Columbia Project: Use of Software to Achieve Competitive Advantage

STEEL: TOKYO STEEL, K.K.

Gaining and Sustaining Long-term Advantage Through Information Technology

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SOFTWARE AS A TOOL OF COMPETITIVE ADVANTAGE: THE MINI-MILL STEEL INDUSTRY IN JAPAN

Introduction: Objectives of this Benchmarking Study

This mini-mill steel case study for Tokyo Steel (TSC) was completed under a three-year research grant from the Sloan Foundation. The project's purpose was to examine, in a series of case studies, how US and Japanese firms who are recognized leaders in using information technology[1] to achieve long-term sustainable advantage have organized and managed this process. While each case is complete in itself, each is part of this larger study.[2] A comparable US steel company case on mini-mills is underway for Nucor.

This case for a Japanese mini-mill steel producer, together with other cases[3], supports an initial research hypothesis that leading software users in the US and Japan are very sophisticated in the ways they have integrated software into their management strategies. They use it to institutionalize organizational strengths and capture tacit knowledge on an iterative

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[1] In this paper and the overall study, the terms "software, information technology (IT) and systems" are used interchangeably. Further, when referring to the firm as a whole, the text uses "it", but when referring to management, "they" is used. The mini-mill sector covers non-specialty steel producers using electric arc furnaces.

[2] The industries and firms examined are food retailing (Ito-Yokado), semiconductors (NEC and AMD), pharmaceuticals (Takeda and Merck), retail banking (Sanwa and Citibank), investment banking (Nomura and Credit Suisse First Boston), life insurance (Meiji and Nationwide), autos (Toyota), steel (integrated mills and mini-mills, Nippon Steel, Tokyo Steel and Nucor), and apparel retailing (Isetan and Federated). Nationwide has replaced USAA, as the latter was unable to participate. These industries and cases were generally selected based on the advice and research of specific industry centers funded by the Sloan Foundation. These are the computer and software center at Stanford, the semiconductor and software centers at Berkeley, the financial services center at Wharton (University of Pennsylvania), the pharmaceutical and auto centers at MIT, the steel project at Carnegie-Mellon, the food services project at the University of Minnesota, and the apparel retailing center at Harvard. The case writer and the research team for this case thus wish to express their appreciation to the Alfred P. Sloan Foundation for making this work possible and to the Sloan industry centers for their invaluable assistance. They especially appreciate the time and guidance given by the steel research center at Carnegie-Mellon as well as the staff at Tokyo Steel (TSC) who were generous with their time. Still, the views expressed in this case are those of the author and not necessarily those of TSC or its management.

[3] This refers to cases for which interviews have been completed. See footnote 2.

basis. In Japan this strategy has involved heavy reliance on customized and semi-customized software (Rapp 1995), but is changing towards a more selective use of package software managed via customized systems. This is seen in this case in Tokyo Steel's development of a system to automate and integrate its different mills. In turn, US firms, such as Merck, who have often relied more on packaged software, are customizing more. This is especially so for the systems needed to integrate software packages into something more closely linked with the firm's business strategies, markets, and organizational structure.

Thus, coming from different directions, there appears some convergence in approach by these leading software users. The cases thus confirm what some other analysts have hypothesized; a coherent business strategy is a necessary condition for a successful information technology (IT) strategy (Wold and Shriver 1993).[4] These strategic links for Tokyo Steel and the Japanese steel industry are presented in the following case.[5]

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[4] These and other summary results are presented in another Center on Japanese Economy and Business working paper: William V. Rapp, "Gaining and Sustaining Long-term Advantage Through Information Technology: The Emergence of Controlled Production," December 1998. Also see: William V. Rapp, "Gaining and Sustaining Long-term Advantage Using Information Technology: Emergence of Controlled Production," Best Papers Proceedings, Association of Japanese Business Studies, Salt Lake City, UT, June 1999.

[5] All the cases are being written with a strategic focus. That is, each examines a firm's IT strategy rather than the specific software or IT systems used. In this sense, they illustrate how IT is used to improve competitiveness rather than what specific software a firm is using. The latter is generally only noted to illustrate and explain the former. This emphasis was not specified when the project began but has evolved as research has progressed. There are three major reasons the cases have become focused this way. First, at a detailed level, all these firms have unique software and IT systems due to the way each weaves organization with packaged and custom software. There is thus little others could learn if a case just explained each firm's detailed IT system or systems. Further, the cases would be long and would quickly drown the reader in data since IT pervades all aspects of these very large corporations. This was apparent at an early stage in the study when the project team tried to develop IT organization charts for Takeda, Merck, and NEC. The second reason is that, at a general level, differences in firm IT systems can be almost trivial since there are only a limited number of operating system options, e.g. IBM mainframes, Unix workstations, and Windows or MAC based PCs. Third, information technology changes very rapidly and thus each firm is constantly upgrading and evolving its systems. So detailed descriptions of each IT system would rapidly become obsolete. For these reasons, focusing the cases on strategic principles developed as the best way to explain to readers something they could use and apply in their own situations. This reasoning has been confirmed when the material has been presented in different forums as discussants have commented favorably on the approach. Equally important, in the interviews and conversations with management, this is where they have focused their responses. That is, as the various cases illustrate, the firms manage their IT decision-making by following a set of strategic principles integrated with their view of their competitive environments. This is similar to Nelson and Winter's (1982) rules and routines for other kinds of management decisions and innovations, and illustrates these firms' evolutionary approach to IT use and development. Their basic reasons for this incorporate the points noted above, i.e. each firm's unique system, the limited operating system options, and IT's rapid technical change. Based on what the case study teams have learned, therefore, it is these firms' strategic approaches, including the concept of controlled production explained later, that seem to have the widest applicability and offer other organizations the most potential insights

This is because this case along with the other cases also illustrates that the implementation and design of each company's software and software strategy is unique to its competitive situation, industry, and strategic objectives. These factors influence how each chooses between packaged and customized software options for achieving specific goals, and how each measures its success. Indeed, as part of each firm's strategic integration, Tokyo Steel and the other leading software users interviewed have linked software strategies with overall management goals. This is achieved through clear mission statements that explicitly note the importance of information technology to firm success.

Each has coupled this view with active CIO (Chief Information Officer) and IT (information technology) support group participation in the firm's business and decision making structure. Thus, for firms such as TSC, the totally independent MIS (Management Information Systems) department is a thing of the past. This may be one reason why outsourcing IT development for TSC has not been a real option. However, the company's relatively successful business performance in steel is not based solely on software. Rather, as

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without becoming dated in how to use IT to improve competitiveness. The detailed strategy described here, though, only applies to mini-mills producing steel in Japan.

described below, software is an integral element of the firm's overall management strategy with respect to producing and selling steel through the Japanese trading companies (TCs) to major customers, especially the Japanese construction firms. It also plays a key role in serving corporate goals, such as enhancing mill productivity by improving order management, production scheduling, and equipment processing, while reducing inventories or strengthening supply capabilities. These systems are thus coupled with an appropriate approach to selling, production, customer delivery, new product development, and constant cost reduction that reflects TSC's clear understanding of its business, its industry, and the firm's competitive strengths within this context.

This clear business vision (Appendix I), especially the strategic focus on continuing cost reduction as described below, has enabled TSC's management to select, develop, and use the software they believe is required to assist TSC's mills to operate at a higher and more consistent level of performance. It also enables them to produce higher value added products, such as hot rolled coil. In turn, TSC has integrated this support to its mills into a total information system for the firm (Exhibit 1) that is linked with the company's overall operations. Since this vision has also impacted other corporate decisions, TSC seems to have good human resource and financial characteristics, too. (See Appendices I & II on Strategy & Operations as well as Firm & Industry Data).

Tokyo Steel does, however, share some common IT issues with other leading software users. An example of this is the creation of large, proprietary, interactive databases that promote automatic feedback between various stages of the order, production, and delivery processes so that they and customers can track an order's progress through the system. Its ability to use IT to economize on traditional production systems and to batch inventories, by reducing the amount of steel that must be held at various points in the production process, through integrating and making the process more continuous, is also a common management initiative for other leading software users. In addition, TSC has been able, organizationally and competitively, to build beneficial feedback cycles or loops that increase productivity in areas such as customer delivery and product availability, while reducing cycle times and improving production and product supply.

Management recognizes that better cycle times between TC orders and ultimate delivery reduce costs and improve business forecasts since production plans are for shorter periods. Customer satisfaction is enhanced, as well, through more timely completion of the process. Therefore, software inputs are critical factors in TSC's and other leading users' overall business strategies. There are strong positive results for doing it well, and potentially negative implications for competitors.

However, TSC does not appear to be a leader in a possible new production paradigm, "controlled production" ("CP"). Rather, it appears to be a very efficient mass production producer, using economies of scale for standardized products, as well as incorporating aspects of lean production by integrating discrete production processes, and tying output more closely to actual demand. It has not, however, developed an approach for capturing the significant improvements in productivity delivered by "controlled" production. This is because "CP" requires monitoring, controlling, and linking every aspect of producing and delivering one's products and services, including after-sales support and product changes. TSC has not yet developed this approach, and it does not appear to be part of its longer-term strategy, since it continues to rely on the TCs for order flow and independent scrap producers for its major raw material. A controlled production approach would require actively using IT systems to continuously monitor and control functions that were part of a supply structure responding to changes in expected or actual consumer demand. That approach would also use IT to influence or stimulate those changes in demand. It would also work to influence the characteristics of its supply chain. Such external effects can only happen when IT is integrated with the firm's total business environment, both internal and external, from an operational and organizational standpoint, reflecting an overall business strategy and clarity of competitive vision that seeks to actually impact the external environment to the firm's competitive advantage.

Nevertheless, IT systems are integral to how TSC organizes, delivers and supports its mills and steel business, from product development, to ordering, to production, and through to delivery. This sequence is particularly critical in steel where the demand and supply for particular products shifts according to the customers' business and economic situation. That is, as economic conditions affect the demand for autos, ships, and construction differently, the mix of steel products demanded by TSC's clients, through the TCs, is constantly shifting.

In TSC's case, as with the other leading software users examined in this case study series, the key to using software successfully is to develop a mix of packaged and customized software that supports the firm's business strategies and differentiates it from competitors. TSC's management has done this by using IT to enhance TSC's existing organizational strengths as a low cost producer of standard steel products, rejecting the idea of trying to adapt its organizational structure to the software used.

They have also looked to functional gains to justify the additional expense incurred in customizing certain systems. These expenses include the related costs of integrating customized and packaged SW into a single information system while training employees to use it. This integration is done by first assessing the possible business uses of software within the organization and its operations. Particular focus is placed on IT's role in enhancing TSC's core competencies in more efficiently developing, producing, and delivering several different types of standard steel products. Management, therefore, does not accept the view that IT systems are generic and are best developed by outside vendors who achieve low cost through economies of scale and who can more easily afford to invest in the latest technologies.[6]

Approach: Methodology and Questions

In undertaking this and the other case studies to assess the importance for each firm of the issues noted above, the project team sought to answer key questions while recognizing firm, country, and industry differences. These have been explained in the summary paper referenced in footnote 4. They are set forth in Appendix I as well, where TSC's profile is presented based on the company interviews and other research. Readers who wish to assess how TSC's strategies and approaches to using IT address these issues may wish to review the

[6] Tokyo Steel and the other cases have been developed using a common methodology that examines cross-national pairs of firms in key industries. In principle, each pair of cases focuses on a Japanese and American firm in an industry where software is a significant and successful input into competitive performance. Excepting Nationwide Insurance, the firms examined are ones recommended by the Sloan industry centers as ones using SW successfully. A leading securities analyst recommended Nationwide as a replacement for USAA. So all the firms are recognized by their industries as being good at using IT to improve competitiveness. To develop these "best-practice" studies, the research team combined analysis of current research results with questionnaires and interviews. Further, to relate these materials to previous work as well as the expertise located in each industry center, the team talked with the industry centers. In addition, it coupled new questionnaires with the materials used in a previous study to either update or obtain a questionnaire similar to the one used in the 1993-95 research (Rapp 1995). This method enabled the researchers to relate each candidate and industry to earlier results. The team also worked with the different industry centers to develop a set of questions that specifically relate to a firm's business strategy and software's role within that. Some questions address issues that appear relatively general across industries, such as inventory control. Others such as managing the IC manufacturing process are more specific to a particular industry. The focus has been to establish the firm's perception of its industry and its competitive position as well as its advantage in developing and using a software strategy. The team also contacted customers, competitors, and industry analysts to determine whether competitive benefits or impacts perceived by the firm were recognized outside the organization. These sources provided additional data on measures of competitiveness as well as industry strategies and structure. The case studies are thus based on extensive interviews by the project team on IT's use and integration into management strategies to improve competitiveness in specific industries, augmenting existing data on industry dynamics, firm organizational structure, and management strategy collected from the industry enters. Further, data was gathered from outside sources and firms or organizations that had helped in the earlier project. Finally, the US and Japanese companies in each industry were selected based on being perceived as successfully using software in a key role in their competitive strategies. In turn, each firm saw its use of software in this manner while the competitive benefits were generally confirmed after further research. In the case of steel, the team was particularly aided by presentations given by the Carnegie-Mellon steel group at the annual Sloan Industry Center Meetings from 1997-99 as well as the book produced by that Center (Ahlbrandt, Fruehan, and Giarratani 1996).

summary prior to reading the case. For others, the profile summary may represent a useful outline.[7]

Introduction to Case

The case study begins by placing Japan's steel industry, particularly its mini-mills, in a competitive context and then examines the governmental policies, economic factors, and competitive dynamics affecting Japan's steel markets and its mini-mill producers. As Japan's leading independent mini-mill producer (Appendix II), Tokyo Steel's evolution, competitive situation, and current strategies are an integral part of this picture. Its present situation well illustrates the competitive issues facing Japan's mini-mill steel producers. Currently, the large, integrated Japanese steel companies, as well as foreign producers, are aggressively challenging the Japanese mini- mills in their domestic market, having largely driven them from export markets in the 1980s and 90s. It is thus critical for TSC to successfully manage its development in this increasingly competitive Japanese market, especially for the standard products it produces. Indeed, it has little choice since steel products represent virtually all its revenues, operating earnings, and invested capital (Appendix II). In 1997, 99% of its sales were steel products, and most of its profits (88%) came from domestic sales (Yamada & Cosgrove 1998).

At the same time, TSC's organizational structure and software product choices help us understand its use and demand for IT. The case study then describes how TSC uses IT as a tool to create competitive advantage in selling and delivering steel products. The last section summarizes the research and case study findings and identifies other potential strategic benefits

[7] The questions are broken into the following categories: General Management and Corporate Strategy, Industry Related Issues, Competition, Country Related Issues, IT Strategy, IT Operations, Human Resources and Organization, Various Measures such as Inventory Control, Cycle Times, and Cost Reduction, and finally some Conclusions and Results. The questions cover a range of issues from direct use of software to achieve competitive advantage, to corporate strategy, to criteria for selecting software, to industry economics, to measures of success, to organizational integration, to beneficial loops, to

from TSC's use of IT. However, to appreciate IT's role within TSC's total strategy and business operation, some industry, market, and economic characteristics need to be explained.[8]

The Industry Context: Japan's Steel Industry and its Mini-Mills[9]

In their 1996 assessment of Japan's steel industry and of Tokyo Steel, Ahlbrandt, Fruehan, and Giarratani (A, F&G 1996) describe a market that in the early 1990s "was awakened to the fact business as usual would no longer work." For the integrated producers, this was a far cry from the 1960s and 1970s. Then Japan's steel industry was perceived globally as an industrial juggernaut, dominating world steel markets and giving Japanese steel users such as auto producers and shipbuilders a huge competitive advantage (O'Brien 1992; Ostrom 1996; A, F&G 1996). In addition, this industrial clout was highly concentrated in five large integrated firms (O'Brien 1992; Appendix II). However, beginning even in 1970, the situation for Japanese mini-mill producers was quite different (Uriu 1991; A, F&G 1996). A combination of the Nixon shock, that dramatically revalued the yen, and the first oil crisis, that raised electricity prices, hit this industry particularly hard. Japanese growth and construction demand fell, while costs rose sharply, forcing the industry into dire economic straights (Uriu 1991).

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training and institutional dynamics, and finally to inter-industry comparisons. These are summarized for Tokyo Steel in Appendix I.

[8] O'Brien (1992) describes how "steel was one of Japan's earliest and possibly most dramatic industrial successes. … The industry was rebuilt in the early 1950s, and, … for the next two decades, Japan's steel output grew at an average annual rate of 15%. By 1976, the industry was capable of producing nearly 150 million tons of steel yearly and was responsible for 16% of the world's steel market share. Even in the mid-1980s, when it had lost superiority in steel to Korean companies, Japan produced over 20 percent of the world's steel exports." But this assessment only applies to the integrated producers. Mini-mills primarily converting scrap iron into rebar for construction have faced a very different situation (Uriu 1991).

[9] Minimills use electric furnace technology that is far simpler and less capital intensive than integrated production. They use steel scrap and, more recently, directly reduced iron ore in various forms that are melted by electric arcs generated between graphite electrodes. Low start-up costs and simpler technology allow for easier entry and smaller localized production (Appendix II). Thus, the mini-mill producers have the advantage of lower transportation costs, lower capital costs (about 25% of an integrated mill), and a simpler production process that uses about half as many man-hours per ton produced (Appendix II). However, as long as they depend on scrap inputs, they are limited in the quality of steel that they can produce. So in the 1970s and early 80s, Japanese mini-mill producers were largely confined to the construction market, producing re-enforcing bar (rebar) for concrete construction. In 1980 more than 87% of total mini-mill output was bar steel and structural shapes, both

These economic pressures built during the 1970s from two sources (Uriu 1991). The first was the further decline in domestic steel demand for construction, as the Japanese economy felt the combined pressures of further yen appreciation and another oil crisis. The second was the emergence of a small group of more efficient mini-mill competitors such as Tokyo Steel. It was during this period that a "boom & bust" cycle emerged that caused the industry to periodically seek protection under various guises as a "depressed" industry. These periods often coincided with government fiscal policies that sought to either stimulate or restrain the economy (Uriu 1991). While exports provided some relief in the 1970s and early 1980s, unlike the integrated producers, exports by Japanese mini-mills virtually disappeared with the yen's rapid appreciation after the Plaza Accord, in 1985. So today Japan's mini-mill industry is basically local steel production for the local construction market.

Some firms tried to solve the problem of declining demand and rising costs by just rationalizing production, reducing capacity and their labor force, while seeking government (MITI) controls against downward price pressures. Others, however, evolved into new, higher value-added products while modernizing and improving production efficiency. Even though the latter were considered "outsiders", their strategy was quite successful against the relatively inefficient and economically weak mini-mill competitors, who became weaker with every boom & bust cycle, despite their initial political influence (Uriu 1991).[10] As Uriu (1991)

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used in construction. In 1985 bar steel accounted for 62% of industry output. Thus, in the 1970s the combination of a weak construction market and much higher energy costs due to the two oil crises was devastating (Uriu 1991 and A, F&G 1996).

[10] Robert Uriu in his doctoral dissertation on Japan's depressed industries notes: "On the one hand were the industry 'insiders,' the majority of firms in the industry that, because of their relative lack of competitiveness, favored collective stabilization efforts. On the other hand was a small group of firms, known as the industry 'outsiders,' that preferred a market solution. During the 1970s it was the industry 'insiders' that held sway. The insiders persistently sought to impose industry-wide limitations on total production, and later on excess capacity, … The industry succeeded in mobilizing public policy in support of its stabilization efforts: the industry appealed for and was granted permission to form a series of recession cartels to monitor and enforce cooperative production cuts, and later sought designation under new legislation passed in 1978, the Structurally Depressed Industries Law (*Tokuanho*), to help in the coordinated reduction of excess supply. However, the bitter conflict between those in favor and those opposed to stabilization eroded the tenuous consensus among the minimills, … By the mid-1980s the minimills had gradually abandoned their efforts to seek industry-wide reductions in output, which had proven essentially unenforceable."

explains concerning these "outsiders", of whom the leader was TSC, "The competitiveness of these firms, which accounted by 1980 for about 25% of the industry's capacity, made them confident that they could prosper without stabilization efforts. These firms were not only unwilling to cut production, but were determined to increase their production shares at the expense of firms that were cooperating to stabilize competition." In fact, these "outsider" firms, who felt they could succeed without price "stabilization", were ultimately proven right since their lower costs meant they were able to better survive the downturns, while making more money during the upswings than their inefficient competitors. These funds allowed them to expand capacity. Indeed, during the 1980s, TSC built large cash reserves and funded its expansion mostly from cash flow or stock issues, while remaining relatively debt-free (Appendix II).

Tokyo Steel has been the leader of this "outsider" group, roughly, since 1972, and its clear economic success by the late 1980s is a testimony to its successful strategic initiatives (Appendix II). This is because, realistically, their approach could not be replicated by most mini-mill competitors.[11] For example, while the total production of Japan's mini-mill producers

fell from 11.3 million tons in 1973 to 7.0 to 8.0 million for 1975-78, TSC was able to increase its share from 4.3% to 9.4% (Uriu 1991).[12] Indeed, TSC continued to increase its capacity from

[11] This is not true though relative to integrated firms in 1990s. (See Appendix II "Cost Reduction Efficiency Indices Major Japanese Producers 1994-98" where 6% cost reductions are shown as being replicated by all integrated producers.) In fact, as A, F&G (1996) note, integrated producers were quite effective in "reducing the size of their corporate bureaucracy, cutting out management layers, combining jobs, and speeding up decision making by forcing it down farther in the organization." Unfortunately, TSC, who was already quite lean, could not achieve similar economies. Its combined executive and sales offices occupy one floor of a building and are less than 50 people (A, F&G 1996). So the increased competitive price pressures due to industry-wide cost reductions has actually hurt them (Appendix II) with their costs as a percent of revenue per ton rising from 86.0% in 1993 to 104.5% in 1997.

[12] Today's Tokyo Steel was formed from the 1975 merger of Tosa Denki and Tokyo Seitetsu. Uriu (1991) explains this development during the depressed output period from 1974-78. "The story of the young president of Tosa Denki Seikojo (later to merge with Tokyo Seitetsu), deserves mention. Iketani Masanari, the son of Iketani Taro, the then president of Tokyo Seitetsu, had entered his father's firm in 1968. When the ailing Tosa Denki, at that point Japan's 7th largest bar steel producer, asked Tokyo Seitetsu for help in managing its operations, the junior Iketani was sent as managing director in 1969 and became Tosa Denki's president in 1970, at the age of 25. By 1975 Iketani had transformed Tosa Denki into Japan's largest bar steel

about 1.8 million tons in 1980 to 4 million tons in 1994 (Uriu 1991 and A, F&G 1996). This helped TSC maintain competitiveness while also raising production at its mills. Financial performance also improved (Appendix II). In this sense TSC was able to do in a depressed

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producer, and had no intention of curbing future growth plans for the sake of stabilizing the market or rescuing ailing minimills. Tosa Denki and Tokyo Seitetsu merged in December 1975, soon after the 1975 cartel was formed, with the junior Iketani becoming president (the senior Iketani became the firm's chairman). He and Tokyo Seitetsu then embarked on a decade-long confrontation with the insider minimills … Tokyo Seitetsu's competitive edge can be seen first in its growing market share: in 1965, the combined output of Tokyo Seitetsu and Tosa Denki was 4.3 percent of the industry's total output, while 10 years later this figure had more than doubled, to 9.4 percent. Similarly, their combined share of bar steel nearly tripled in this period. Second, it had remained remarkably free of external borrowing. Whereas the rest of the minimills had borrowed upwards of ¥500 billion, mostly from shosha and banks, Tokyo Seitetsu had been able to use internal resources to fund its expansion efforts. … Tokyo Seitetsu's underlying competitiveness and independent position made Iketani a fervent believer in the free market, and absolutely opposed to the recession cartels and other cooperative efforts. He lambasted the rest of the industry for attempting cooperative solutions, arguing that such arrangements would allow uncompetitive firms to survive without trying to lower costs or improving technology, and would hurt the more competitive firms." He thus moved ahead aggressively between 1978 and 1980, completing 2 large furnaces and a large bar mill at Okayama and increasing bar production by almost 95% as well as market share from 4 to 7% (Uriu 1991). This scenario was repeated during the 1980-81 recession when TSC expanded output by a third and increased its market share to 9 percent.

industry what many successful Japanese firms had done in a growth market (Abegglen & Stalk 1985): build capacity, gain market share, improve efficiency, lower costs, lower prices, gain market share, build more new modern capacity, further lower costs, etc., etc.

Even in the 1970s, more energy-efficient production technologies had achieved a 20% reduction in energy costs per ton of crude steel. At the same time, TSC like other Japanese companies ("Kaisha") (Abegglen & Stalk 1985) gradually moved into higher quality products, forcing out existing competitors. (The firm data presented in Appendix II clearly show the shift from low value commodity products, such as rebar, in to H-Beams, and more recently, to hot rolled coil.) This approach worked quite successfully through the Bubble Period (1985-89). At that point TSC's strategy brought it on a collision course with the large integrated producers, who for the first time, were facing significant economic and competitive difficulties of their own (Ostrom 1996; A, F&G 1996; Appendix II). However, unlike the situation in the US, the large integrated firms did not move over for the expanding mini-mill producers. Instead they fought back aggressively with pricing and product innovation strategies of their own (A, F&G 1996; Appendix II; footnote 11). A, F&G (1996) note that "in the H-beam market, for instance, Tokyo Steel held a 30% market share in the early 1990s, but as steel demand declined, Nippon Steel began to focus on this market through aggressive price competition. By 1994, sluggish demand coupled with Nippon's aggressiveness drove the price of H-beams down by more than half. Nippon Steel and its affiliates succeeded in capturing about 30 percent of the market with Tokyo Steel's share falling below 20 percent." This competitive situation continued through 1996 (Harada 1998 and Appendix II.)[13]

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[13] Interestingly, this was a different result from what happened in the early 1980s when TSC and other "outsiders" first entered the H-Beam market and were attacked by the integrated mills. During that period, the mini-mills' share rose from 24.3% in 1977 to 59.1% in 1987. However, as noted elsewhere, the integrated producers in the interim had significantly cut costs due to the fact that "the majors by the 1980s had been shocked out of their complacency, and made significant rationalization efforts," (Uriu 1991). At the same time, the minimills were facing the difficulties of a strong yen and a weak domestic market.

Further, the appreciation of the yen in the 1990s, along with the collapse of the Bubble Economy meant that all Japanese producers, both integrated and mini, were now subject to greater economic impacts due to trade fluctuations and international competition. This meant exchange rate changes and external steel demand would play a much larger role than before in determining firm profitability and the demand for all Japanese steel in domestic and export markets. While exports had been an important demand factor for Japanese integrated producers since the 1960s (O'Brien 1992), as noted above, after the early 1980s exports were not important for the mini-mills that were supplying a low value product, re-enforcing bar, to the Japanese construction industry. Indeed, given the relatively large number of producers and no outlet for the excess capacity that reached 5 million tons in 1987, the industry was subject to "cutthroat competition … exacerbated by the undifferentiated nature of the main minimill product, bar steel," (Uriu 1991).[14]

This changed somewhat as TSC and some other companies moved into higher value added products such as H-beams or plate for construction (Appendix II). Nevertheless, a strong or weak Yen relative to the dollar or currencies tied to the dollar have had an effect. This is due to the fact the Japanese mini-mills' main raw material is local steel scrap that is priced in yen and is often above US prices (A, F&G 1996) whereas the integrated producers import coal and iron ore from overseas priced in dollars. Therefore, when the yen is strong, the integrated producers have a cost advantage in the areas where they compete with minimills, and when it is weak, minimills have an advantage. Also, TSC's flat-rolled products compete with imports, so that the weak yen in 1998 helped them, but its recent strengthening in 1999 has hurt them (Yoshida 1996). The worst market combination for minimills and TSC, therefore, is a strong

[14] In mid 1970s there were 250 producers of bar steel, including 50 mini-mills and 5 major integrated producers, the latter having 12% of the market (Uriu 1991).

yen and weak domestic demand, such as the current (1999) strong yen and depressed economy. This was also true during the industry's first big drop in demand, following the Nixon Shock in 1971 and the yen's first major upward revaluation.[15] Further, in these circumstances, greater competition in export markets for integrated producers stimulates their interest in selling into the local construction market, even at marginal cost, in order to maintain mill output since shutting down a blast furnace is very costly (O'Brien 1992).

This is why a weak yen or the converse situation is not necessarily bad for the integrated producers.[16] Indeed, Mr. Nagai, of Morgan Stanley Dean Witter, has argued how a weak yen can potentially help the profitability of Japanese integrated steel producers (Nagai 1998). Given these various market conditions, though, it is very difficult for Japanese mini-mill producers to anticipate either prices or demand. Also, international market pressures have been exacerbated by Japan's continued economic weakness that limits local demand generally. So other large Japanese corporations are not building or expanding capacity, thereby reducing the demand for construction steel, the minimills' main market (Harada 1998). Therefore, TSC's assets and revenues have actually shrunk since 1993, though production capacity has expanded somewhat to over four million tons (Appendix II).

Added to these considerations is the assessment of some observers that Japan still has too much steel capacity in both mini-mill and integrated production (A, F&G 1996, Harada 1998a, and Tilton 1999). Indeed, due to the expansion of Tokyo Steel and others, Japanese mini-mills in 1994 accounted for over 30% of Japan's raw steel production, up from 24% in 1980, even though Japanese steel demand has not grown (Appendix II). Thus, firms such as

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[15] For contrary views on constant downward price pressures on steel producers, see Tilton (1999) & Ostrom (1996).

[16] In 1998 Nikko's Mr. Harada (1998a) expected 1998 steel demand to be 95 million tons, down from 102.8 million in 1997. Also, he expected exports to the US to fall due to a stronger yen and US anti-dumping pressures.

TSC must rationalize and modernize operations further to maintain their position as flexible, low cost producers of standard steel products for the construction industry.

Given this combination of factors, it is hardly surprising that TSC and other efficient Japanese mini-mill producers have concentrated their efforts on efficiency in all respects. They have also started and expanded production of higher value added products: first, H-beams in the late 1970s, then flat-rolled products such as hot-rolled coil in 1992, and cold-rolled galvanizing in 1997 (Yoshida 1996;Appendix II). Unlike the integrated producers, they have not diversified into new businesses, and they have kept their head office operations very lean. Nor have they participated to any great extent in the global proliferation of new steel capacity. Indeed, TSC recently announced the sale of its interest in Tamco, a US mini-mill producer (Yamada & Cosgrove 1998).

However, as explained above, almost all the large Japanese integrated steel producers are still very much in the steel business. Further, they have announced and successfully executed several rationalizations (Appendix II and footnote 11) and remain formidable competitors.[17] It is for this reason that TSC has recognized that another strategic approach is required to address the cyclical nature of the industry, the increase in global cost-based

[17] In 1995 Mr. Fujitani (1995) of NKK noted that all "the five major Japanese steel companies have targeted cost reductions totaling 930 billion yen in 3 years from 1994. (NKK's target is 175 billion yen). Cost reduction measures include first, reduction of employees eliminating multi-layer management (about 25,000 employees) through a 25% cutback of white collar and20% cutback of blue collar employees relying on substantial incentives for early retirement and relocation to subsidiaries; second, cutback of capital investment to 30-40% of traditional investment; third, drastic reconsolidation of manufacturing plants; and fourth, reconstruction or readjustment of diversified businesses and more concentration on core businesses." Similarly NSC reported in its 1997 Annual Report (NSC 1997) that during its 3d Medium Term Business Plan for FY1994-96 it reduced annual steel division costs by ¥300 billion. In addition, during 1996 it implemented "a new strategy designed to precisely respond to market trends under a single, unified system integrating by product, the whole of manufacturing, marketing and research and development resources." See Appendix II for cost and price impacts of these cost-down strategies. These cost reduction strategies take account of the "multipart process" noted by Ostrom (1996). "In an integrated plant iron ore goes in one end of the mill, and finished steel products come out the other. Hence, steel makers need a variety of raw and intermediate materials, such as iron ore or steel scrap, as inputs. In Japan these account for three-quarters of the cost of producing a ton of steel. At least for an integrated plant, steel companies also need massive amounts of capital. A plant with an annual capacity of 3 million metric tons of crude steel requires around $5 billion in capital; this accounts for about half of the remaining cost of production. By contrast, labor costs are relatively modest and comprise about one-third the costs net of raw materials and intermediate inputs. The 10 percent share of total costs accounted for by labor in the steel industry contrasts with the 25 percent share paid to labor in the case of labor-intensive industries, such as precision instruments."

competition, and periodic excess capacity. Otherwise, the firm's basic business as well as the company would continue to be a toy of exchange rate fluctuations and global economic fluctuations (Harada 1998a and A, F&G 1996).

Therefore, the strategic problem for a Japanese mini-mill producer such as Tokyo Steel as for US mini-mill such as Nucor, is how to remain a low cost producer in order to ride the waves of booms and busts, as well as to move into higher value added products. As Yoshida (1996) explains increased productivity, cost reduction, and an expanded product line are the key elements of TSC's strategy. However, for the latter part of its strategy to work, it must also protect itself from the impact of increasingly differentiated, even customized, products being offered by the integrated producers in the higher value added segments.[18] Only in this way can it create a lasting competitive edge in an increasingly competitive environment, from both domestic and overseas competitors. Its vulnerability, in this latter respect, is reflected in TSC's relatively low share of contract sales with Japanese automobile and appliance manufacturers, compared to the integrated producers (Yoshida 1996), especially as NSC's customized, model design, e-commerce strategy is specifically focused on increasing such contract sales.[19]

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[18] For a full discussion of Nippon Steel's new customized casting and e-commerce strategy see case study: William V. Rapp, "Steel: NIPPON STEEL, K.K., Gaining and Sustaining Long-term Advantage Through Information Technology," Center on Japanese Economy and Business Working Paper, Columbia, New York, 2000 (expected).

[19] Regarding TSC's strategic vision, Yoshida (1996) states: "In contrast to its same-industry competitors, who are pursuing earnings recovery through personnel and capital investment reductions, Tokyo Steel has adopted a growth strategy based on a long-term vision. Management has therefore continued to make large capital investments for improving profitability and increasing production. This is why improvements in company performance have been slow to emerge." With particular respect to TSC's flat-rolled product initiative, Yoshida (1996) observes the following: "Of greatest interest in the company's expanded product line is hot-rolled coils, whose production began in October 1991, a first for domestic furnace operators. To facilitate this venture, Tokyo Steel established a direct-current electric furnace, continuous casting facilities and a hot strip mill at its Okayama plant. The production of pickled coils also began in April 1995, and the sales of steel sheet totaled 1,270,000 tons in fiscal 1995. … Tokyo Steel has entered the downstream area of flat-rolled production to increase the value added of its products and to boost sales through an expanded product line. … Tokyo Steel has invested ¥70.0 billion in the Okayama plant's hot-rolled coil facilities, … Hot-rolled coil operations require fewer than 200 employees…, whose number remained unchanged when production was increased threefold." Similarly, he explains: "Tokyo Steel began the production of sheet piles on its Kyushu plant's H-beam line in April 1994. … This was a field dominated by blast furnace firms until the company's entry. In contrast to sheet piles priced at ¥100,000 per ton by blast furnace operators, Tokyo Steel is selling its product at ¥55,000 per ton. … The company is also planning to manufacture sheet piles at its Utsunomiya plant."
Conversely, when it cannot increase production easily due to intense competition, it emphasizes cost reduction. So in terms of H-beams and rebar, Yoshida explains TSC's strategy as follows: "Tokyo Steel is seeking to raise the operating rate by

While remaining low cost is important in most industries, this strategic issue is especially critical in standard steel products. This is due to even more competition for the available markets from an expanded number of competitors, both integrated mills in Japan and new mills in the NICs (Newly Industrialized Countries) such as one recently announced for Malaysia. The competitive field is increasingly crowded with Japanese and foreign firms of every description. Nevertheless, if a firm can successfully and efficiently sell existing and new customers a wider range of standard products at low cost, then cash flow should improve, as sales and earnings increase. Indeed, this is what TSC did successfully in the 1970s and 80s in competing against the inefficient "insiders". However, it has stumbled a bit with this strategy in the 1990s as it has encountered an aggressive response from the large integrated producers, led by Nippon Steel (A, F&G 1996 and Appendix II). It remains to be seen whether this approach will work in the decade ahead.[20]

This is the key strategic issue TSC has been facing. Ahlbrandt et al (1996) explain this situation for the Japanese market in their study. " Traditionally the integrated companies have regarded their captive mini-mills as autonomous subsidiaries, letting them produce the less technically sophisticated and more commonly oriented products, such as bars and shapes for the housing and construction industries. This hands-off approach also characterized the way they viewed the competition from the independent mini-mills – they paid little attention. All

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establishing a factory with the world's most advanced facilities as well as by sharing production lines. The company has invested ¥40.0 billion in the construction of a new plant in Utsunomiya to replace the large, aging steel shape plant in Okayama. The new plant permits the continuous feeding of scrap and incorporates waste heat recovery, improvements that will reduce electric power costs by 30%. … The Takamatsu plant has specialized in the production of reinforcing bars. Tokyo Steel has invested ¥8.0 billion in a near complete overhaul of facilities, a project that was completed in October 1996. … Streamlining … has reduced by 100 an employee count of 280, and productivity gains of 30% are anticipated. As part of the overhaul, the Takamatsu plant will begin manufacture of wiring rods, a first for Tokyo Steel." The latter are also a higher value added product that will again expand its product line and should enhance revenues as well.

[20] The situation is further complicated by the fact many minimills have ties to Nippon Steel and other integrated producers (Uriu 1991 and A, F&G 1996). As many as 12-14 are linked to NSC, 3-4 with NKK, and 3-4 to Sumitomo. So the majors are indirectly supplying bar in addition to their own 12% share.

this changed when Nippon realized that Tokyo Steel was ‘invading’ its markets, as Nippon Steel executives put it.

Tokyo Steel has a capability of producing about 4 million tons a year and had sales of about $1.5 billion in 1994 (compared to Nippon Steel’s 25 million tons and 20 billion in sales). It began to move its product lines into higher value-added markets in 1984, when it opened an H-beam and plate mill. In 1992 Tokyo Steel entered the hot-strip market, and in 1995 it started up a new mill to produce H-beams and sheet piling. It is also considering investments in cold-rolled and galvanizing facilities for 1996. Each of these steps is a direct attack on the integrated producers’ “most lucrative markets.” NSC’s response to this, as noted above, has been rapid, competing on the basis of price for all products that overlap.

The impact of this on Tokyo Steel is seen clearly in its financial performance since 1993. In 1994, “while production fell by only 6 percent, its sales volume (valued in yen) catapulted downward by a dramatic 25 percent, producing the first loss in nine years.” These losses have continued into 1998, with a concurrent impact on share value from ¥1400 to around ¥500. It has dissipated their cash hoard and cash margins per ton produced (Appendix II).

Yet, Tokyo Steel is the most successful independent EAF (Electric Arc Furnace) producer in Japan. However, “it does not enjoy some of the advantages of US EAF companies. Scrap prices can run 25 percent higher in Japan than the United States, and Japanese blast furnace producers are very cost efficient. In addition, Tokyo Steel’s wage rates and bonus levels are similar to those of their competitors in the integrated sector, and most of the work practices (job rotation, few job classifications, and few restrictive work practices) are comparable between the two. As a result, based strictly on operating costs Japanese minimills like Tokyo Steel are at about a 10 percent cost *disadvantage*. On a total cost basis, however, minimills compete very well, and low fixed costs make the difference. Some of this can be explained by the low capital costs associated with scrap-based production, but much of the Japanese minimill advantage can be traced back to lean corporate structure and low over head," (A, F&G 1996).[21]

Nevertheless, the H-beam price competition became so severe that in 1996 Japan's domestic price was the lowest in the world, 7000 yen per ton below the US and 13,000 yen below South Korea (Yoshida 1996). Therefore, since FY 1993 (3/94), losses due to the H-beam war continued, resulting in five years of consecutive losses for Tokyo Steel, through FY 97 (Yamada & Cosgrove 1998; Appendix II). TSC's solution to this situation has been to further modernize and improve production efficiency, in which effort IT plays a critical role. For in this kind of competitive situation, where one is producing a standard product of good or acceptable quality, price and cost become the key variables. This is especially true when your market, the Japanese construction industry, is suffering severe economic hardships. Still, drastic cost cutting has not yet offset the impact of dramatic price declines (Appendix II). Therefore, TSC has scrapped its plans to build a new hot-coil facility, and President Iketani has made less aggressive marketing statements, indicating his intention to avoid competing directly with the blast furnace producers, such as NSC (Yamada & Cosgrove 1998).

In October 1997, he commented in the *Nikkei* newspaper: "The principle raw material for electric furnace makers is scrap iron generated by blast furnace-steel makers. Electric-furnace makers must work within the limits imposed by the availability of scrap. We each have

[21] TSC and other EAF producers' situation can change dramatically with the exchange rate. In the summer of 1998 when the yen was weak H. Suzuki (1998) could write that Japanese scrap prices were 34% below Korean prices making TSC the world's low cost H-beam producer. However by 1999, with the yen strengthening from over 140 to the $ to about 105 everything was changed. For example, TSC can no longer export competitively to the US as yen appreciation eliminated the 20% Korean premium and the 40% US premium. This again illustrates the need for a different strategy.

our place in the market. Electric-furnace steel makers cannot become blast furnace steel makers," (Yamada and Cosgrove 1998). Further, TSC appears to be curbing its previous expansion plans, selling its Mie factory site to Chubu Electric (Iwano & Kusu 1998).

Tokyo Steel's Focused Steel Strategy

TSC is very much a part of this competitive and economic environment. While its financial situation is still good, with little debt and positive cash flow, its overall situation has deteriorated, from exceptionally strong in 1993 to much weaker in 1998. Revenues for Fiscal 1998 of about ¥160 billion and expected revenues for 1999 of ¥140 million have been stagnant since 1994, and are down significantly from over ¥200 million in 1993. Further, operating losses of ¥7.7 billion are not expected to turnaround until Fiscal 1999 (March 2000), at the earliest. In addition, it has been forced to draw down its large cash reserves to cover its operating losses and capital expenditures (Appendix II). Therefore, it has not been able to translate its expanded market share or its operating efficiencies in terms of man-hours and expenses per ton, relative to other Japanese producers, into a meaningful and long-term strategic benefit (Appendix II).

TSC recognizes that it needs to further improve its cost position to defend against the industry's continued downward price pressures, stagnant demand trends, and emerging competitive developments.[22] Furthermore, given the evolving economic and competitive

[22] Out of a 103 million tons of steel products produced in Japan in 1995 and 1996, about 93 million ended as finished steel, split between ordinary (78 MM tons) and specialty (15 MM tons) products. (The total included finished exports of about 22-24 MM tons.) About 53 million tons were hot and cold rolled products, including plates and sheets (coated, finished, and uncoated). Both domestically and for export, automobiles are the largest users of high quality sheet, followed by appliance makers. NSC's domestic share of the 11 major Japanese car manufacturers is 40% and of the 8 major appliance makers 44%. It also has about 38% of Japan's capacity to produce these products compared to TSC's 4% (NSC 1997a and Harada 1998). NSC's share is more than twice the next producer, NKK, and 50% more than its share of total Japanese steel production. Out of NSC's total steel sales in 1996 of ¥1.7 trillion, ¥1.1 trillion were flat-rolled products (NSC 1997a). Therefore, NSC's strategy has been to concentrate on appliances and autos, through its customized casting and e-commerce approach, that enhances its position in a market where its existing competency is very strong. This is consistent with Ahlbrandt et al's view that producers in "today's steel market" can only succeed by choosing "markets where they believed it was possible to create and sustain a competitive advantage" and by using "technology to help secure and maintain market position." At the

context for all Japanese steel companies explained above, this strategy has to address certain fundamental conditions. It has to use its existing steel making capacity; it has to accept its heavy dependence on the construction industry even for flat-rolled products; and it has to establish a competitive advantage in steel products for construction relative to other Japanese producers, including the large integrated ones. So while it has entered new markets that can use its expanded rolling capacity, such as automobile demand for hot rolled coil (Harada 1998), 70% of its output is still used in construction projects (Yoshida 1996). However, the strategy TSC has developed appears to address these conditions and depends on three basic aspects of its business. In addition, this approach is currently benefiting from an increased interest in steel frame houses and the current low interest rates and tax deductions that have stimulated an expansion in Japanese housing demand.

The first is TSC's very modern and efficient steel-making capacity as well as its trained labor force. The second is its lean corporate management and production strategy, and the third is its sophisticated use of IT to economically rationalize and manage production and inventories. Though it is difficult, TSC makes a particular effort to manage and analyze the complex information related to all aspects of its business. It makes sure its products and customer supply structure are competitive, in terms of technological developments in both IT and steel making. It has coupled this approach with an effort to integrate data management at the order and corporate level (order allocation) with an IT system that links the head office (HO) strategy with each mill. In turn, the mill's production management system is linked with its equipment controls to enhance each mill's productivity. The object is to improve customer

same time, this strategy poses a risk to TSC's low cost standard product approach, since NSC will not only defend this market vigorously, but may lock TSC out through a design-in, customized, JIT, e-commerce system that creates demand for customized not standard products.

supply, TSC's pricing policies, and its production flexibility. In this manner, TSC is using IT to achieve a result that meets the strategic goals for its various steel businesses.

One effect on steel users and providers of the global proliferation of steel products has been that the relatively simple structure of Japan's steel industry, from the consumers' and producers' viewpoint, is changing rapidly. Previously, if one wanted to buy steel from a Japanese producer you placed the order for a standard steel product through a Japanese trading company (TC). The TC placed the order with a steel producer, and the steel was shipped to either a domestic or export location. As explained by Tokyo Steel, for many standard products, such as construction rebar, this system continues today.

For each standard product option, there is in fact a clear set of suppliers (Harada 1998). However, for many other products, such as the wire used in a bridge (Fortune 1998) or the sheet used in many automobiles and appliances (NSC 1997a and NSC 1997), the quality or product produced is custom-made to client specifications. While there has always been some steel product customization for particular projects, this has generally been on a case-by-case basis, due to higher cost compared to buying the off-the-shelf, predetermined industry standard. This is the tailor-made suit versus ready-made suit paradigm that is firmly entrenched in the mass-production revolution that transformed the world economy during the 20th Century.

However, a new strategy is challenging that perception (see footnote 21). In particular Nippon Steel is working to bring the steel business within the lean-production paradigm and extend it into an emerging "controlled" production paradigm. The difference between this "custom-made" approach and that used by other steel producers is presented in a briefing by ENICOM, Nippon Steel's 100%-owned IT subsidiary, (Enicom1998a). This report specifies that NSC's "all customer support" leads to "more frequent status reports, on-time delivery and more categorized products” that improves customer satisfaction. This is a direct challenge to Tokyo Steel’s “commercial usage” for “ready-made” sales. Indeed, it will put a premium on TSC meeting its focused cost-down strategy for standard products.

This is because by dominating the premium, truly high-value, end of the steel market (customized sheet products for auto and appliance makers), NSC can aggressively pursue a marginal cost pricing strategy in rebar and H-beams. We have already seen this in terms of TSC’s initial expansion into H-beams, which, at the time, were high value-added products from TSC’s viewpoint, but were a standardized, non-premium product from NSC’s position. As described above, this enabled NSC to attack TSC’s and other mini-mills’ bread and butter as well as TSC’s “high value” products. At the same time, NSC’s truly high-end business is protected by its customized e-commerce approach (Rapp 2000). This pricing approach becomes very attractive when it helps NSC keep its blast furnaces operating continuously at capacity (O’Brien 1992). Similarly, it permits NSC to subsidize some of its related mini-mills with “cheap” but high quality scrap from its mill-runs. Therefore, TSC has to develop plans that will offer its customers a reasonable variety of standardized products at a competitive price, without attracting “excessive” competition from NSC.

This means its goal is to determine how it can most efficiently produce these products while also rationalizing its existing mill capacity, since further expansion into sheet and hot rolled coil is risky. Only in this way can it maintain profitability and avoid the “excessive” competition (Rapp 1999) typical of this boom-and-bust industry. Key aspects of TSC’s strategic solution have been: building its new mill at Utsunomiya, that produces higher value added products, such as hot rolled coil; producing products more continuously; and reducing rebar capacity, which is a true commodity product (Appendix II). It is also emphasizing sheet steel for construction and autos, since, in these products, it only competes with the integrated producers and higher quality mini-mills rather than the full spectrum of steel competitors.

TSC's aims in implementing the new system are to automate and rationalize its mill production so it can produce and deliver standard steel products in a timely, cost-effective manner. TSC also needs to assure that these steel products develop along with its own steel-making technology, in a way that is responsive to advances in the industry. This includes using IT, as well as responding to its customer's evolving needs. This will be a particular challenge to the extent that NSC develops customized steels for some of those customers. Further, TSC must continue to reduce delivery times, so it can better meet customers' supply requirements and pare its own inventories. This means tracking product requirements by customer group, since TSC is very conscious of the expense of producing and delivering standard products to different customers.

At the same time, TSC recognizes that working through the TCs means that its customers are also targeted by competitors and competition is largely based on price. So competition for their customers' business will continue to be fierce. Indeed, this is a primary driver for TSC's focused cost-down product approach. As already explained, TSC has spent considerable effort in evaluating costs and in increasing productivity. Indeed, it believes its focused strategy is good at achieving cost-containment with revenue enhancement dependent on moving to higher value added products. Both these approaches require constantly improving steel making technology and IT system support. Further, TSC's management recognizes that this approach has become even more important, as old and new competitors add new, and upgrade old, steel-making capacity. This is because increased competition puts pressure on prices, especially when economic activity is depressed. It has, therefore, become critical to target market segments with specific standard product needs, and where TSC is the low cost provider.

Additionally, as the new IT system is constantly being revised based on the observed "best practice" of its mills, the system is constantly improving the consistency, performance, and productivity of both the mills and TSC's production efficiency overall. So far the system has improved not only product delivery, but has lowered costs. As explained below, the system achieves these results by simplifying deskwork and order tracking; by confirming and allocating the order; and by adding value through supporting each mill's optimal functioning. Yet, this is an iterative process, involving trial and error. For instance, operational and system control problems at the new Utsunomiya Works required various system and plant layout modifications that took about a year to resolve. And in 1998 quality problems at Takamatsu required a change in the production process (Iwano 1998).

Furthermore, because new systems are development cost-intensive, the costs are subject to user-base economics (Rapp May 1997 and Gurley 1998). That is, each additional user or sale reduces the cost of delivering products to others by spreading the fixed system's costs over more and more users or output. Success in this area is thus subject to a beneficial loop of increasing returns. A clear indication of the benefits to the TSC of this strategy has been its ability to expand the production of some of its mills and further reduce staff without any loss in efficiency. This should give it some of the cost and operating profit advantages it needs at a time when corporate earnings and revenues are under pressure (Appendix II). Importantly, the steel analyst at Nikko was aware of what TSC was doing in terms of IT and its mill production system, and felt these definitely improved TSC's competitive situation.

TSC's management's approach is, of course, dynamic in that they are constantly looking for ways to improve cost and operating efficiencies, as well as the required IT support. This is part of the constant strategic upgrading and development of the company's IT and steel production system that has allowed it to increasingly shift towards higher grade steel products at lower costs. The basic decision criterion in this respect has been to enhance the mills' capabilities with systems and machines, to expand the capacity of the system, and to reduce costs, all through extending the use of electronics and mill capacity (A, F&G 1996 and Yoshida 1996). However, TSC needs to keep in mind its ultimate customers' shifting needs so that it is always targeting those who want higher quality standard products at lower cost.

Information Technology Infrastructure and Project Selection

TSC's basic information system is a typical Japanese "three-tier" mainframe system, similar to most other large Japanese companies (Rapp 1995).[23] The mainframe manages a series of servers that manage the PCs and workstations (Exhibit 1).[24] In addition, because it is a real time on-line system, it has been totally integrated with TSC's own business operations, as is typical of most large Japanese firms.

In addition to reducing paperwork, the improved systems and communications have facilitated order tracking and processing, improving customer satisfaction. The clear objectives of speeding communication, improving mill productivity, and increasing client satisfaction have thus enabled TSC to select, develop, and use the software required for each function, and

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[23] The mainframe (Fujitsu) at the Okayama plant controls servers that control the network system and communicate with the mills and their equipment. The mainframe has the task of scheduling production and operations, as well as tracking orders (Exhibit 1). The next IT project is how to use the accumulated information to improve the system and its competitive impact.

[24] TSC uses a client server system (9 FNA servers) controlled by a mainframe at the Okayama plant (Fujitsu GS 8400) - Exhibit 1. So this is a large system. Each plant and office has its own IT system since each location has its own unique operation in terms of what it is doing. In fact each plant decides its own actual production once it has been assigned orders by head office. So how much each plant produces is related to these assigned sales.

to integrate it into the support system. This is because it is relatively easy to measure whether these objectives have been achieved. Except for the operating systems, TSC has generally developed all its own software and IT systems.

Outline of Systems Use at TSC [25]

Tokyo Steel's main computer operation, in fact, is not at the Head Office (Honsha) but is at its main mill in Okayama (Exhibit 1). The host computer located there is a Fujitsu mainframe. It, in turn, is connected directly to TSC's mills or *Kojo* at Kyuushuu, Utsunomiya, and Takamatsu, in addition to the mill at Okayama. They have major offices in Tokyo (Head Office), Osaka, and Hiroshima. Their branches in Kyuushuu and Nagoya are connected to the system via the Hiroshima and Osaka branches, respectively. A high speed WAN (Wide Area Network) is used to connect the mills and the offices. There are local area networks within each mill and office. Each branch office and mill has a local server, and there is a process computer for each mill.

Orders are received at the branch offices by fax from the trading companies (TC). That has been the typical system for all steel companies until the recent advent of NSC's e-commerce system for appliance and auto producers. So TSC is part of the TC steel ordering network, just like the integrated blast furnace producers. But it has not yet migrated to the e-commerce system, developed by the integrated producers with the TCs, to serve the appliance and automobile industries. However, to the extent that the new e-commerce system becomes a vortex business, TSC will be forced to follow as the TCs push in this direction, with perhaps

[25] Based on briefing by Tokyo Steel's Head Office (HO) Systems Group July 1998. Meeting was with the young Mr. Iketani, who is in charge of finance and administration that includes TSC's IT department. Mr. Noguchi, the manager in charge of IT, was there too, in order to explain the details of TSC's IT operation and its relation to steel making.

adverse competitive consequences for TSC (Gurley 1998).[26] However, TSC does have plans to use the Internet for receiving orders, which is consistent with the extension of the e-commerce strategy as presented by NSC (Dazai 1997 and Dazai & Maruyama 1997).[27]

When the branch receives the fax, it inputs the information into TSC's system. But from TSC's perspective, it is not yet an order. This only happens after all the data on all orders from all the branches for that day are received. It is at this time that TSC prepares a production schedule and a specific order is then sent to a given mill. The order flow is connected to the process computer that controls each mill, and the data flows back to the Host Computer at Okayama. Once the orders have been assigned to a particular mill, TSC will then aggregate the material requirements associated with these orders, based on the product mix actually ordered.[28]

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[26] J. William Gurley (1998) has an excellent analysis of the criteria needed to establish a strategically effective e-commerce system. He notes such a system must address both industry and IT issues. More specifically he stresses that "the companies that will do well … are the ones that take the time to understand the context of the industry in which they operate. Rather than aggregate technology, they must aggregate context." For this reason, "the home-run opportunities belong to companies with people who deeply understand how a particular industry works; who understand how the Internet as a channel can serve that industry. These companies will build Websites that aggregate buyers and sellers to help facilitate both the decision-making process and the subsequent delivery of products or services. Kevin Jones of *Interactive Week* calls these butterfly businesses, because if you draw a picture of a service that aggregates buyers and sellers, it involves two triangles pointing inward at the single Web source." Gurley "prefers to call these sites vortex businesses, since their success involves aggregating not just the two butterfly wings of buyers and sellers, but also technology, content, and commerce." Further, he emphasizes "the hard part isn't assembling technology; the hard part is aggregating context;" only in this way can one "create an industry transforming vortex."
A key element in this regard is "understanding the features and specifications a customer would typically evaluate to make a purchase decision. The intricacies of such decisions vary enormously from industry to industry; … search routines need to be set up to follow the thinking of a typical industry decision-maker." In addition, the system must reflect "a complete understanding of the way products or services are moved in each industry. How are products ordered? How are they delivered?" Finally, the vortex must make "the information generated at the Website … available in various forms to the industry community." From these perspectives, the e-commerce system NSC has helped pioneer for Japanese steel would seem to meet Gurley's criteria as a vortex business. Furthermore, NSC would seem to be in his words a "New Age facilitator". This is because it is helping to integrate a large fragmented commercial market with "many independent buyers and sellers … who will find value in a single, automated site that concentrates information" and where "acquiring the data needed to build the content on the site" is "not overly difficult."

[27] For detailed discussion of NSC's e-commerce strategy and the challenges its poses for all steel makers and buyers see William V. Rapp, "Steel: Nippon Steel, K.K., Gaining and Sustaining Long-term Advantage Through Information Technology," Center on Japanese Economy and Business Working Paper, Columbia, NY, 2000 (expected)

[28] While, from this description there seems to be a direct connection between TSC's raw material, i.e. scrap purchases and its order flow, actually the connection is quite tenuous. Rather, TSC decides to buy or not to buy scrap according to price fluctuations. Therefore, if TSC feels the scrap price is good, it will buy and if it feels scrap is too high, it will not. Since scrap prices reflect cyclical demand, this counter-cyclical approach is one way TSC can control its raw material costs. So the scrap supply is decided independently, though in terms of production flow it is delivered on a just in time basis to the mill processing an order. TSC only buys Japanese scrap. It does not import, since the local price is cheap. Indeed, currently Japan is a net exporter of scrap. Still, because scrap is so critical to its operation, Tokyo Steel works to maintain good relations with scrap dealers, which may be one reason why it has not entered the scrap business, even through a subsidiary.

It takes about three months to progress from order, to material needs, to production and delivery of a product, based on a rolling inventory of raw material, in-process inventory, and finished product. Based on this analysis of orders and inventories, each month a more precise one-month production schedule is sent to each mill. (This is similar to the integrated producers' approach, except those producers have a six-month schedule for coal and iron ore deliveries that the mini-mill producers do not face, since their raw material is locally sourced scrap.) As each mill uses a three-shift system, the Head Office decides the exact shift to which a particular order is assigned and a precise schedule is then sent to each mill. All this is done through computer connections. The criteria for assigning orders are first by product, and then geography. This is because TSC can only assign orders to mills that produce certain products. In turn, due to transport costs, especially for low-value rebar, it wants the mill near the order site.

This production assignment task is the responsibility of the Planning Adjustment Center (PAC) that tracks the output and order data for each mill and adjusts the orders to even out the product flow for each mill. However, the PAC does not need to use a sophisticated algorithm to do this, such as the one developed by NSC to allocate its orders between and within mills (Rapp 2000). Yet, depending on the mill and product, even though TSC is producing a standard set of products, each product is still made in response to a specific order. It is not producing product for inventory or speculation. The selling price for each product is posted on the 20th of every month, and this data is gathered by the TCs who then collect their orders on the 25th, in response to the prices posted by the various steel producers. Then, depending on the product, the orders come in two forms, one specifying a delivery date and the other with no date. The latter are probably being bought by the TCs for their own inventory, while the former are coming from specific end-users through the TCs. From TSC's perspective the ideal production time, from order to delivery, is about 45 days.

Not all orders are tracked through the system, as is in the case of Nippon Steel (Rapp 2000). This is because TSC produces standard products so its customers have less concern about the uniqueness of their orders and possible delivery delays. Thus, the TCs only need to access the aggregate amount of a certain product being produced and shipped. This data is available from the mill sheet at each mill. Since it is a standard product, quality is guaranteed as well as a set of specifications. Indeed, inside the computer, the standard products are all the same in terms of grade, size, etc., and there is no real difference in quality, though when TSC exports to the US, the specifications will allow for inches. Therefore from TSC's perspective, there really is a limited product menu compared to the customized approach of NSC (Rapp 1999 and 2000). However, export prices will vary with the yen, though TSC can only really export when the yen is weak, not when it is strong, since raw material (scrap) and value-added costs are then both high.

After production is complete, the Head Office (HO) then instructs each mill via the host computer at Okayama, how much of each product should be delivered to each stockyard, including those run by the TCs. The sale is complete at the point of delivery. There is, however, no direct delivery to the customer. All physical delivery to the customer is done through the TCs. This differs from the integrated producers, such as NSC (Rapp 2000), indicating TSC is not as closely connected with its clients. It also reflects a potential weaknesses in TSC's low-cost standard product strategy, since there is no design-in potential or close client collaboration, as there is with NSC's customized e-commerce JIT strategy (Rapp 1999 and 2000).

Each of TSC's mills and offices uses a Fujitsu (FNA) server, but in addition each has an office automation network. Therefore, each system is independent by plant and office, while also being linked to the common system. (See schematic diagram of computer network, Exhibit 1.) The initial installation for this system was in 1980, and it has been gradually upgraded. The last upgrade was at Okayama in April 1997, for the Hot Coil production system. PCs were introduced in 1991 with a second version in 1996. TSC works in five year increments because of its lease arrangements and also because it is then generally ready for the next version.

TSC's current big systems' effort is due to Y2K, which they are finding expensive to address. Through November 1997, it had cost them 200 million yen to solve Y2K-related issues and 240 man months of time. This is because TSC has 18,000 Cobol based systems, and is creating about 400 new ones a year. Within these systems, about 8,000 programs have had to be scrapped and replaced due to Y2K. In March 1998 they were able to introduce some automatic conversion software (Fujitsu RW 2000) that checks each dating system automatically. While not eliminating the problem, as everything still has to be checked and tested, this has helped reduce the time required by 100 man-hours.

The number of people they have, who would be considered computer experts, that are maintaining and running the system/network are ten, three in Tokyo, three in Okayama, and one at each mill. In terms of the network, everything is concentrated in Okayama, where the common network is administered. Until 1987 each mill and office had its own independent program, but after 1987, the system was centralized at Okayama into a common system. The former method is similar to the way Nucor is still operating its system, in that each mill has its own IT operation, and there is no common or centralized system. It took TSC one year to develop its centralized system from the various stand-alone operations.

The new core system was all designed by TSC, and then outsourced to third party programmers. That is, essentially all the software for its own unique EMS (Enterprise Management System) or ERP (Enterprise Resource Planning) was tailor-made from scratch to TSC's own design requirements. Subsequent upgrades, changes, and modifications have usually been done by TSC's IT group itself. This would include tasks such as how to handle the order faxes coming to the new mill at Utsunomiya. Since other mini-mill competitors appear to be doing the same thing, TSC's view is that despite the cost, this is the common approach in Japan. (Indeed, see Rapp [1995] with respect to the emphasis large Japanese firms place on software customization and self-development.) Each production process, and the programs that control each line, raw material flow, semi-finished production, finishing, and control operations, were all developed by TSC itself. Further TSC feels these internally developed systems are a part of the key to its success and efficiency.

However, while these are mainframe-related systems, the process-computers that control each piece of machinery and equipment are developed by the equipment makers, such as Hitachi. The software for these controllers is then upgraded. On balance, though, once the system has been decided, there is not much change unless the process is changed. These changes are often done at the time of regular annual repair and maintenance (summer/winter refurbishment). The latest plant at Utsunomiya is the most advanced in using computer controls, and is virtually 100% Computer Controlled. It can manage the steel within a micron of thickness, as well as length, speed, etc. However, as part of its focused standardized product strategy, TSC is only producing ordinary steel products, such as H-beams and rebar used in general construction, no specialty steels. The sheet it produces goes into furniture, appliances, and cars. In the case of the latter, they do finishing and galvanizing for companies who buy fixed quantities of a specific steel. However, the last two markets will come under real pressure from NSC's customized casting e-commerce strategy, especially in a strong yen environment (Rapp 2000, Dazai 1997 and Dazai & Maruyama 1997). So, it is likely TSC will continue to be heavily dependent on Japanese construction, even for its plate and sheet sales (Harada 1998). They do have a special trade subsidiary, though, that maintains contact with the auto industry.

In any case, the Utsunomiya plant uses a very advanced technique of rolling at very high speed, that must adjust the rolling speed as the product expands, because it is getting thinner. A computer manages this adjustment. Further, if the overall process can be accelerated, then more slabs can be processed closer together, without them "running" into each other. The plant can then produce the required sheet in a shorter time span, improving productivity. This is similar to NSC's new rolling system at Kimitsu, except that at Kimitsu NSC was customize-casting each individual order by thickness, grade, and composition with each order having its own, unique slab of steel. So in that case, the computer had to allow for the different specifications associated with each slab as well, since nothing is standardized.

At Utsunomiya, slabs are similar, since TSC is producing a standardized product. Therefore, the order of difficulty for NSC, compared to TSC, in terms of IT and managing the caster, is quite different. Nevertheless, the new mill rolls continuously while the old mill actually stopped and rolled each slab on a batch basis, before moving to the next slab. Such faster, continuous rolling saves heat and complements the compact size of the new mill, which also saves heat. In this way energy consumption is improved, increasing overall efficiency. Furthermore, people controlled the old mill, but now, there is a CRT in front of each furnace, like a video game. So temperature is controlled remotely. This has helped reduce man-hours so that each worker is now producing roughly 5000 tons of steel, or double the previous rate

(Yamada & Cosgrove 1998). This is how the Production Program is designed to more efficiently and productively support the demand (juchu) represented by orders from the TCs, and their customers' demand for steel. Maintaining this demand network, through low cost supply using IT, remains TSC's software challenge.

<u>Implementation of Focused Cost Reduction Strategy</u>

When the study team was briefed on TSC's new IT strategy and its implementation at the new Utsunomiya Works, (perhaps the world's most efficient, at 5000 tons of steel per worker), TSC's management indicated they had developed the system, themselves, to implement a focused cost-down or Kaizen (Imai 1986) initiative. Prior to this, steel-making IT was still very customized at each plant, because each produced different product groups, and so the associated systems were different. This is because steel production is not like auto assembly, where the system associated with assembling a car is similar for each car. Autos also usually have only one design division; so the design system is more integrated into the production process (Womack, Jones and Roos 1990). However, in steel, even within a standard product category, each order can have several possible specifications in terms of shape, size, and grade. Further, the process and materials flow can be different for higher value-added products, such as H-beams, compared to rebar and can vary with each plant. Product quality therefore depends on equipment, people, and process control. Managing this situation is relatively complex, even for mini-mill producers such as TSC, despite its ability to focus production on specific plants, with self-contained and dedicated IT systems. As explained above, HO gathers steel demand information efficiently from the TCs and transfers it to the mills, producing specific products.[29]

Once the order is assigned to a plant, that mill's system takes charge of the order in terms of production scheduling. Once the order has been specified, the mill's IT system controls how and over what period the steel is made. This is called the open steel supply chain, and there is a one-to-one flow of data and the physical movement of the steel. Thus, as part of this IT steel management process, TSC gathers data from the many elements that contribute, directly and indirectly, to the making of the steel and related costs, until it arrives at the customer. The information flow to a certain degree must mirror the product flow, but it need not be as precise as in the customized-casting approach used by NSC (Rapp 2000 and Dazai 1997). This is because TSC is producing a range of standard products that can always be placed in inventory by the TCs, to meet future demand requirements. This may be one reason why TSC pursues a more focused order production strategy. Still, because TSC's core business and investment is in its physical steel production facilities, it is extremely important that it uses its mills efficiently. This is why it uses computers and sophisticated IT systems to manage the production system that then feeds into accounting, and the allocation of human resources. TSC has invested, and continues to invest, heavily in this IT area, including scheduling systems, even though TSC is concentrating on the most popular steels (ENICOM 1998 and interview Tokyo Steel). The trunkline making these connections is a high-speed digital network.

For this reason TSC has not been able to adopt an outside ERP (Enterprise Resource Planning) or EMS (Enterprise Management System) package. TSC sees these factors as mission-critical issues that its own new proprietary ERP can perform. However, as already

[29] Retailing steel is different and occurs at steel centers, some of which are run by the TCs. While at the product level, each plant and product has its own control system different from those at other plants, certain functions are controlled centrally.

explained, this ERP is not a package from an outside vendor, but was developed totally by TSC. Furthermore, it is completely customized to TSC's operations, since no outside vendor would have the knowledge about how the mills and the existing system actually worked! It must also be tightly integrated with the mills' physical, technical, and personnel operations and with the corporate systems or IT used inside the company, i.e. what is not needed to support steel production or the order system. This is primarily related to Kaikei (accounting) and human resources (HR), though in addition to personnel, accounting, and production, all purchasing and sales systems have been developed internally, too.

In this way it appears that the IT strategy is being driven at least partially by TSC's strategic decision to move to low-cost focused production, as a way to capture and hold important customers and market segments. This means mill efficiency must be optimized for a standard set of products. At the first level of order/production detail, TSC is working on roughly a monthly basis. At the next level of detail, the production system becomes even more precise. This is consistent with the focused production strategy described above.

Once TSC receives an order, it first screens it for Quality Design because some mills can produce as many as 10,000 different steel products. This screening then determines what processes will be needed to achieve the specified steel and, in turn, the amount of steel that will be required, as well as the timing for producing that steel, given all other orders in the pipeline. Once volume and production timing are determined, a delivery date can be scheduled. This scheduling program was one reason why TSC had a Y2K problem that had to be fixed. Based on orders TSC has in hand, including those remaining from the previous week, it repeats this production scheduling process every week and selects the orders to be produced. This weekly schedule then translates into a daily plan and schedule, leading to the final product.

These include scrap purchases, transportation, aggregate demand forecasts, personnel, and accounting.

This process control applies to TSC as a whole and all the products it produces. Sequencing as well as efficient production, a la Toyota (Womack, Jones and Roos 1990), is the key to economic success in this situation. Major cost efficiency variables appear to be yield, inventory, and delivery, since the last determines when TSC gets paid, as well as its ability to efficiently meet its customers' requirements. In this manner, the system is constantly balancing costs and physical efficiency, though the emphasis is on the latter. But TSC also knows the supply chain differs by industry and firm. TSC is not like Takeda or Ito-Yokado, and because of this, it could not copy a system. Rather, as explained above, it had to develop its own system, just as Takeda and IY had to develop theirs (Rapp 1998 and 1999).

Benefits, System Linkages and Strategic Impacts

Unlike the integrated producers, there is little information sharing among Japan's mini-mills, particularly the "outsiders" (Uriu 1991). Neither have computer systems been closely compared within the industry. Given this freedom to act independently relative to IT, TSC feels it can retain the benefits generated by relentlessly pursuing its focused cost-reduction strategy. Therefore, unlike continuous casting, TSC does not feel IT system benefits will just be competed away by the industry. Also, TSC can use the data gathered for decision-making across the firm. Thus, management will have better information to respond to the changes evolving due to expanding competition. These benefits could be very important when many of the changes occurring are not just technical, but are regulatory, and are not just limited to steel firms, but affect customers, too. Indeed, such issues are critical, since steel sales in Japan will remain TSC's business for the foreseeable future (Yoshida 1996 and A, F&G 1999).

Customers, Intermediaries, and Strategic Organization

TSC's focused approach on a low-cost standard product strategy seems less customer-oriented than Nippon Steel's customized approach. Rather, it appears more similar to US producers, such as Nucor's. That is, TSC offers its customers, through established price and availability, the ability to quickly order, at competitive prices, from a predetermined set of industry standard quality products. However, it cannot respond easily and efficiently if the customer prefers something else, or wants to design specific customized steel into its lean production system. Therefore, TSC is at a potential disadvantage among certain customer segments in comparison to the approach NSC is developing and marketing, that is more flexible and precise production. NSC believes that with this approach, centered on e-commerce and customized casting, it can respond more precisely to what is actually demanded by each customer, even on a JIT basis. (See Rapp 2000, Dazai 1997 and Dazai & Maruyama 1997.) Since such product-tailoring closely allies customer and producer, TSC is organizationally less closely tied to its clients than NSC.

Still, TSC's management has not tried to adapt TSC's organizational structure to the software it has developed, or to force its customers to use something convenient or low cost to TSC, but not helpful to them, such as packaged programs or standard products, not fully compatible with customer needs. Rather, the overall system has been designed to help TSC supply to its customers low-cost standard steel products of good quality. Management's perspective, in this regard, is that given the segments TSC is targeting, the functional and market gains from a customized strategy would not justify the additional systems and technical expense needed to efficiently produce and deliver such products. It is in this way that TSC has integrated the requirements of its primary customer base, mostly construction companies wanting standard products at low cost, into its sales, production, and IT strategy. It is not clear though whether this will be true for its automobile and appliance customers.

Any outsourcing of IT systems would put TSC and its IT support systems one step removed from its mills and the TCs. In addition, the overall system, and its close integration with each mill, is so large and complex that only TSC has the legacy knowledge to modify the existing systems, or to integrate new systems, without disrupting steel production and product delivery. These are major reasons TSC has rejected outsourcing or EMS concepts, and has, instead, developed internally virtually 100% of its own application systems and software. Its human resource (HR) policies appear to be closely aligned with this process and its IT systems, as emphasized by Ahlbrandt et all (A, F&G 1996), since employees use them and customers get the benefits of automation and better, low-cost supply. This approach should continue to improve costs and, in turn, sales, an important strategic goal in developing the new systems.

Summary – Being a Low Cost Supplier

In their study, "Information Technology, Work Practices, and Wages," Larry Hunter and John Lafkas (H & L 1998) note two approaches to using IT in the workplace. One automates existing practices to reduce skills needed to perform a task, "deskilling". Ahlbrandt et al call this "dumbing" (A, F&G 1996). The other enhances employees' existing skills, extending capabilities and making them more productive, "upskilling". H & L indicate that IT systems that generate information, as opposed to just automating existing tasks, tend to be "skill-biased" and support high performance work practices. They are "upskilling". Such "upskilling" usually improves existing skills, creates new ones, and leads to greater worker autonomy. The IT system usually evolves and changes with the job so there is a co-evolution of technology and work practices. As such development is based on the firm's original choices, it supports an evolutionary understanding of IT's use and how certain firms achieve best practice (Nelson and Winter 1982). Further, since H&L correlate upskilling with higher wages and strategy solutions; this approach should be preferred when possible.

Indeed, their specific results and comments on cross-selling and cross-selling prompts by the IT system are worth repeating here. "More extensive use of this software is consistent with … the potential of technology to create new kinds of information and new ways of linking different sorts of data. Such software can suggest sales opportunities to its users, provide information that enables users to link together … services that might have been previously unrelated, and can help the service representative to engage the customer more fully in the sales and servicing processes." From this perspective, one can see TSC has selected a combination of upskilling and deskilling in developing its focused cost-down IT system to solve its strategic problem. Its solution is deskilling to the extent TSC has substituted IT for tasks previously done by order support personnel. However, it has been upskilling in terms of mill use, productivity, and related personnel. Overall, from a steel business perspective, the latter seems more important.

The recent declines in steel demand, combined with the pressures of periodic yen strength and expanded competition, has forced TSC to develop a steel production, sales, and IT approach that differentiates it from other Japanese steel producers and foreign competitors. TSC's strategy emphasizes continually modernizing its mill structure through a more automated order and production allocation system, as well as expanding the products it can supply to meet its customers' current and evolving steel requirements for standardized products.

To differentiate its strategy, TSC's management is depending on three basic elements: 1) its mill and personnel infrastructure, including its proprietary IT system; 2) its focused product sales strategy; and 3) management's evaluation of their existing and potential customers' constantly evolving steel requirements. Though difficult, TSC systematically collects, manages and analyzes the data needed to link these elements together and to integrate that information directly with its mills' own sophisticated production systems. This is because TSC envisions its customers as having evolving steel requirements that will change and become more sophisticated over time, given the customers' own product innovation and the development of new steel-making technology. It is also consistent with its own historical evolution into higher value-added products, and away from commodity steels, such as rebar.

A critical part of TSC's success in implementing this strategy is to develop, sell, track, produce, and deliver these products on a timely and cost effective basis. It must also assure that its product development evolves in ways responsive to changes in its customers' steel requirements. Furthermore, this product development must also be responsive to changes in the mini-mill technology used to produce steel, and the IT used to control the overall process, from order to production, to delivery. In turn, TSC is constantly modifying this system, based on its understanding of how the system is working and how it could be improved, through feedback from mills, customers, and TCs. In this way TSC is constantly offering new and old customers better low-cost standard products, responsive to their changing steel demands. The mechanism to deliver these can be adapted to changes in IT technology, such as web-based ordering. And, TSC does seem to be good at doing this sort of thing. It has trained personnel, who understand mini-mill steel production and IT, which are critical to the success of such a strategy. Both technical streams are needed to develop higher value-added steel products, new steel making and processing technologies, and the supporting IT systems.

For example, to efficiently meet customers' demand, TSC has recently linked several processes, using artificial intelligence and microprocessors, that now enable higher quality steel to flow directly from the furnace to the continuous caster, through cold rolling and finishing (Appendix I – Company Profile). This close integration of organization, personnel, and technology is important since, as is well known, when conflicts arise among managers and employees in goal setting, employees can sabotage the system and productivity improvements become limited (H&L 1998; A, F&G 1996). Simplicity and easily understood, measurable goals are thus part of this successful IT strategic development and its implementation.

As with other leaders in using IT, establishing *beneficial* IT loops, with articulated goals and outcomes, appears to be part of the process, as well. For example, using IT to improve process, energy, and cost efficiency keeps the information loop on orders, products, and delivery focused on the customer's demand for low-cost high-quality standard products that leads to repeat business. Such repeat orders stabilize revenues and increase TSC's user base of products and customers. This reduces the fixed cost per ton of steel produced, while enhancing demand for higher value-added products, somewhat less subject to price pressures. This justifies more IT investment to improve and expand the system to other customers and products, further building revenues, while lowering fixed system costs. Gurley (1998) calls this use of IT a vortex business (see footnote 25). However, TSC may have to become more defensive if NSC is able to extend its e-commerce system, which is a vortex system, beyond the appliance and automobile producers to the major construction companies.[30]

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[30] These results are consistent with those of the Sloan industry center as reported in April 1998 and in A, F&G (1996). The Center's research indicated the critical differentiating variables between steel producers seem to be R&D expenses and the

Still, such a customer focused supply capability should lead to more orders. This will reinforce TCs' acceptance of the strategy, and TSC will build the basis for its own business success, including client, industry, and product diversification. This will help reestablish its earnings and asset base, which have been under pressure (Appendix II). Given current economic and competitive conditions, domestically and globally, such developments are critical for TSC's competitive position in comparison to other Japanese producers (Harada 1998). A stronger company will always find it easier to retain customer and market confidence in an uncertain environment.

Yet the dangers to TSC, even if its continuous cost-down strategy is fully achieved, of NSC's "vortex" business are well stated by William Gurley (1998) and should not be minimized. This is especially true for a capital-intensive industry, that is vulnerable to diminishing returns, due to product commoditization and foreign exchange fluctuations. "Vortex businesses are likely to have one very powerful edge over traditional distribution and manufacturing operations: They will get increasing returns rather than diminishing marginal returns. As a site becomes successful, the chances of its becoming more successful increase. The more buyers are attracted, the more sellers will be drawn in, and the more products that are available, the more customers will be drawn in. That, in turn, makes content aggregation easier - vendors must bring you content, rather than your having to gather it. Everything gets drawn to the center of the vortex. The implication is clear: Great vortex businesses will tend toward monopolies, and there will be no such thing as second place." (Gurley 1998)

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decision-making process. The more efficient producers spend much more on R&D and push decision making farther down in the system. In addition, the successful firms have an articulated conscious strategic link between technology and market objectives, based on technology, people, and organization. Indeed, research by Ichniowski shows organization matters and particularly the integration of human resources, technology, and plant layout. Also, see Fujitani (1995) on high Japanese R&D expenditures in steel.

At the same time, TSC's integrated IT strategy corresponds to several important criteria for success in steel, or any business, stressed by Ahlbrandt et al (A, F&G 1996). Each IT investment decision is "made in light of a focused market strategy" and fits with the totality of the firm's investments, including links to steel making technology and the employees' knowledge base. TSC's managers, at both the corporate and mill level, "understand and take advantage of the interlocking nature investments" in the broadest sense, (machines, IT, employee skills, HR practices, and organization), as well as the complementary relationships. This includes the recognition that "new technology and human capital must be developed in use at the same time." Further strategy and practice are aligned "in the same direction so they reinforce one another," and so that improvement is continuous. In turn, the basis for this is "a conviction about where they want to go that is rooted in a deep understanding of products and markets," while "setting a very high goal: to pursue quality and efficiency simultaneously." This includes the conviction of TSC's president, Mr. Iketani (A, F&G and Uriu 1991), another key management element in A, F&G's analysis. In addition, the emphasis at TSC along with the other leading IT users is on the "effective use of technology … to gain quality or cost advantage", as opposed to being "on the cutting edge of technology" for its own sake.

In this way one can see that TSC is using IT as an integral part of its business strategy from order to delivery, even if its model for IT use is not migrating towards controlled production. This is because it remains focused on being the low-cost supplier to a price-sensitive order-by-order set of transactions for a standard product, with a well-known market price. It is not trying to change the very nature of that competitive environment, as NSC is attempting, through its customized e-commerce strategy. Therefore, TSC has used IT to impact its competitiveness, but not its competitive environment. It is not trying to change the way its customers look at their steel requirements and supply base so as to favor TSC's business strategy. It is just trying to be the low-cost provider of its customers' standard demands.

Yet, TSC uses IT to shape its mills and so conforms to the view presented by Ahlbandt et al that "truly important cost or quality differences can virtually always be traced to technology," … and " technology shapes the workplace." Indeed, this approach would appear to place TSC in the middle of, rather than beyond, the technology strategic model posed by A, F&G (1996). In this sense, A, F&G's view is correct on "the importance of competition in determining a company's or an industry's level of attention and commitment to ongoing improvements in productivity, quality, and customer responsiveness objectives."

As explained in the introduction to this case, the major driver for TSC is a focused cost-down supply strategy in which IT plays a key role. The motivation to keep costs down has been forced by the need to get ahead of foreign exchange impacts and the industry's cost-cutting initiatives during the 1990s. But to do this, TSC's new approach has to reduce the ability of competitors to merely emulate TSC's strategic and technical advances, as facilitated by global equipment vendors (A, F&G 1996). By coupling steel-making and organizational skills with proprietary IT systems to create and implement its focused cost-down initiative, TSC has moved somewhat in this direction, since competitors do not have access to the key IT element. At the same time, TSC must monitor the impact on its steel business of the ways in which NSC's e-commerce customized casting strategy may actually be changing the playing field and the rules of the game. To the extent TSC is successful, to some degree, in both respects, their strategy should reinforce the Nikko Research steel analyst's rating of TSC as the top Japanese mini-mill company, from a business and an IT strategy perspective, but still a hold not a buy from an investment perspective.

APPENDIX I

Profile Tokyo Steel from Its Web-page

"Steel supports the foundation of contemporary society and its use is considered a measure of the progression of civilization. Because supplies of steel-making resources are limited, steel recycling is becoming a vital issue. As a leading electric-furnace steel maker, Tokyo Steel is playing a vital role in recycling important resources, thereby ensuring that these resources are used more efficiently. In this era of increased emphasis on recycling and efficient resource use, we believe that our corporate mission is to produce high-quality products at the lowest possible costs. Currently, we manufacture and market a wide variety of steel products, including H beams, universal plates, I beams, and other types of steel. Tokyo Steel has succeeded in developing numerous production technologies in line with its ongoing efforts to provide customers with top-quality, low-cost steel. Representative of these technologies is our Al Expert System, a production-control system based on artificial intelligence that enables efficient control of all phases of steel production. Our in-house developed 150-ton ultra-large direct current electric furnace-the largest of its type in the world-is controlled by microprocessors and sensors for the production of high-quality steel. Using these and other leading-edge technologies, which are attracting attention worldwide, Tokyo Steel is also vigorously cultivating newer fields, including hot coil. Tokyo Steel was the first Japanese electric-furnace steel maker to succeed in producing hot coil. By diversifying into leisure and other fields, we are also contributing the economic development of local communities. Presently, Japan has one of the world's leading economies and is home to many top companies in a broad range of industries. With a spirit of challenge, Tokyo Steel will continue to explore new potentials of steel in its quest to contribute to the further development of society in the 21st Century. While striving to provide high-value added products, Tokyo Steel is fulfilling an important social responsibility by carrying out recycling in response to the need of a worldwide balance between resource usage and the preservation of the environment." Masanari Iketani, President

Company Outline and Growth – "Strengthening Our Corporate Structure to Better Meet Evolving Customer Needs"
Establishment: November 23, 1934
Capital: ¥30.9 billion (As of March 31,1998)
President: Masanari Iketani
Employees: 1,283
Areas of Business: (1) Manufacture and sale of bar, varieties of steel materials, and specialized steel products.
(2) Acting as agent for insurance against damages and automotive insurance for damages.
(3) Managing sports facilities, and restaurant business.
(4) Selling and purchasing real estate, leasing, renting and administration business.
(5) Selling and buying securities, cash flows, foreign exchange business.
Head office: Tokyo
Other offices: Osaka, Nagoya, Kyushu, Takamatsu, and Utsunomiya

Plants: Okayama, Kyushu, Takamatsu, and Utsunomiya

HISTORY

1934 Company founded. Total capital: ¥1,000,000.
1936 Senju Plant No.1 open-hearth furnace completed.
1937 Senju Plant No.2 open-hearth furnace completed. Senju Plant small shape mill completed.
1939 Senju Plant electric arc furnace completed. Senju Plant structural shape mill completed.
1953 Merged with Toa Kokan Kogyo Co., Ltd.
1959 Senju Plant No.3 open-hearth furnace completed.
1960 First construction phase of the Okayama Plant began.
1962 Okayama Plant No.1 open-hearth furnace completed. Okayama Plant structural shape mill completed.
1964 Okayama Plant small shape mill completed.
1969 Okayama Plant No.1 universal mill completed. Purchased the Kochi Factory of Tosa Steel Works, Ltd. and started operating it as the Kochi Plant. Purchased Daimaru Seiko Co. and started operating it as the Kyusyu Plant. Kochi Plant No.1 electric arc furnace completed.
1970 Moved the Kyusyu Plant to new site at Wakamatsu-ku, Kita-kyusyu. Kochi Plant No.2 electric arc furnace and bloom caster completed.
1971 Kyusyu Plant No.1 and No.2 electric arc furnace and 2~ 3 Strand bloom caster completed.
1973 Kyusyu Plant structural shape mill completed. Okayama Plant No.1-4 strand bloom caster completed.
1974 Listed on the second section of the Tokyo Stock Exchange.
1975 Listed on the second section of the Osaka Stock Exchange. Merged with Tosa Steel Works, Ltd. Total capital: \4.08 billion.
1976 Listed on the first section of both Tokyo and Osaka Stock Exchanges.
1978 Okayama Plant No.1 and No.2 electric arc furnaces No.2-5 strand bloom caster and No.2 completed.
1979 Okayama Plant bar mill completed. Opened Osaka Office. Succeeded in casting beam blank at Kochi Plant. Senju Plant finishing mill revamping completed.
1983 Introduced caliber-less rolling and direct rolling technologies in the Takamatsu Plant bar mill.
1984 Completion of universal mill and new 3 strand combinative at Kyusyu Plant. Started manufacturing large-size H beam and universal plate.
1987 Changed Osaka office status to Osaka Branch. Opening of Amazing Square.
1989 Completed 130 tons D.C. electric arc furnace at Kyusyu Plant.
1991 Completed hot strip mill at Okayama Plant.
1992 Completed 150 tons D.C. electric arc furnace and 2 strand slab caster Okayama Plant.
1993 Okayama Plant No.1 CCM partially revamped. Total capital: ¥24.7 billion (As of March 31, 1992)

<u>EXHIBIT 1</u>

Outline of Tokyo Steel's IT Management System

Summary Answers to Questions for TSC – Its Steel Strategy & Operations

General Management and Corporate Strategy	Yes	No
Has the firm integrated IT into their management and production strategy, including using it to institutionalize organizational strengths and capture tacit knowledge on an iterative basis?	**x**	
Has the firm succeeded solely on the basis of its software strategy?		**x**
Does the firm believe some customized software and its close organizational integration enables it to capture and perpetuate on a more consistent basis certain tacit knowledge and unique corporate features, i.e. core competencies, that account for its continued success in the marketplace with reliability and repetition important elements in their thinking?	**x**	
Is firm's software strategy successful because it is well managed and introduces software innovation when it serves corporate goals for enhancing productivity or customer relations within its industry?	**x**	
Does company generally meet established criteria as a quality organization such as: effective organizational self assessment, use of project and especially cross functional teams, improving quality outcomes through reducing uncertainty, rapidly diffusing learning throughout the organization including the use of software and information technology, effective implementation of organizational and technical change, facilitating change via evolution rather than revolution or reengineering[31], emphasizing participatory management, having process excellence, using value added analysis, actively doing benchmarking, constant organizational improvement, commitment to concrete realistic goals, effectively managing a dynamic iterative experimental process through goal setting, training and constant consultation?	**x,** bench-marking unclear	
Does the firm plan in detail for operational excellence including the contribution of IT to the allocation of resources?	**x,** see web-page	
Do planning systems enable management to make better business, operating and resource allocation decisions, including IT?	**x**	
Do projects focus on a small number of IT goals, usually three or fewer, with a well-defined system reaching from the commitment of senior management to the department level with associated metrics?	**?**	

[31] MIT Systems Dynamics Group in 9/97 presentation estimated 70% of reengineering efforts fail.

Is the firm a "high performance" workplace for services?	**?**
Is there a heavy emphasis on improving process through IT?	**x**

Industry Related

Are industry economics and competitive dynamics important strategic drivers for the firm and for its use of IT in that IT has been adapted to the firm's particular industry and competitive situation?	**x**
Are there industry paradoxes such as: falling stock prices, production improvements that create product improvement difficulties, or employees' active product use that retards improvements?	Fall stock prices but good IT

Competition

Is software a significant and successful input into the firm's competitive performance?	**x**
Does the firm explicitly and consciously perceive implications of IT strategies and use on their competitiveness and business success?	**x,** also see web-site
Are there direct links between IT strategies and overall management goals?	**x**
Do customers, affiliates, competitors, industry analysts, government officials, industry associations and suppliers perceive the competitive benefits or impact of the firm's use of information technology?	**x**
Has the firm gained first mover advantages through successfully introducing software-related innovations?	**x**

IT Strategy

Is firm a sophisticated software user that consciously designs and implements an IT strategy to achieve competitive advantage?	**x**
Does firm combine several types of IT to achieve an advantage?	**x,** firm & production
Does firm's system work to rapidly uncover implementation barriers, including using new or better IT, while generating cross-functional	**x,**

[32] Easton, G. S. and S. L. Jarrell, "Using Strategic Quality Planning More Effectively: Lessons Learned from NSF Project Research," Columbia Business School conference presentation, September 1997

and hierarchical consensus so measured goals are achieved?		
Is leadership at different levels actively involved in IT planning, assessment and deployment with regular progress reviews that link plans, goals, metrics, milestones, resources and responsibilities?	**x,** CEO involved	
Does system allow for flexibility and innovation plus change and individual efforts if they meet goal, planning and metric criteria?	**x**	
Is there a clear vision making project and new software selection straightforward and closely related to strategic goals and processes?	**x**	
Does this IT strategy involve conscious and clearly defined reliance on customized and semi-customized software in addition to packaged software with specific criteria and goals for selecting each type, and do they have ways to measure this so the firm knows customized software achieves functional or market gains that justify the added expense, including related costs of integrating customized and non-customized software into a single information system?	**x**, have consciously developed all their own SW	
Does firm use option valuation methods to manage uncertain random outcomes since this approach seems at the software implementation frontiers even among very well managed companies?[32]		
Does strategy include greater use, development and integration of industry and company specific vertical application SW and embedded SW in production & delivery processes to improve competitiveness? If the firm has an embedded software strategy, is this integrated or interactive with their other IT and overall business strategy in ways affecting production, product design or service that improve quality and costs long term?	not clear as ecommerce low **not clear**	**No**
Do they favor increased outsourcing of software design and development?		
Does firm believe large-scale outsourcing by many US companies assumes those firms' IT systems development need not be integrated with their business organization and that they view their IT systems as generic products best developed by outside vendors who can achieve low cost through economies of scale? That is, do they feel these firms' approach focuses on software costs and such firms do not see differences in systems used by competitors?	no stated opinion but 100% SW developed in-house as true most large J firms have customized	**x**, use own SW
Do they believe this is a mistake by competitors that gives them a long-term and sustainable competitive advantage over such companies because they believe outsourcing surrenders a firm's		

strategic software options since systems service companies have an incentive to develop increasingly standardized products and are one step removed from the company's customers and business? clearly believe developing own SW gives then an edge

Has the firm established a software strategy that is open and interactive with its customers and/or suppliers?

Has this enabled it to capture information or cost competitive externalities?

<u>IT Operations</u>

x, not part e-system

Do participants own goals and are then committed to implementation strategies? **N/A**

Does the firm embed software into its production and delivery processes with competitive market implications?

x, user driven IT

Is software technology tied to high speed telecommunications technology, allowing the firm to track, receive and deliver shipments or services directly or on-line without further handling or processing? **x,** no e-system

Does it manage potential risks in extensive IT use or open systems? Do they work to ensure consistency and reduce programming errors? **x,** have optic WAN & LANs

Is informal interaction a key aspect of planning and implementation?

Is firm's system institutionalized and self-reinforcing with good communication and consensus building while IT plays a role, including preventing retrospective goals or target reduction? **x**

x, plant based, user initiated

<u>Human Resource and Organizational Issues</u>

Does firm pay close attention to systems training and organizational integration for all employees, reducing errors through improved consistency and staffing efficiencies across the firm since software can confound even routine operations? **x**, plant & branch base

Does certain software require special HR competencies or education? **not clear**

Does the firm try to change human behavior to use software?

<u>Parameter Metrics - Inventory, Cycle Times and Cost Reduction</u>

Are goals or targets tightly linked to regularly reviewed metrics with inputs coming from all levels that are often cross-functional affecting large parts of the organization, e.g. cycle times, timely delivery, and customer satisfaction?	**x**	**x**
Does the firm have standard agreed ways to explicitly organize or manage this software selection process?	**not clear**	
Does the firm have agreed ways to measure and evaluate success in using software to promote objectives such as lower costs, contract time, market share, product development times, or system support?		
Are IT costs balanced against overall long-term productivity or revenue gains?	**x**, internal developed with users	
Does the firm have methods to ensure increased customization costs result in lower costs downstream so developing and using customized software makes sense?	**x,** cost produce & sell steel	
Has the firm created large interactive databases to allow automatic feedback between stages or players in the production and delivery process? And are these databases constantly being refined and updated on an interactive basis with actual performance results in a real time global environment?	**x** **not clear needed**	
Are there competitive and metric impacts such as reducing inventory costs and wastage while improving the quality of customer service?	**x,** order allocation system	
Has the firm used software to create beneficial feedback cycles that increase productivity, reduce cycle times and errors, and integrate product and delivery?		
Do other firms or analysts have alternative measures of competitiveness or views on the appropriate industry strategy?	**x**	
Has the firm achieved better than industry growth, superior delivery, improved control, reduced down-time or changeover problems, reduced product or process errors, fewer complaints, an improved product development process, and/or any other definite and measurable progress relative to competitors?	**limited**	**Not noted**
Do the firm's metrics go beyond financial to areas like customer satisfaction, operational performance, and human resources?		
Does their evaluation system apply to new product development and significant projects as well as to continuous operations?	**x**	

x

x

Summary and Conclusions

Conclusions and Results	Yes	No
Can you summarize mission statement on the role and impact of IT as a tool of competitive advantage for this firm in this industry?	**x**, see web-page	
Is it consistent with strategies identified as successful or appropriate in existing competitiveness research from Sloan's industry study center?	**x,** 1996 book	
Are there important business or IT situations requiring further research?	follow-up	
Are intellectual property issues important in explaining firm's successful and sustainable use of IT to achieve competitive advantage?		**x**
Are beneficial cost impacts generally an important consequence of this firm's successful software strategy?	**x**	
Does this company fit a profile where IT seems most likely to contribute to enhanced competitiveness?	**x**	
Based on this study is the market for vertical application and embedded software growing?	not clear	
Since Japanese competitors normally do not outsource, do Japanese firms see themselves as benefiting from this US trend?	US not compete	
Does this leading Japanese firm assign positive value to improved integration and enhanced control through selective customization?	**x**	
Do general measures such as decreased costs, as evidenced by reduced account servicing expenses, reflect benefits of a successful IT strategy?	**x**	
Are the benefits of a successful software strategy also reflected in specific industry standards such as an expanded customer base?	**intent**	
Does this leading IT user have explicit criteria for selecting package versus customized software and for semi-customizing IT packages?	**x**	
Does this firm closely integrate or couple their software and business strategies beyond mere alignment?	**x**	
Do they closely integrate their organizational and HR policies with their software systems?	**integral**	
Have they reorganized to use software and information technology?	**x,** new	

	plants
Has IT codified or built on existing organizational strengths or core competencies, including HR alignment with business and IT strategies?	**x,** focus low cost production
Have they embraced and integrated information technology as part of their business strategies and core competencies?	**x,** AI new plant
Is MIS function integrated with the rest of the firm in terms of organization and decision making?	**x,** integral

APPENDIX II

SOME INDUSTRY AND FIRM DATA

Financial Positions and Forecast: Large Japanese Steel Firms & Tokyo Steel 3/3/98

Consolidated (Billions of Yen and %)

Company		Sales	Growth Rate	Operating Profit	Ordinary Profit	After-Tax Profit
Nippon Steel	**‘98**	**¥3077**	**0.9%**	**181.6**	**86.5**	**5.9**
	’99	**2950**	**-7.0**	**130.0**	**80.0**	**2.0**
	’00	**2930**	**-0.7**	**120.0**	**80.0**	**5.0**
NKK	‘98	1934	3.0	73.6	37.2	14.3
	’99	1860	-3.8	54.0	18.0	5.0
	’00	1850	-0.5	52.0	17.0	4.0
Sumitomo	‘98	1469	0.8	98.7	40.7	4.0
	’99	1450	-1.3	94.0	31.0	11.0
	’00	1500	3.4	104.0	41.0	20.0
Kawasaki	‘98	1244	0.9	74.8	43.4	8.5
	’99	1200	-3.5	70.0	42.0	14.0
	’00	1200	0.0	73.0	46.0	18.0
Kobe	‘98	1535	0.1	84.4	12.9	-4.9
	’99	1450	-5.5	67.0	0.0	-6.0
	’00	1430	-1.4	63.0	-4.0	-8.0
Tokyo	**’98**	**167**	**4.6**	**-7.7**	**-8.4**	**-10.2**
	’99	**145**	**-13.1**	**-4.0**	**-4.0**	**-5.0**
	’00	**162**	**11.7**	**-1.0**	**-1.0**	**-2.0**

Source: Nikko Research Center, Harada (1998)

Adjustments in the Minimill Sector (Uriu 1991)

Year	**Number Firms**	**Number Furnaces**	**Capacity (Million MT)**	**Workers**
1978	69	146	20.79	36,400
1983	58	115	25.98	30,600
1987	56	93	27.50	19,300

Rankings of Major International Integrated Steel Companies

(Times per year, ¥ bil, MT, 1000¥)

Company*	Gross Asset Turnover	Rank	Free Cash Flow	Rank	Tons per Worker	Rank	¥ Operating Expenses/ton	Rank

Nippon Steel	**0.69**	**8**	**89**	**3**	**1048**	**2**	**79.9**	**7**
NKK	**0.63**	**10**	**68**	**5**	**664**	**4**	**104.9**	**11**
Sumitomo	**0.53**	**12**	**-13**	**10**	**649**	**5**	**93.8**	**10**
Kawasaki	**0.51**	**13**	**73**	**4**	**853**	**3**	**87.6**	**8**
Kobe	**0.64**	**9**	**33**	**6**	**440**	**9**	**179.8**	**12**
Thyssen AG	1.52	1	-27	11	75	13	293.6	13
Usinor Sacilor	1.09	2	113	2	256	11	89.3	9
USX	0.99	3	25	7	508	7	64.8	6
Bethlehem	0.92	4	-33	12	468	8	57.7	5
Iscor	0.87	5	2	9	132	12	47.1	2
British Steel	0.87	6	114	1	322	10	57.3	4
LTV	0.76	7	14	8	569	6	54.7	3
Pohang	0.61	11	-64	13	1234	1	46.4	1

Source: Nikko Research Center (Harada 1998)

Cost Reduction Efficiency Indices Major Japanese Producers 1994-98 (Average 1994=100)

Company/Year	1994	1995	1996	1997	1998	‘94-‘98 Reduction
NSC	100.4	96.8	93.5	95.4	94.1	-6.3
NKK	99.9	98.0	94.9	95.3	96.2	-3.7
Sumitomo	100.4	98.1	94.9	95.1	95.5	-4.9
Kawasaki	100.5	98.8	96.3	95.1	94.0	-6.5
Kobe	97.6	95.0	92.7	95.6	96.6	-1.1

Source: Nikko Research Center (Harada 1998)

Cost Reduction vs. Revenues: Tokyo Steel and Major Japanese Producers 1993-97

Company	**NSC**	**NKK**	**S-Steel**	**K-Steel**	**Kobe**	**Tokyo**	**7EF**
Tons /worker	697	475	453	549	288	2858	1473
Cost/ton '93	76067	79241	90228	82474	87551	41315	50850
'97	64588	65494	83471	67078	83662	38836	46030
¥ Benefit	11480	13747	6757	15396	3889	2479	4820
% Benefit	17.8	21.0	8.1	23.0	4.6	6.4	10.5
Revenue/t '93	80895	77207	96076	83963	74980	48051	57646
'97	66764	67696	85981	69454	62492	38836	46030
Cost % '93	94.0	102.6	93.9	98.2	116.8	86.0	88.2
Revenue '97	96.7	96.7	97.1	96.6	133.9	104.5	102.3

Source: Nikko Research Center (Harada 1998); 7 EF is average for 7 largest electric furnace producers.

Expected 1997-98 Steel Related Earnings, Volume & Prices (Unconsolidated) – (¥ Billions)

NSC, NKK & TSC/Year	**3/91**	**3/92**	**3/93**	**3/94**	**3/95**	**3/96**	**3/97E**	**3/98E**
Nippon Steel Revenues	2231	1950	1723	1683	1722	1722	1725	**1720**
% Total Sales	84.8	82.3	79.8	80.5	82.0	79.0	78.6	**78.2**
Volume (million MT)	26.7	24.1	24.4	25.4	25.7	25.9	25.9	**25.8**
% Annual	-3.3	-9.7	1.4	3.8	1.2	0.7	1.0	**-0.4**
Price/ton (¥1000/MT)	83.6	80.9	70.5	66.3	67.1	66.6	66.6	**66.7**
% Annual	1.8	-3.2	-12.8	-5.9	1.1	-0.7	0.1	**0.2**
NKK Steel Revenues	978	866	760	734	740	724	732	**726**
% Total Sales	74.4	68.6	63.2	62.6	63.8	61.1	64.2	**63.9**
Volume	11.7	10.7	10.6	10.3	10.2	10.0	10.2	**10.0**
% Annual	-3.7	-8.7	-1.2	-2.8	-0.9	-1.5	1.0	**-1.5**
Price per ton	80.5	77.2	68.9	66.9	67.8	67.7	67.9	**68.4**
% Annual	2.5	-4.1	-10.7	-3.0	1.4	-0.1	0.3	**0.7**
Tokyo Steel Revenues	**212**	**201**	**152**	**140**	**144**	**164**	**192**	**204**
% Total Sales	**99.5**	**99.0**	**99.3**	**99.7**	**99.0**	**99.2**	**99.2**	**99.2**
Volume	**3.8**	**4.1**	**3.8**	**3.8**	**3.8**	**4.3**	**4.8**	**5.0**
% Annual	**-0.8**	**7.7**	**-5.4**	**-1.6**	**1.4**	**12.1**	**12.1**	**3.7**
Price per ton	**56.3**	**49.4**	**39.4**	**37.0**	**37.6**	**38.1**	**39.9**	**40.7**
% Annual	**-99.9**	**-12.2**	**-20.3**	**-6.2**	**1.7**	**1.3**	**4.8**	**2.8**

Source: Salomon Brothers Japanese Equity Research (Yoshida 1997)

Key Firm Data - Tokyo Steel	3/31/93	3/94	3/95	3/96	3/97E	3/98E
Revenues (Billion ¥)	203.3	152.7	140.3	145.8	165.3	194.0
Operating Income	22.0	(14.7)	(9.2)	(5.2)	(1.0)	14.0
Income Pretax	24.5	(12.3)	(8.7)	(9.8)	(4.0)	13.5
Cash Flow	32.4	3.9	5.0	5.2	6.3	8.9
Capital Expenditures	51.4	3.0	3.8	47.7	26.0	5.0
Steel Revenues	200.9	151.6	139.9	144.3	163.9	192.5
Sheet	28.5	33.1	42.7	52.6	60.1	75.2
Rebar	64.9	47.1	35.6	29.6	34.7	35.2
H-Beam	92.5	49.4	42.6	42.6	45.8	53.0
Other	15.0	22.0	19.0	19.5	23.3	29.0
Total Assets	309.8	271.4	270.9	264.7	215.1	215.1
Cash Assets	104.3	96.8	70.6	49.4	41.0	54.9
Current Assets	183.5	161.8	163.8	131.5	-	-
Property, Plant, Equipment	117.6	104.4	101.8	127.6	134.4	120.0
Debt	69.3	54.3	55.6	55.4	24.2	24.0
Stockholder's Equity	209.9	193.7	182.7	171.6	159.4	148.3
Steel Output (1000 tons)	4065	3847	3784	3837	4300	4820
H-Beam (1000 tons)	1820	1300	1165	1150	1225	1350
(price 1000¥/ton)	50.8	38.0	36.5	37.0	37.4	39.3
Rebar (volume)	1320	1240	1090	920	990	1000
(price)	49.2	38.0	32.7	32.2	35.0	35.3
Sheet (volume)	620	807	1050	1270	1540	1850
(price)	46.0	41.0	40.7	41.4	39.0	41.8
Employees	1480	1534	1508	1442	1340	1320
Steel Scrap Price (¥/ton)	14200	16400	16300	15500	14000	14200
Pre-Tax Return on Equity (%)	11.7	-6.4	-4.8	-5.7	-7.1	-6.9

Source: K. Yoshida (1996), H. Suzuki (1998)

<u>Firm Data</u> (continued - billion ¥)	**3/96**	**3/97**	**3/98**	**3/99E**	**3/00E**
ASSETS & LIABILITIES					
Cash, Short term Money Claims	72.1	41.0	54.9	36.5	46.0
Fixed Assets	127.6	134.4	120.0	108.5	99.0
Total Assets	264.7	247.3	236.2	215.1	215.1
Debt	24.2	24.2	24.0	10.0	10.0
Equity	171.6	159.4	148.3	141.3	141.3
Sales	145.8	159.6	166.9	140.0	141.0
Operating Income	-5.2	-8.2	-7.7	-7.0	0.0
Net Income	-9.8	-11.3	-10.2	-7.0	0.0
Cash flow	5.2	6.3	8.9	9.5	14.5
Investment	41.6	26.1	6.0	5.0	5.0
Steel Sales (1000 MT)	3737	4145	4103	3900	4000
H-Beam	1550	1745	1700	1660	1750
Rebar	955	800	800	840	850
Hot Coil	1332	1600	1603	1400	1400
Steel Price (1000¥/MT)	37.5	38.1	40.1	35.4	34.5
H-Beam	37.5	38.5	39.3	34.6	35.0
Rebar	34.0	32.5	34.0	27.6	27.0
Hot Coil	39.0	39.0	44.3	40.0	38.0
Scrap Price (1000¥/MT)	13.5	13.8	15.0	11.0	11.0
Pre-tax ROE (%)	-5.7	-7.1	-6.9	-5.0	0.0

Source: H. Suzuki, 1998

BIBLIOGRAPHY AND REFERENCES

1. Abegglen, James and Richard Stalk, Kaisha, Basic Books, New York, 1985

2. Ahlbrandt, Roger, Richard Fruehan, and Frank Giarratani, The Renaissance of American Steel, Lesson for Managers in Competitive Industries, Oxford University Press, NY, 1996 (A, F&G)

3. Dazai, Takeo, "Practical Application Research, Steel EC," NCALS Steel EC Project, Presentation, Tokyo, 1997.

4. Dazai, Takeo, and Toyoshi Maruyama "Practical Research of the Steel Products EC," CALS Expo International 1997, CALS, Tokyo 1997

5. Easton, George S. and Sherry L. Jarrell, "Using Strategic Quality Planning More Effectively: Lessons Learned from NSF Project Research," presentation at Columbia Business School Conference on Quality, New York, September 1997

6. ENICOM, "Nippon Steel & Information Systems for Strategy of Business," Steel Making Systems Division, presentation, Tokyo, 1998a

7. Fujitani, Yoshitaka, "Challenges Facing Japanese Steel in Today's Global Economy," Occasional Paper Series, No. 21, Center on Japanese Economy and Business, Columbia, New York 1995

8. Gurley, J. William, "Creating a Great E-Commerce Business," Fortune, New York, March 1998

9. Harada, K. "Korean and Japanese Steel Industries," Industry Report, Nikko Research Center, Tokyo, 1998

10. Harada, K. "Steel Sector," Industry Report, Nikko Research Center, Tokyo, 1998a

11. Hunter, Larry W. and John J. Lafkas, "Information Technology, Work Practices, and Wages" Working Paper 98-02, Wharton, Financial Institutions Center, 1998

12. Imai, M., Kaizen: The Key to Japanese Competitiveness Success, Random House Business Division, New York, 1986

13. Iwano, "Tokyo Steel," Goldman Sachs Japan Research, Goldman Sachs, Tokyo 1998

14. Iwano & Kusu, "Tokyo Steel," Goldman Sachs Japan Research, Goldman Sachs, Tokyo, 1998.

15. Japan Information Access Project, "Information Resources on the U.S. and Japanese Steel Industry," Japan Information Access Project, Washington, DC, 1998

16. Nagai, Toru, "Steel: Yen Weakness a Plus," Morgan Stanley Dean Witter, Tokyo, 1998

17. Nagai, Toru, "Steel: Monthly Supply/Demand and Market Trends," Morgan Stanley Dean Witter, Tokyo, 1998a

18. Nelson, Richard and Sidney Winter, An Evolutionary Theory of Economic Change, Cambridge, MA, Harvard University Press, 1982

19. Nippon Steel, Annual Report 1997, NSC, Japan, 1997

20. Nippon Steel, Basic Facts About Nippon Steel 1997, NSC, Japan, 1997a

21. Nomura Research, "Nippon Steel," Japanese Equities, NRI, Tokyo 1998

22. O'Brien, Patricia, "Industry Structure as a Competitive Advantage: The History of Japan's Postwar Steel Industry," Business History, Vol. 34, No. 1, 1992

23. Yamada, Seiichi and Robin Cosgrove, "Tokyo Steel Manufacturing," Dresdner Kleinwort Benson Research, Tokyo, 1998

24. Ostrom, Douglas, "Japanese Steel Companies Gird for New Challenges," JEI Reports, Japan Economic Institute, Washington, D.C., 1996

25. Rapp, William V., The Future Evolution of Japanese-US Competition in Software: Policy Challenges and Strategic Prospects, Final Report Japan-US Friendship Commission, Columbia Center on Japanese Economy and Business, 1995

26. Rapp, William V., "Gaining and Sustaining Long-term Advantage Through Information Technology: The Emergence of Controlled Production," Center on Japanese Economy and Business Working Paper, Columbia, New York, 1998; and Rapp, William V., "Gaining and Sustaining Long-term Advantage Using Information Technology: Emergence of Controlled Production," Best Papers Proceedings, Association of Japanese Business Studies, Salt Lake City, UT, 1999.

27. Rapp, William V., "Steel: Nippon Steel, K.K., Gaining and Sustaining Long-term Advantage Through Information Technology," Center on Japanese Economy and Business Working Paper, Columbia, NY, 2000 (expected)

28. Suzuki, Hiroyuki, "Steel Update," Japan Daily Notes, Merrill Lynch, Tokyo 1998

29. Tilton, Mark, "Antitrust Policy and Japan's International Steel Trade," Working Paper, No. 159, Center on Japanese Economy and Business, Columbia, NY, 1999

30. Tokyo Steel, "Tokyo Steel Manufacturing Co., Ltd.," Tokyo Steel K.K., Tokyo, 1998

31. Uriu, Robert, "The Steel Minimills 1970-85," Chapter 3 of unpublished dissertation, Columbia University, New York 1991

32. Wold, Geoffrey H. and Robert F. Shriver, Strategic Systems Planning for Financial Institutions, Probus, Chicago 1993

33. Womack, J. P., D. T. Jones, and D. Roos, The Machine that Changed the World, Rawson Associates, New York, N.Y., 1990

34. Yoshida, Kenichiro, “Tokyo Steel Manufacturing,” Salomon Brothers, Tokyo, 1996