sense that

participation will have some beneficial effect, that is, that the individual is able to successfully participate. Subjective competence is the belief on the part of an individual that she can exert influence.

If any individual believes he has influence, he is more likely to attempt to use it. A subjectively competent citizen, therefore, is more likely to be an active citizen. Individuals who participate at home, at school, and, especially, at work are more likely to participate in politics than those who do not. This reflects a relationship between the extent of opportunities to participate in job decisions and the extent of subjective political competence. Those who report that they are consulted about decisions on their job are more likely than others to score high on the scale of subjective political competence. The same relationship exists between informal job participation (freedom to protest) and sense of political competence. Those respondents who report that they feel free to protest decisions are more likely to feel subjectively competent to influence the government.

Opportunities for job and political participation have a reciprocal effect on each other: that is, the relationship between perceived ability on the job and perceived ability to participate in politics may represent not merely a generalization from the work place to the political sphere, but a generalization in the other direction as well.

There is evidence that the impact of participation in nonpolitical decision making - at home, school, and job - is cumulative. The individual who has consistent opportunities for nonpolitical participation is more likely to generalize this to political participation.^{viii}

Advanced manufacturing business practices that constitute genuine employee involvement, mediated through the mechanism of subjective competence increase the stock of social capital, which in turn strengthens civil society and thereby democratic government.

The benefits of advanced manufacturing accrue to a community whether “community” refers to a neighborhood, city, region, state or nation. But the concerns and strategies of communities will vary based on their size. Certainly neighborhoods want advanced manufacturers to locate in the neighborhood or nearby so that jobs are accessible.

There is no inherent reason dictating that advanced manufacturing is more successful if located in an urban city, suburb, or rural area. However, advanced manufacturers will want to locate on a plot of land that allows for construction of modern well designed plants. Normally this means a one story structure with room to expand. Urban and suburban communities that seek to attract or grow advanced manufacturing will need to have land use policies that allow for the assembly of such plots at a competitive price.

Companies do tend to locate in clusters of firms in the same or related businesses. They seek access to a specialized workforce, specialized suppliers, and business and technology networks. A manufacturing cluster consists of manufacturers, suppliers, advisors, research institutions, education providers and other entities that have expertise in the particular subsector.

Communities will be most successful in attracting and retaining companies that are naturally part of or closely related to existing clusters.

Plant location decisions are powerfully and most importantly driven by the cluster effect, by the geographical location of customers, and the economics of transportation of inputs and outputs. Beyond these “geographical factors” plant location decisions are somewhat opaque. In a time when local communities compete with various financial incentives in a race to the bottom to lure firms companies have strong reasons to overemphasize the importance of these lures. Why not take free money? Those on the inside know that plant location decisions are driven by hard economic analysis. Incentives tend to have less impact on the bottom line than several other factors.

Among the non-geographical factors that weigh heavily in location decisions the skill level of the available labor force is often the single most important factor. For unionized firms good labor relations is a related factor. Labor costs are often the next most important factor. Labor costs are not the same as wage levels for the sophisticated company. Depending on the industry subsector energy costs can be important. Other factors include the availability of improved sites matching company needs and ease of doing business. The latter can mean relative freedom from a series of bureaucratic annoyances, costs of items like workers compensation and/or government cooperation. Cooperation is not the same as incentives.

The Environment and Manufacturing

Advanced manufacturing is environmentally sustainable. This means that it does not release toxic materials into the environment and utilizes processes that minimize the consumption of scarce resources.

There is much talk about “green jobs” and the “green economy” these days. These are in some ways misleading terms. There are environmentally friendly, or green products. These are products that either help protect the environment (biodegradable household cleaning products, industrial scrubbers for power plants) or reduce the consumption of resources (solar panels, hybrid automobiles). The processes that produce these products – and therefore the jobs -- are no different than the processes used to produce environmentally damaging products. For example, machining a gear that goes into a wind turbine is no different from machining a gear that goes into a SUV. The current environmental concerns present in the world do create a demand for green products and advanced manufacturers will pursue these markets. But the jobs and the skills required to hold down the jobs will not be “green” or in any other way unique.

Although the ultimate use of the product doesn’t dictate a changed process manufacturers can choose among processes that are more or less environmentally friendly. For example, a machining company can recycle lubricant or choose to dispose of it.

Advanced manufacturers will produce the products required to create a greener environment but even more important advanced manufacturers will be in the forefront of developing new technologies and products. It’s far more likely than we can build a greener world through manufacturing and economic drivers than through litigation.

-
- ⁱ Among the studies are David I. Levine, *Reinventing the Workforce*, Washington DC: Brookings Institution, 1995; Peter P. Schoderbek and William E. Reif, *Job Enlargement*, Ann Arbor, University of Michigan, 1969; Frederick E. Schuster, Larry D. Baker, Thomas E. McKay, *et al.*, "Management Practice, Organization Climate, and Performance: An Exploratory Study," *Journal of Applied Behavioral Science*, vol. 33, no. 2, June 1997: pp. 209-226; Sandra E. Black and Lisa M. Lynch, *How to Compete: The Impact of Workplace Practices and Information Technology on Productivity*, Cambridge MA: National Bureau of Economic Research, Working Paper 6120, August 1997; Rajiv D. Banker, Joy M. Field *et al.*, "Impact of Work Teams on Manufacturing Performance: A Longitudinal Field Study," *The Academy of Management Journal*, vol. 39, no. 4, August 1996 pp 867-890; Betty G. Dillard, "Team-Based Sewn Products Manufacturing: A Case Study," *International Journal of Clothing Science and Technology*, vol. 12, no. 4, 2000, p. 279-292; Sandra E. Black and Lisa M. Lynch, *Measuring Organizational Capital in the New Economy*, First Draft, National Bureau of Economic Research, Cambridge MA, April 2002, available at <http://216.239.37.104/custom?q=cache:XfkvnyNArwUC:www.nber.org/books/CRIW02/criws02/Lynch.pdf+Measuring+Organizational+Capital+in+the+New+Economy&hl=en&ie=UTF-8>, May 15, 2003; Jeffrey Pfeffer, "Seven Practices of Successful Organizations," *California Management Review*, vol. 40, no. 2, Winter 1998; Casey Ichniowski, Kathryn Shaw and Giovanna Prennushi, "The effects of human resource management practices on productivity: A study of steel finishing lines," *The American Economic Review*; vol. 87, no. 3, 1997, pp 291-313; and Gary Herrigel, *Manufacturing Possibilities*, Oxford: Oxford, 2010.
- ⁱⁱ Two classic texts on this subject are Douglas Murray McGregor, "The Human Side of Enterprise," *Management Review*, November 1957 and Frederick Herzberg, *Work and the Nature of Man*, New York: World, 1966. Also see Richard B. Freeman, Morris H. Kleiner, *et al.* *The Anatomy of Employee Involvement and Its Effect on Firms and Workers*, Cambridge MA: National Bureau of Economic Research, Working Paper 8050, December 2000; James T. Bond, Ellen Gallinsky and Jennifer E. Swanberg, *The 1997 National Study of the Changing Workforce*, New York: Families and Work Institute, 1998.
- ⁱⁱⁱ David Blane, Eric Brunner and Richard Wilkinson, eds. *Health and Social Organization*, London: Routledge, 1996. In particular see the articles by Syme and Marmot. See also Richard Wilkinson, *The Impact of Inequality*, New York: New Press, 2005; Richard Wilinon and Kate Pickett, *The Spirit Level*, New York: Bloomsbury, 2010; and Ichiro Kawachi, Bruce Kennedy and Richard Wilkenson, eds. *The Society and Population Health Reader, Volume I, Income Inequality and Health*, New York: New Press, 1999. To keep up to date the *British Medical Journal* continues to publish topical research on this issue.
- ^{iv} See, for example, P. Singh, "Strategic reward systems at Southwest Airlines," *Compensation and Benefits Review*, 34 (2), 2002, pp 28-33 or J. Pfeffer and J. F. Veiga. "Putting people first for organizational success" in P.J. Frost, W.R. Nord, and L.A. Kefting, eds. *HRM Realit: Putting Competence in Context*. 2nd Edition, New Jersey: Prentice Hall, 2002, pp 18-31.
- ^v Casey Ichniowski, Kathryn Shaw, and Jon P. Gant, *Working Smarter By Working Together: Connective Capital in the Workplace*, paper presented at a National Bureau of Economic Research conference on "Organizational Economics" in Cambridge MA on November 22-23, 2002, <http://www.nber.org/reporter/winter03/conferences.html> April 28, 2003.
- ^{vi} Robert D. Putnam, *Bowling Alone: The Collapse and Revival of American Community*, New York: Simon & Schuster, 2000.
- ^{vii} Regina Birner and Heidi Wittmer, "Using Social Capital to Create Political Capital: How Do Local Communities Gain Political Influence? A Theoretical Approach and Empirical Evidence from Thailand," in Nives Dolsak and Elinor Ostrom, eds. *The Commons in the New Millennium*, Cambridge MA: MIT Press, 2003.
- ^{viii} Gabriel A. Almond and Sidney Verba, *The Civic Culture*, Princeton: Princeton University Press, 1963.