

HUMAN CAPITAL IN JAPANESE MANUFACTURING: EVIDENCE AND PRACTICES FROM A KEY CAPITAL GOODS SECTOR

RONALD KALAFSKY

UNIVERSITY OF NORTH CAROLINA-CHARLOTTE
DEPARTMENT OF GEOGRAPHY AND EARTH SCIENCES
CHARLOTTE, NC

Abstract

Japan's metalworking machinery industry maintains its dominance across international markets in terms of both production and innovation. Much of this success can be attributed to firm-level and industry-wide practices, many of which concentrate on the importance of the workforce. A set of interviews across the industry confirms that a number of unique practices play a role in the industry's competitiveness. However, several demographic trends could lead to a human capital shortage in a sector that demands a highly skilled workforce.

Introduction

Japan's metalworking machinery sector has long been one of its most successful durable goods industries. While in most industrialized economies this sector's production has declined or moved offshore, many Japanese manufacturers continue to thrive and are considered to be among the world's best, leading in total output and exports (Gardner, 2005). A central factor in the success of these producers has been related to the workforce. Across the machine tool industry and other capital goods sectors, Japanese firms have integrated workers at all levels of the corporate hierarchy into the manufacturing process, which has contributed to continued innovation and productivity (Farrant and Flynn, 1999). This paper provides a brief

examination of the role of human capital in the operations of Japanese metalworking equipment manufacturers across a number of facets, including producer-level strategies and corporate culture. It is informed by a series of onsite interviews within the metalworking machinery sector and related support organizations, which reveal unique firm-level practices and suggest that human capital remains a central component of the industry's continued dominance. Before further discussion of the interviews, a research context for this study and a brief background of the industry are in order.

RESEARCH CONTEXT

When examining a national industry and comparing its manufacturers against

competitors from other countries, it is important to consider the often divergent institutional settings in which manufacturing develops. Much of the most recent research confirms that in order to understand a firm or an industry, one must take into account a holistic view of the environment in which the economic activities take place (Redding, 2005). The contrasting business and economic systems of different countries provide wholly different environments for industry (Boyer, 2003). Even within market-based economies, there are vastly different degrees of government involvement in private sector activity (Boyer, 1990; Amable, 2003). Moreover, there are wide variations in institutions and the relationships between a range of economic actors (Whitley, 1999). This becomes apparent when looking at large manufacturing states such as Germany, Japan, and the US, in aspects ranging from plant-level labor relations to government intervention in the economy. Japan's rapid rise as an economic power is attributed in most corners to a distinctly unique institutional environment. Overall, the Japanese economy has been seen as a mix of free-market policies and active government intervention that has changed as that country's economy has developed (Sakakibara, 1993). Until the last decade, it must be noted that various levels of the Japanese government were very active in

directing and advising the private sector.

In order to understand the dynamics of an industry and the firms within it, one must also be aware of the culture of the firm, including internal relationships within the organization (Schoenberger, 1997). The organizational cultures within a firm or industry are also informed by national cultures which also must also be taken into consideration. A useful example of this is seen in research by Hofstede (1980), who found that national culture plays a role in company dynamics with respect to measures such as individualism and views on time. In related work, Trompenaars and Hampden-Turner (1998) determined that culture is pivotal to comprehending norms within business operations. Culture extends to all facets of the company, as work by Gertler (2004) demonstrated that culture is indeed integral to the successful implementation of advanced technologies for manufacturers.

BACKGROUND

The metalworking machinery industry includes the production of metal forming and metal cutting equipment¹, in addition to assorted support industries that make the innumerable parts and

¹ Within Japan, metal cutting equipment is often viewed as the machine tool sector. Metal forming equipment is often categorized separately.

accessories that are involved in developing machines that shape metal. It is a broad category, encompassing products as diverse as industrial presses, grinders, and lathes that are used throughout the secondary sector. Accordingly, the products of this industry form the basis for most other manufacturing, especially in key durable goods industries such as aircraft, household appliances, and motor vehicles and increasingly, its products play a pivotal production role in leading edge markets such as surgical equipment, replacement body parts, and semiconductors. The metalworking machinery industry is remarkably small in absolute numbers, comprising far less than one-percent on total national employment and value-added. Still, given its fundamental role in the abovementioned industries, the sector is the recipient a great deal of attention, both from others in manufacturing and within policy circles.

Given the above description, it is understandable that the metalworking equipment industry was viewed as a fundamental element of Japan's post-war reconstruction (see Sarathy, 1989). During the early years of the rebuilding process, capital goods producers such as the one described in this paper had access to various forms of government assistance. Some of this assistance came in the form of lower import duties (for early reverse

engineering) and research assistance (Tsuji and Ishikawa, 1995; Tsuji, 2000). In many ways, this initial government support and intervention provided a foundation from which the industry could transform into an international competitor. A related, perhaps more critical aim was to assist Japanese manufacturing at-large to become more competitive as well.

There is little doubt that investment in research and new technologies enabled this industry to become a recognized force in a relatively short amount of time (Kotha and Nair, 1995). By the 1970s, Japan's machine tool industry and related sectors ranked among the world's leaders, in terms of both production and innovation. A number of industry-level strategies also enable this rapid rise. One pivotal approach was the early and wide-ranging adoption of CNC (computer numerically controlled) technologies, which provided the industry with a distinct advantage on international markets (Tsurata, 1988). Additionally, Japan's manufacturers developed products that were highly advanced and of superior quality, but were also affordable to both large firms and smaller metalworking operations (Tsuji, *et al.*, 1999). Overall, Japan's early success in metalworking machinery production did enjoy many forms of government intervention, yet much of its later

success actually occurred in spite of government involvement and was a direct result of firm-level strategies such as the abovementioned CNC integration and continual attention to innovation.

The bursting of the “bubble economy” in early 1990s and the prolonged domestic economic slump negatively impacted internal demand for new machine tools (see Okamoto, 1994). However, due to the utility and technological advancements of Japanese machine tools, the domestic slump was counterbalanced by the industry’s success on international markets. During this challenging period, the industry managed to maintain high production levels and even increased world market share. The next section begins to details some of the strategies that have enabled the industry to maintain its leadership edge.

HUMAN CAPITAL: IMPORTANCE AND PRACTICES

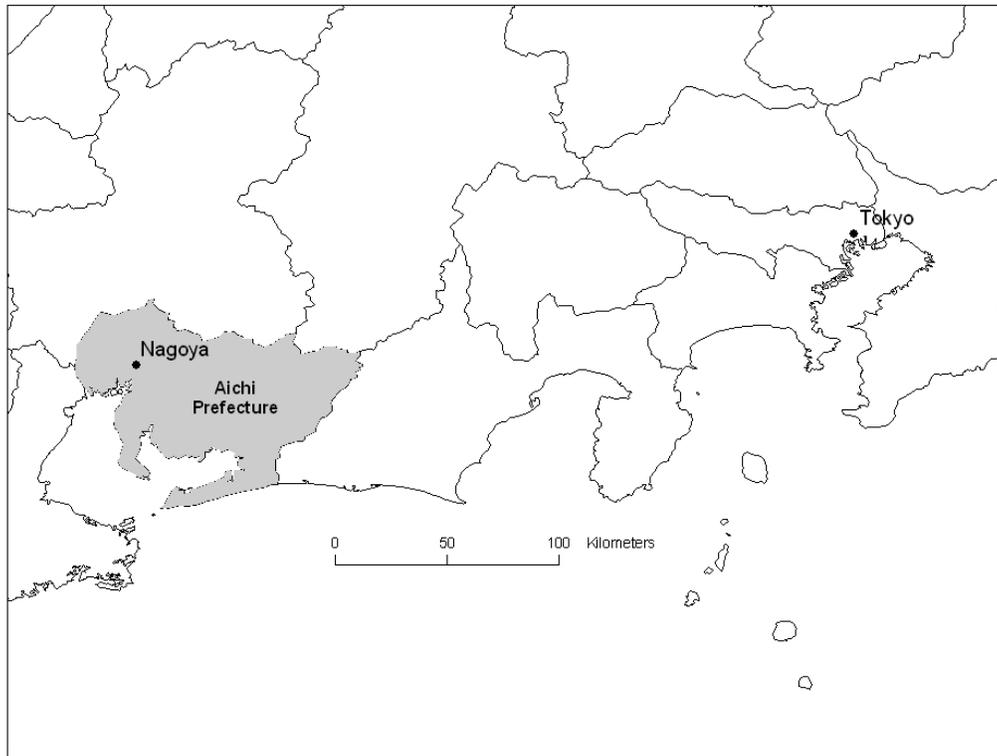
The remainder of this paper discusses findings from interviews from within the industry. Onsite visits and conversations were conducted in 2003 and 2005 with 41 representatives working in and related to Japan’s metalworking machinery sector. The interviews took place largely within the Tokyo metropolitan region and in Aichi Prefecture, the location of many metalworking firms and manufacturing giants such as

Toyota (see Figure 1). This group included metalworking machinery firms; component makers; affiliated trade groups, and manufacturing organizations. The trade groups work closely with machinery producers and are often managed or staffed by current and former workers from within the industry.

The corporate interview is a useful means to examining the evolving operations of business organizations. Schoenberger (1991) illustrated that this method is particularly valuable for looking at group dynamics and likewise, Yeung (1995) demonstrated that in international business studies, the corporate interview yields particular richness in examining the continually changing dynamics of firms and offers a degree of flexibility in firm-level research. Differences in national culture often provide obstacles to conventional survey methods, hindering attempts to ascertain interactions both within and between firms. In general, the interview is seen as an important tool in international business analyses. In terms of this paper, these interviews were largely exploratory and form the basis for a more in-depth study of the industry.

It should be mentioned at the outset that many of the strategies and concepts described in this could apply to Japanese manufacturing at large. This is

Figure 1. Central Japan and Aichi prefecture



Source: Map created by author; data from UNEP/GRID Spatial Data Clearinghouse

understandable given the industry's centrality to most manufacturing processes – one interviewee referred to the machine tool sector as, "...the mother of all manufacturing." While there could be understandable bias in the statement, this sentiment has nonetheless been shared by others involved in manufacturing in locations outside of Japan (Hogan, 2004) and by researchers as well (Graham, 1993; Finegold, *et al.*, 1994). The onsite conversations provided numerous insights on a series of connections between the metalworking machinery producers and customers across the spectrum of durable good production.

The interviews revealed that relationships within these metalworking organizations are often imbedded in institutions that in many ways are unique to Japan. Until the past decade, the Japanese workforce has been noted for its relative stability. Accordingly, one of the principal components of the success metalworking machinery firms across Japan is the relatively small turnover rate for most producers. Large Japanese manufacturing companies have traditionally been reluctant to layoff workers, a practice that was mentioned throughout the interviews. In fact, one equipment firm representative revealed that many companies across this industry have long viewed employment stability as more important than shareholder

value. This has undeniably been a factor in the success of Japanese machine tool manufacturers. By contrast in North America, high worker turnover has often complicated the process of integrating new manufacturing technologies (Gertler, 1995). Beyond this longstanding principle, most interviewees provided a pragmatic reason for maintaining workforce stability: machinery technologies have become so advanced it is important to have a workforce that is familiar with highly technical processes and products. Given the quality levels expected by the users of this equipment, every firm representative emphasized that employees must feel that they have a vested interest in not only the company but also in the customer. This is linked to related messages that were seen on signs posted in two of the factories that were visited. Another finding which illustrates this was seen in one of the largest and most successful machine tool manufacturers, where workers at every level of the corporation carry a wallet-sized card that reminds them of their commitment to quality and the customer. The concept of workforce stability is quite important in Japan and confirms what has been seen in the literature regarding the integration and use of advanced production equipment (e.g. Gertler, 1993; Gertler, 1995).

A related structural aspect of Japanese machine tool success

regards the current composition of the workforce. The interviews suggested that much of the current success within the Japanese metalworking industry stems from the rebuilding process in the country at large. During that period, a large number of university students studied engineering or one of the physical sciences. In the 1960s well through the 1980s, it was possible for graduate at any level to obtain a position in the manufacturing sector. As will be discussed in the next section, this is expected to change, due to demographic changes and overall transitions in Japanese career preferences. In the meantime, this large body of engineers and scientists has enabled the continued innovation at many firms.

Many interviewees discussed another strategic reason that, in their opinions, explains some of the industry's success. There is a prevailing belief within the industry that Japan capital goods manufacturers have been much less protected and/or assisted by government intervention than other sectors such as banking or retailing. Essentially, most manufacturing firms were left to fend for themselves on world markets. In the case of metalworking equipment production, this suited these firms quite well. After initial government assistance that was discussed in the previous section of this paper, it has been largely a series of firm-

level or industry-wide initiatives that have allowed the Japanese machine tool industry to continue to thrive. While the lack of policy-based support is a common lament throughout most industrialized countries, every metalworking industry representative admitted that government help was far less than desired. At the same time, it has prompted the industry to independently seek new markets and product lines.

Another point that is often overlooked in explaining the industry's continued success is the fact that within Japan, manufacturing in general is still viewed as a good profession, which helps to attract workers to the metalworking sector. According to six of the interviewees, much of the blame for the economic stagnation and collapse of the bubble economy has been laid at the feet of the financial industry, specifically banking and real estate. Manufacturing is seen as the economic sector that kept a modicum of stability in Japan's economy through the past decade. Given their importance, visibility, and success, machine tool and related metalworking machinery manufacturers are accordingly viewed as more stable employers and therefore attract some of the better employees. This is especially the case in manufacturing-intensive regions such as Aichi Prefecture. Within the secondary sector at-large, the first employment choices are the

obvious manufacturing giants such as Toyota and Canon. Across the industry detailed in this paper, leading machine tool firms are extremely attractive to younger workers, as world-leading toolmakers such as Mori Seiki and Okuma often have the first selection of new graduates.

There is also an interesting regional aspect to the labor supply matter that emerged from the interviews and is worth noting. Within the Aichi prefecture, there is of course competition between the numerous metalworking and myriad manufacturing firms for skilled employees. Some of the workforce advantages stem from the demographic changes in Japan, which will be discussed further in the next section. Family sizes have become much smaller, with many families having only one child. What helps many Aichi-based employers is that there is a large sense of obligation to look after one's parents that is still prevalent in the region. Many of these children prefer to stay in the Aichi region in order to be near one's parents. This works to the advantage of many of the machinery companies, as they have access to a comparatively stable regional workforce. In turn, this also helps the more prestigious toolmaking firms, as again, they are the first choices among potential job applicants. Linked to this generally favorable impression of manufacturing is the concept of *monotsukuri*. A rough

translation means 'making things', but it is a broader idea, actually extending to hands-on creation. To the generation who came of age during Japan's rebuilding process, actually 'building something' is quite important. This is easily understandable, given the tasks of this industry's firms and products. Also, given the failings of Japan's service sector and the general view of the machinery industry in Japan, the importance placed upon the concept of *monotsukuri* is plainly evident. While discussing this idea, one firm representative also discussed the concept of *gijyutsu gino no densho*. Even the interviewees admitted that this was difficult to describe, but the best estimation is some combination of technical skill and innovation that is passed to the next generation within a firm or industry. It is viewed as an obligation to relay these skills to the next generation of manufacturing workers. In this sense, the manufacturing is viewed as not only a skill, but also as an art. A very important part of this is that within these companies, the worker is viewed (in the words of one company representative), "...not as a simple person." Rather, he or she is viewed as an integral part of the company.

The term *meister* was used continually throughout the interviews with company representatives. This originates with the German process of a manufacturing worker who is a

master of his or her craft or process, and has been widely adopted by Japanese firms. Within many of the metalworking equipment firms, this is a goal that many production-level employees are supposed to work toward. At one Japanese machine tool maker, the board of *meisters* has been expanded several times and the title is seen as an important goal within the company. This is firmly embedded in the belief of manufacturing as both a trade and as an art. The similarities between Japan and Germany with respect to the national economies and in particular, manufacturing, are striking. Incidentally, these two countries consistently rank first and second in world machine tool production.

Within individual companies, this industry, and manufacturing in general, a number of important practices have helped Japanese toolmakers to remain among the best internationally. An important part of the manufacturing process is the concept of *genba-shugi* or field-oriented management. A representative (and retired engineer) from one industrial organization stated that perhaps the best way to describe this concept in English as “site-ism”. This would appear to be a fitting translation, as an emphasis is placed on being onsite in order to learn the process. In many firms, it is a policy that all engineers get into the field to actually observe what is occurring on the factory

floor. The belief is that this will enable engineers to understand what occurs on the production line and throughout the company. Beyond this, many companies and organizations described this process as a critical part of office personnel understanding the importance of the role of the plant floor worker to the success of the organization. Within most machinery firms, this is a commonly-used process.

One of the largest Japanese machine tool producers that was visited during the interview process explained a program in which every employee must work on the production side of operations. A firm representative confirmed that these trainees actually assemble machines that are bound for customers, which emphasizes the importance of the task. This is just one example of the internal training programs that most large machinery producers use. As was mentioned in many interviews, such programs provide an enduring respect for the production workers and moreover, it helps employees to understand the entire manufacturing process for that particular product. As one company representative explained, the end result is that an engineer will not design a product that is difficult to assemble.

Without a doubt, the process of *kaizen* (constant improvement) is essential to the success of Japanese manufacturing. The other concepts

previously mentioned tie into the kaizen process. Given the work circles and the resulting cooperation between different parts of the corporate hierarchy, the process of constant improvement is enabled. Kaizen was fully implemented through all of the factories that were visited. In many ways, it is not an exception; rather it is standard practice across most Japanese manufacturers. Given the abovementioned practices that place all workers on the factory floor at one point, it is understandable that this contributes to the kaizen process. Incidentally, an interviewee mentioned that a kaizen program was implemented at his employer's US branch plant, with less than satisfactory results until an individual cash reward was offered for improvement suggestions. This example illustrates that even within the same corporation, national culture often plays a pivotal role. It should be mentioned that all metalworking companies that were interviewed have internal activities that emphasize quality and improvements in productivity.

TRANSITIONS AND CHALLENGES

Japanese metalworking machinery manufacturers obviously place an emphasis on human capital and have in place a number of strategies for workforce development. At the same time, there are a number of impending challenges for manufacturers.

Observers have noted for some time that Japan must address major structural challenges in order to continue as a major industrial power (Yamamura, 2003). Keeping this in mind, it is worth exploring what competitive issues that the industry is now facing. The interviews revealed several looming issues that could challenge the industry and its leading position. These are not problems rooted within the industry itself, but the result of larger structural changes within Japan.

The first, perhaps most critical problem is largely demographic. An ageing population and the shrinking workforce provide a formidable challenge to machine tool producers. Since the industry is so heavily dependent upon innovation to maintain its edge against international rivals, it has become important to continue to find skilled workers. Given that the working-age (and overall) population is shrinking, it remains to be seen if the manufacturers of this advanced equipment can continue to recruit and retain the workers that are so pivotal to their success. Almost everybody who was interviewed agreed that although the labor shortage is not a critical problem now, it certainly will be within the next 10-15 years given Japan's demographic trends. In a proactive approach, some metalworking firms are now extending employment for older workers beyond the traditional

retirement age in order to at least temporarily hold off potential labor shortages.

Some firms are already starting to see shortages in certain engineering functions and in production positions. While there is no trouble recruiting mechanical or manufacturing engineers, it is often difficult to recruit software engineers that can assist with the increased automation or the proprietary computer controllers of some firms. According to company representatives, prospective recruits are instead attracted to a more 'glamorous' firm, such as Fanuc (an industrial robotics and controls producer) or to actual software firms. This shortage, while small, is important as engineers form the technological future for the industry.

Additionally, the shrinking labor force problem is already beginning to impact the smaller machinery firms and the parts manufacturers. A representative from a parts-makers trade group admitted that it has now become extremely difficult to recruit workers to smaller and medium sized enterprises (SMEs). Some of this stems from obvious financial attractions and relative stability found at the larger firms. Yet some of this also stems from yet another geographical angle – many of the SMEs in the parts industry are located in largely rural prefectures which are not necessarily attractive to younger workers,

despite the familial obligations that were discussed earlier.

Given the attractions of other industries, such as information technologies and telecommunications, it remains to be seen whether machinery manufacturers can indeed maintain their attractiveness to younger members of the workforce. This was a concern voiced in all but a few interviews, not only in metalworking equipment production but in conversations with companies in many types of manufacturing. Beyond the demographic trends that presage a shrinking labor force for metalworking manufacturers, the interviewees acknowledged the slow generational change with respect to the perception of manufacturing. In almost every conversation and onsite visit, the dilemma of the "3K" problem arose. The 3Ks stand for *kitsui* (difficult), *kitanai* (dirty), and *kiken* (dangerous). These are labeled as the general perceptions of manufacturing. These labels often have been applied to occupations such as construction, but now many see these as applying to manufacturing, even in sectors as advanced and as relatively 'clean' as the metalworking industry. In order to address this perception issue, many firms now take part in programs that introduce high school students to the secondary sector, in order to show them what modern manufacturing actually looks like.

There is a general consensus within the industry that younger people are not attracted to manufacturing due to the perceived characteristics mentioned above. Additionally, much to the lament of many of the interviewed manufacturers, information technologies are a big attraction to younger workers. Interestingly, the 'Livedoor' situation was raised during six interviews as a disturbing situation (an upstart internet company that attempted to purchase an established Japanese broadcaster). While far outside the realm of metalworking or manufacturing, this situation is largely emblematic of changes in Japan's economy in the opinion of some interviewees. This was viewed as generally indicative of 'the next generation' avoiding manufacturing as a vocation, symbolic of declining emphasis on manufacturing, and avoiding employment at established firms.

A final competitive challenge to note is the evolving nature of the firm in Japan. As discussed earlier, there was a large sense of obligation to employees. Several individuals admitted that this is changing, as short-term returns become increasingly important and the overall economy changes. The shorter-term view is becoming increasingly prevalent, as profits become increasingly important to investors. Moreover, the traditional networks of companies are dissolving and individual firms are

expected to be financially viable. This alone has compelled many firms to think of profitability perhaps at the expense on long-term labor force stability.

CONCLUSION

The interviews suggest that machinery firms across Japan view workers as an integral part of firm-level and industry-wide success. Much of this is maintained via a number of concepts or practices that are grounded in Japanese organizational culture, such as relatively low turnover rates. Many of these policies place an emphasis on the importance of production workers to the firm's success and they have undoubtedly contributed to the industry's unparalleled achievements on world markets. It would be difficult to directly apply these systems within another work environment, given numerous cultural and organizational differences.

Demographic changes are threatening the relative stability of Japanese manufacturing and at its core, the machinery industry. The central challenge for firms in the next several decades will be to recruit new workers at all levels from a steadily shrinking workforce. Moreover, changing perceptions of manufacturing could shrink this workforce further, as has happened in many advanced economies. Given that consumers of these capital goods demand increasingly high-end equipment, this pressing human capital issue

is one of the largest challenges for the industry.

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