Customization in Japan: Opportunities and Constraints

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"Today most of a building is built with technology developed and best understood by manufacturers and specialty subcontractors."

- Charles B. Thomson [1]

INTRODUCTION

In most of the developed world, a split divides architectural practice, with activities related to design and those related to site construction separated for legal and economic reasons.[2] The result is that the values of the two territories also remain isolated: achitects' concerns regarding aesthetics, materiality, or the impact of intangibles such as natural light are not ones which most contractors have been trained to address. Further, important communication between architect and contractor, characterized primarily by written and drawn documents, do not effectively convey the significance of these issues. Similarly, the contractor holds concerns which are not communicated to the architect; staging, safety, ease of fabrication, or the changing economic climate are indicated only crudely, through pricing. On larger projects, Western architects attempt to address this split through the use of consultants and the accretion of personal experience—imperfect mechanisms in a volatile and increasingly sophisticated context.

Furthermore, while architects and contractors struggle to communicate their goals through imperfect means, the act of construction itself offers its own challenges. Alan Day notes in his recent book, *Digital Building*, that "The two key characteristics of the building industry are fragmentation and uncertainty."[3] Uncertainty is a natural result of not only the complexity of contemporary construction processes and architectural equipment, but also unknown or unpredictable factors such as soil performance, weather, and the variable results of crafts such as concrete work or welding. Under such circumstances, "it is impossible to make formal contracts that cover all problems and difficulties that might come up. Instead, technological cooperation must, to a large extent, be founded on mutual trust and expectations that unforeseeable problems will be solved in a cooperative spirit."[4] Just such a cooperative spirit is found within Japanese practice.

Collaboration in design and construction, where the construction and design development phases are essentially collapsed, is not universal in Japan. However, it is recognized as a highly effective instrument, and it is common for leading architects and contractors to support using this approach for the design development of innovative structures. Architects speak of Japanese construction with rare generosity. Cesar Pelli said simply "there is no more satisfying experience than building in Japan."[5] Rafael Vinoly is quoted as saying that in the Japanese system "works incredibly well" and that " ... design professionals and construction managers cannot isolate themselves from the process..."[6] Kathryn Findlay, whose practice is based in Japan and the United Kingdom, describes her early experiences in Japan with warmth, saying, "When I first began working on the construction site, the process was relatively smooth, [and I thought] Japan's contractors more accommodating, compared to England, where even a small building required detailed, difficult drawings to be completed ... [In Japan] we're able to get substantive changes implemented on the site, after construction has begun ... "[7] And Tadao Ando, reflecting on his recent experiences building in Chicago and preparations for the addition to the Kimball Museum, is quoted as saying, "After all, Japan is blessed to be small and geographically isolated, I think. In architecture, too. The design consultant and the contractor work collaboratively, so it is easy. The contractor says 'leave this to us' about some area, and the architect is happy to do so."[8]

These comments allude to some of the key factors which permit successful collaborations to occur, and result in the innovative and technologically sophisticated work Japan is known for. As Vinoly notes, architects are not isolated from construction—thus, architectural staff recognize and respond to construction-related problems. Similarly, contractors learn the issues important to architects and can assist the designer in finding ways to achieve these ends. Findlay reinforces this point; the contractor responds to the architect. Additionally, as she notes, the process is more flexible and an architect is not confined to torturously drawn media. Rather, through models and countless hours of discussion, the architect and contractor cooperatively engage in design development. Further, as she also notes, there is flexibility during construction as well. Finally, Ando not only points out that designated design development is often encouraged by contractors and accepted by architects, but also begins to suggest a reason that collaborations are successful. It is not so much geographic isolation but rather economic isolation and the Japanese oligopolic system which is key, as I will discuss.

In collaboration, there are clear benefits, as these architects indicate, but there are some very real disadvantages as well, and I will discuss these, too.

ARCHITECTS AND CONTRACTORS

In Japan, both architects and contractors are capable of many of the activities that define design development and construction supervision. Contractors, as Ando indicated, may design details. They also direct working drawing production, guide the project through governmental regulation, and hold liability—all areas which are generally considered the architect's responsibilities in North American practice. Architects inspect and approve formwork and concrete pours, review proposed welders' skills, visit plants, and directly

interact with manufacturers' production staff (as I outline below), areas conventionally considered the domain of contractors in the West. As one author blandly noted, "The concept of division of labor is not well adopted in Japan ... "[9] But this also reflects Gutman's predictions that " ... architects will have to learn to share responsibility with other professions and organizations in the building industry."[10]

In fact, the line between architect and contractor can grow extremely blurry; in one project I researched during 1998, many of the architect's site-based staff were actually on loan from the contractors. In another case, a retired employee of a large contractor acted as an advisor to an architectural firm during a major project's basic design. Although there were no guarantees that the contractor would be awarded the job, this was ultimately the case, probably because the former employee passed on inside information. In the meantime, the architect's staff received valuable advice as they worked out how to execute a challenging structural system. Such liminal staff are also found in Japanese manufacturing alliances, where the term "guest engineer" has been coined. As the scholar Jeff Liker points out, these individuals serve as a " ... two-way conduit of information flow ... [and] may be able to influence specifications for the subsystems" in a way which benefits the contractor.[11]

Most architects confess that they do not initially have a clear sense of the opportunities to collaborate on any given project—even with contractors they are familiar with—until supervising staff have had some experience working together on site.[12] Architect-contractor interactions, rather than being defined by a sense of what is normative or by legal constraints, are worked out over the initial months that design and construction staff work on site. The benefit of this approach is that it allows the individuals directly involved in a building's production to develop an understanding of the biases and experience held by their counterparts. Site-based staff, over time, grow to see themselves as part of a single organization, and because this organization represents a wide range of expertise, it becomes easier to, as a group, propose and work out innovations.[13] By sharing experience across trades, the team is able to reduce uncertainty and innovative ideas can be more quickly developed, because one has access to technically accurate and reliable resources. As the expertise reflected by these teams expands, the pool of available information also expands, and important information is more readily accessed.

DELEGATING DESIGN: ARCHITECTS AND MANUFACTURERS

Jeffery Liker further noted activity in the Japanese auto industry, similar to the construction industry's designated design development, dubbed "black box sourcing." As he outlined it, the practice " ... has three characteristics; early involvement of suppliers, clear communication of the customer's design requirements, and extensive design-related responsibility assumed by the suppliers."[15] Elsewhere he noted that, "Japanese automotive customers often initiate the design process by giving the supplier a general conceptual description of the part of subsystem. This general description is followed by intense joint activity by the customer's and supplier's engineering staff."[16]

Takahiro Fujimoto found a similar situation, but placed it in a more complex context. In 1993 he surveyed parts suppliers to see how orders were received. For completely new car models, 18 percent of parts were bid, based on detailed drawings provided by the car maker; 49 percent involved development competition among two or more suppliers, based on looser specifications supplied by the car maker; and 32 per cent involved selection of a particular supplier, which then participated in product concept, planning and specification development.[17] This reflects what I observed, although the percentages would be quite a bit different if all materials used in a building's construction were counted. Nonetheless, while there were certainly times when building materials were ordered in a manner Western architects would consider conventional, by bidding from detailed drawings, significant areas of the building, particularly finishes, critical subsystems, and structural materials, were developed in partnership with one or more manufacturers.

As with Fujimoto, I found that these partnerships were of two types. For a limited number of materials, those which were either essential to the overall success of the building design or representing previously untried technologies, cooperative design development would actually begin during the basic design stage. For a broader palette of building components, selection was more likely to occur after the construction/design development phase had been initiated. In the latter case, it was not uncommon for contracts to be offered to more than one supplier, for reasons I will discuss below.

In the case of innovative materials or subsystems, generally architects either sought out suitable manufacturers, or, occasionally, the manufacturers made direct proposals to the architects. In either case, architects and manufacturers began working together prior to bids being put out on a project, and with no assurance that the manufacturer would ultimately receive the order. Some materials suppliers are widely recognized as being supportive of innovation, and if an architect has a new idea for materials produced by these companies, partnership can be established quickly. However, most architects told me that they would have an idea and approach numerous manufacturers about working together, only to be turned away.

The mechanisms used to find a cooperative manufacturer included everything from cold calls on up. Introductions were reported from materials brokers, other small manufacturers, engineers, and even family friends. There seemed to be no consistent pattern, except that contractors were never used to find these manufacturers, in part because no contractor was as yet committed to the project.

Why would manufacturers offer support at this stage, when there was no contract and a great deal of effort might be required, potentially without remuneration? While most manufacturers find such collaboration an expensive nuisance, some see it as product research, which can not only lead to new markets, but increase the manufacturer's prestige. Products may even be offered for free, on the assumption that a leading architect can be an effective way to introduce a new material—as was the case in a heat-absorbing ceramic wall I observed (which was installed for free on a government-funded project) or an all-aluminum structure which was in the initial stages of discussion during my research. Additionally, manufacturers may feel that offering advice gives them an edge when a supplier is selected, both because the manufacturer has greater technical information and considerable lead time, and also because the architect will want to continue the partnership during construction. Furthermore, manufacturers work with the architect to develop specifications outlining production capacity (not product specifications) for these materials. Obviously, these specifications will include, if not favor, the advising manufacturer.

However, exploratory design development occurring while still at the basic design stage is limited to only the most crucial elements, and much component customization occurs after construction has already begun. Such adjustments are less significant than those noted above, but nonetheless account for the unique and refined characters of Japan's best architecture. Here, contractors and architects tended to employ an interesting mechanism to assure that each manufacturer remained competitive: production was contracted out to two or more manufacturers, with the understanding that if any one producer proved unsatisfying, they could be dropped from the project with little difficulty. Both contractors and architects frequently referred to this strategy. Additionally, the advantages of one fabricator would be used as a goad to others. Thus, for example, one producer might be able to make long sheets of steel, but not thin ones, while another could work with thinner steel. The architect and

contractor would note a competitor plant's strengths, suggesting that, if the manufacturer could not meet similar standards, work could be shifted to the competitor. And this message would be communicated to both producers, in the hopes of getting thinner and longer steel sheet. Similarly, when multiple contractors, subcontractors, or manufacturers are involved in a project, the architect may begin by proposing a challenging idea to the counterpart most capable of its production, then indicate to competitors that the lead firm has begun working on the problem, thus bringing competitors on board.

As T.J. Pempel, a noted economist, summarized such a situation, "Ultimately, power was concentrated ... Contractors typically divided orders among several subcontractors to gain multiple alternative sources ... They could shift contracts among subcontractors as rewards or punishments for past loyalties, current pricing problems, quality performances, or personal whim."[18]

Manufacturers respond to these pressures by bringing production staff quite early in the design process. I frequently witnessed early-stage, on-site consultations involving both a sales representative and someone from production. If the architect's demands seemed simple, or the discussion did not require production advice, further consultation might only involve the sales staff. But on those projects where initial consultations required extensive involvement on the part of production staff, this allowed the fabricator to concurrently design the component and its manufacture, by advising the architect regarding capacity. Sales staff, conversely, were responsible for advising the architect as to how changes affected target costs, which were also determined early in the collaboration.

Nonetheless, such strategies are expensive, and probably at least partially account for estimates that 87 percent of all construction products are priced higher in Japan.[19] While the overall ratio of imported to domestic building materials has probably been affected by the current recession, most construction materials used in Japan continue to be domestically produced. This is in part accounted for by keiretsu ties, both vertical and horizontal, but it is also true that various barriers to trade have maintained an oligopic structure in the marketplace. I discuss the impacts of oligopoly, both positive and negative, below.

COMMUNICATION MECHANISMS

In the collaborations I observed, architects and their counterparts would initially come to a verbal agreement about their goals, without any contractual obligations. At this stage, the process was essentially exploratory; issues under consideration might include whether an idea was feasible, whether the manufacturer could produce the component, what materials or shapes would be most appropriate for fabrication, etc. In many cases, even on well-supported sites by leading architects, some of the ideas floated would later be dropped. The reasons for this varied: an architect decided that an aluminum floor was costly and wanted to use the moneys elsewhere, for example, while a contractor decided that a sophisticated process lifting steel floor panels into place was unwarranted. I did not find that abandoning a proffered idea affected the overall quality of the collaboration. Nevertheless, I can imagine that, where a reasonable level of support has been offered to the architect—assisting in finding suitable manufacturers may occur during the design development/construction phase, and lengthy exploratory discussions are the norm—and an idea ultimately abandoned, this has the potential to affect cooperation.

One salesperson, representing a large furniture manufacturer, told me he sees architects as being of two types. Some "use paper," while others meet to communicate their needs. He described the use of written material as easier, but made the point that his company could then more quickly decide to refuse to put in a bid. With verbally negotiated work, the prices were generally higher, he said, but there was opportunity to remove production barriers and avoid excessive expense.

In Western architectural practice, contractual written and drawn materials are privileged, while verbal communications are often referred to as being "not worth the paper they are printed on"—the implication being that since they are not printed and verifiable, they have no value. However, as challenging material and building component ideas are often investigated prior to a contractual commitment in Japan, all parties do work verbally, perhaps with preliminary drawings or models. Verbal communications are considered essentially trustworthy, especially while the form or execution of an idea is still being developed. If a contractor says something is possible, or estimates that it will cost a certain amount, this is treated as relatively reliable information.

In this way, architects are able to test how various strategies, related to a specific component or subsystem, might impact cost, aesthetics, maintenance, or other issues—without becoming invested in a particular approach. Similarly, contractors or manufacturers can begin to ascertain how committed the architect is to an idea, and which factors initially outlined are flexible. In one case, for example, the architect had a very clear idea about the color of a material he intended to develop, one not available on the market. Initially, he also hoped to use a relatively large size, but as it became clear to the manufacturer that size was not as important, the supplier switched the plant where production would take place, to one which could not work with larger materials but seemed more capable of achieving the desired color. Both plants made prototypes for the architect's review, at different stages in the development process. Jeffery Liker has researched how teams function in the Japanese automotive industry, and he refers to them "being flexible within clear boundaries."[20] For architects who have a clear formal agenda (thinner, more transparent, etc.) or easily articulated goals, it is relatively simple for those they work with to begin to determine how these intentions affect the piece under discussion. In this case, the contractor, subcontractor, or manufacturer will be able to offer suitable guidance on available materials or forms which can comply with the architect's overall intentions. The architect's goals do not have to be communicated verbally, but when one of the functions of negotiation is to determine boundaries, the relatively fixed nature of drawings may not be the best mechanism.

After writing a specification that broadly outlines the capabilities of suppliers, architects will approve one or more manufacturers from a list proposed by the contractor. Over the course of 1998, many related to me that offshore production is becoming an impediment to verbal negotiation. On major components, where the architect felt collaboration was crucial, they simply dug in their heels and refused to approve overseas production plants. But some have also found that Japanese plants are off-shoring only some activities, such as shop drawing production. When designers make changes to the drawings, and problems arise, then they may discover that discussion is not an option. For architects who rely on negotiation and advice over written material, this actually offers a genuine challenge.

Verbal communication, as I noted above, is usually accompanied by the use of models and sketches. On particularly complex or important components, architects, contractors, or even governmental regulations may also require mock-ups or prototypes. These offer an opportunity to check actual production against the more flexible instruments employed in collaboration. Often the designers' expectations can be significantly different than the first mock-up produced. In the case of an architect who intended to use precisely formed pre-cast concrete columns as an aesthetic baseline in a project, for example, chamfered corners, evident on the first mock-up, became a significant point of contention. The architect assumed that details drawn with squared corners would be understood as requiring higher care in production, while the production plant had assumed this was a simplification, and that easy-to-fabricate chamfered corners were perfectly acceptable.

Thus the prototype offers a way to unearth misconceptions, a natural part of any construction experience. In particular, contractors rely on them as a communication tool. When two or more manufacturers supply materials, the mock-up can be used to confirm that suppliers produce comparable materials. Manufacturers also indicate that they appreciate the opportunity to confirm particulars.

Liker also raises the concept of "time windows."[21] He noted that, although suppliers were continuously fine-tuning their production technologies, there were specific periods where these new technologies were introduced to customers—at the initial stage of the collaboration, not later. This roughly correlates with what I witnessed: in most cases, modifications to a material or subsystem were accepted only through the period shortly after review of the final prototype, just as the material was to go into production. When more than mock-up was required, there was a tendency for major modifications to be done up to shortly after completion of the next-to-last one.

Contractors or manufacturers would alert architects to a target date for concluding adjustments, based on the construction schedule. Yet I did see situations where work in the field led an architect, client, or contractor to suggest that a modification might be made. Rarely did this go beyond a simple question of whether change was possible. Manufacturers also indicated to me that they were continuing to work out process technologies during fabrication, and this was reflected in some changes to the final building materials, so that variation in the product run might be apparent.

Architectural staff also regularly indicate when they are involved in working out detailing or material selection for specific areas of a building, and invite the contractors', subcontractors', or manufacturers' input. Thus, they can initiate the opening of a "time window."

THE BENEFITS OF OLIGOPOLY

Neoclassical economists argue that government protection for oligopolies reduces pressure to modernize, to engage in research and development, or to improve the quality of materials produced. In short, the expectation is that market demand forces manufacturers to behave competitively. The Japanese governmental has established incentive programs intended to counter these tendencies, by promoting the introduction of new technologies, upgraded facilities, and higher levels of research and development than might otherwise exist.[22]

In my discussion of the interactions between architects and fabricators, I outlined how competition is introduced into the system, by ordering from multiple suppliers. This reflects conditions throughout Japan's manufacturing community. However, as Liker notes, " ... suppliers would not be willing to invest the amount required, give in to customers' demands for aggressive target prices, and respond to the pressures of aggressive development cycles if the customers could choose from a large group of competitors at any time."[23] It is the fact that both contractors and many supply sectors are oligopolies, with a limited number of dominant agents directing demand, that keeps this system in balance.

Most economists agree that in Japan's basic materials markets, especially those crucial to the construction industry (including concrete, steel, aluminum, ceramics, and pane glass), there are clear oligopolies, with at least 90 percent of the market dominated by five or fewer firms.[24] Furthermore, many of the larger firms are linked to "cooperative" subcontractors, which make up much of the "competition" by smaller firms. In the case of a small craft tile company I visited, for example, it supplied over 90 percent of its product to Inax, one of Japan's largest tile producers. In this way, Inax fielded out less profitable production, while standardized tile shapes were made in a large, fully automated plant.

Customization is particularly found in declining industries, where the producers as a whole are in a relatively weak position. Demand for many of the materials associated with construction has been affected by the bursting of Japan's speculative "Bubble" and the consequent drop in construction orders, and also by a drop in domestic automobile production, which has reduced demands for steel and glass. (As I write this, the *Financial Times* reports that construction orders dropped 21.3 percent in November 1998, the 11th consecutive month orders dropped .25) Although it is beyond the scope of this discussion, I found that customization was more evident in declining, and thus, diversifying, industries, and almost non-existent in industries such as plastics, which were economically more viable and had a broader customer base.

GENUINE DRAWBACKS OF COLLABORATIVE METHODS

> " ... the Japanese approach to product development ... requires an extraordinary effort on the part of all project members; 80-hour weeks are not uncommon."[26]

One of the most significant disadvantages of the kind of collaboration I witnessed was that it was extraordinarily time-consuming, redundant, and thus costly. On one site, each week roughly 30 people—representing the architects, structural and mechanical engineers, contractors, and various subcontractors—would sit down to a meeting which routinely took eight hours. While those who were not directly concerned with the work at hand might occasionally wander off to take a call, most remained in the meeting regardless of whether they were directly involved in the discussion at hand—in part because there was an expectation that their input might be needed. The involvement of large numbers of staff is directly related to the fact that the problem is not tightly bounded, and most observers consider it inherent in the process of collaboration.

While construction has never been considered to have high productivity, this sort of collaboration will certainly work against contemporary efforts geared at increasing efficiency. And although some observers still claim that the Japanese corporation continues to rate customer satisfaction as more important than profitability, the current economy has certainly rendered this a luxury.[27] As Liker notes " ... it is increasingly recognized in Japan that a customer's focus can lead to unreasonable demands and sacrifice on the part of employees..."[28] For many manufacturers and contractors, where prestige is less directly ties to innovation, the high costs of collaboration, which recently have begun to include increased liability, are simply not justified in the current, severe recession.

Paul Herbig, another researcher of Japanese management practices, observed, "The Japanese innovation generation process has an unusually high cost associated with it in terms of the generation of problems and solutions, [a] high degree of social interaction ... human exhaustion and overwork ... mental exhaustion, and burnout."[29] The hours of effort I saw architectural staff put into a project struck me as nothing short of Herculean, and certainly entailed great personal sacrifice.

INNOVATION IN COLLABORATION

> " ... no architect can presume to be so well-rounded as to be competent in all aspects of architectural work ..."
>
> - David Leatherbarrow[30]

Stable relationships among architects, contractors, and manufacturers have their own set of efficiencies, in that the goals and abilities of each actor are better understood by their counterparts. In Japan, I am regularly impressed with the sensitivity to architectural issues articulated by contractors' employees, and by the awareness of production constraints expressed by architects. Yet at the same time, architectural staff often had no applicable experience which could be

relied on in addressing the customization at hand. Rather than attempting to develop a comprehensive body of knowledge, architects' efforts were contrived to work effectively at identifying and accessing useful information held by their counterparts.

In this way, the architects were able to propose and execute innovative construction, often in many of the major subsystems of a building, simultaneously. Lynn and others call this the "garbage can model" of innovation: rather than a clearly established problem-solving sequence, the process allows for " ... a confluence of changing streams of problems, solutions, participants, and change opportunities." [31] As a result, the architectural staff I observed generally seemed more confident, more secure, and more willing to take risks, because they saw the entire construction team as committed to innovation, rather than feeling pressure to personally embody all necessary knowledge.

Thus, architects in Japan will often propose the use of entirely new technologies or materials with complete—and to the outsider, audacious—confidence. One project which I observed, the Saitama Arena, includes a curved, 15,000-ton moving wall, which can be adjusted to allow the arena to take on various configurations. Several years ago the American partners on the project (who were primarily involved in basic design) stated, "Probably the most unique thing about this building is the money being spent on technology that really doesn't exist ... Technology is being developed especially for this building."[32] Today, the necessary technology exists.

Additionally, one result of working out the role of collaboration on site is that relevant staff must perform more autonomously than is the norm in the West, something also noted by those engineers and anthropologists researching Japanese manufacturing. As Itoh states it, "Job demarcation in work organization ... is more ambiguous and fluid ... More de facto responsibility is delegated to the lower ties of hierarchy in Japan.[33] Blau has noted that such autonomy and responsibility generally leads to greater satisfaction, and Day argues that not only morale, but also the quality of work improves when staff feel they are involved in decision making throughout a project.[34]

This is certainly desirable. As educators, though, it offers a sobering challenge, since we must discover a way to teach the skills necessary for these new forms of practice.

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NOTES

[1] Andy Pressman. Profession Practice 101: A Compendium of Business and Management Strategies in Architecture. NY: John Wiley, 1997. p. 283.

[2] S. Gameson, G. Hall, Y.H. Chiang. Construction in Hong Kong: Issues in Labor Supply and Technology Transfer. Aldershot: Avebury, 1996. p. 127.

[3] Alan Day. Digital Building. Oxford: Laxton's, 1997. p. 65.

[4] Jens Laage-Hellman. Business Networks in Japan: Supplier Customer Interaction in Product Development. London: Routledge, 1997. p. 13.

[5] Nicola Turner, "Japanese Sense and Sensibility" World Architecture 11/97, p. 11.

[6] Progressive Architecture, September 1995, p. 74.

[7] Kathryn Findlay, "Ruiji de ha Naku Sai wo" ["Not Similar, Different ... "] GA Japan: Environmental Design no. 30, January/February, 1998, p. 169. (Translated from Japanese.)

[8] An interview with Tadao Ando, by Masatoshi Kawamura. "Digitaru to no Tatakai no Zenyou: Foutowaasu Gendai Bijutsukan" ["Digital and the Fight for the Whole Picture: Fort Worth Modern Art Museum"] Nikkei Architecture, no 623 October 5, 1998, p. 114. (Translated from Japanese, which used the name "Fort Worth Art Museum" rather than the correct name, the Kimbell Art Museum.)

[9] Paul Herbig. Innovation Japanese Style: A Cultural and Historical Perspective. Westport, Connecticut and London: Quorum Books, 1995. p. 120. See also Tetsuji Kawamura, "Characteristics of the Japanese Production System and Its International Transfer Model." In Tetsuo Abo, ed. Hybrid Factory: The Japanese Production System in the United States. New York and Oxford: Oxford University Press, 1994. p. 37.

[10] Robert Gutman. Architectural Practice: A Critical View. Princeton: Princeton University Press, 1988. p. 42.

[11] Jeffery K. Liker, Rajan R. Kamath, S. Nazli Wasti, and Mitso Nagamachi, "Integrating Suppliers into Fast-Cycle Product Development." Jeffery K. Liker, John E. Ettlie, and John C. Campbell, eds. Engineered in Japan: Japanese Technology Management Practices. New York and Oxford: Oxford University Press, 1995. p. 166-167.

[12] Weld Coxe and Mary Hayden, UIA Work Project Group: Trends in Private Practice. "Report from Japan", Final Report, March 20, 1993, and Takashi Nakajima. "Our Experience on International Projects" East-West Encounter: First International Symposium of Asia Pacific Architecture, 1994, unpaginated.

[13] Everett M. Rogers. Diffusion of Innovations, Fourth Edition. New York: The Free Press, 1995. p. 380.

[14] Ibid., , p. 201.

[15] Liker, p. 155.

[16] Ibid. p. 164.

[17] Takahiro Fujimoto, "The Dynamic Aspect of Product Development Capabilities: An International Comparison of the Automobile Industry" in Akira Goto and Hiroyuki Odagiri, eds. Innovation in Japan. Oxford and New York: Oxford University Press, 1997. p. 64.

[18] T.J. Pempel. Regime Shift: Comparative Dynamics of the Japanese Political Economy. Ithaca and London: Cornell University Press, 1998. p. 71.

[19] Mark Tilton, Restrained Trade: Cartels in Japan's Basic Materials Industries. Ithaca: Cornell University Press, 1996, p.179, referring to U.S. Commerce Department and MITI, U.S.-Japan Price Survey, 1991: Fact Sheet. 1991.

[20] Liker, p. 386.

[21] Ibid. p. 171.

[22] Pempel, p. 56.

[23] Liker, p. 182.

[24] See Pempel or Tilton. This serves as a major point in each of the books cited.

[25] Alexandra Harney, "Japan Sees Fall in Construction Orders Again," Financial Times, January 7, 1998. p. 6.

[26] Herbig, p. 149.

[27] John Lorriman and Takashi Kenjo. Japan's Winning Margins: The Secrets of Japan's Success. Oxford and New York: Oxford University Press, 1996. p. 84.

[28] Liker, p. 373.

[29] Ibid. p. 120.

[30] David Leatherbarrow. "Apart and Together: Vicissitudes of Architects in Practice" JAE 45/4, July 1992. p. 203.

[31] Leonard H. Lynn. How Japan Innovates: A Comparison with the U.S. in the Case of Oxygen Steel Making. Boulder, Colorado: Westview Press, 1982. p. 6 and his citations, Michael D. Cohen

and James G. March, Leadership and Ambiguity, (NY: McGraw Hill, 1974) and James March & John P. Olsen. Ambiguity and Choice in Organizations (Bergen, Norway: Univesitetsfolaget, 1976).

[32] Daniel Meis, of Ellerbe Becket, Los Angeles, quoted in "Saitama to Build State-of the Art Arena", Japan Times, July 5, 1995.

[33] Hideshi Itoh, "Japanese Human Resource Management from the Viewpoint of Incentive Theory" in Masahiko Aoki and Ronald Dore, The Japanese Firm: Sources of Competitive Strength. Oxford and New York: Oxford University Press, 1994. p. 238. See also John Creighton Campbell, "Culture, Innovative Borrowing, and Technology Management." In Liker, et al., p. 318.

[34] Judith Blau. Architects and Firms: A Sociological Perspective on Architectural Practice. Cambridge: MIT Press, 1984, p. 53. And Day, p. 80.

Figure 1. Left to right: Sales staff from a supplier, contractor, and project architect meeting on site.

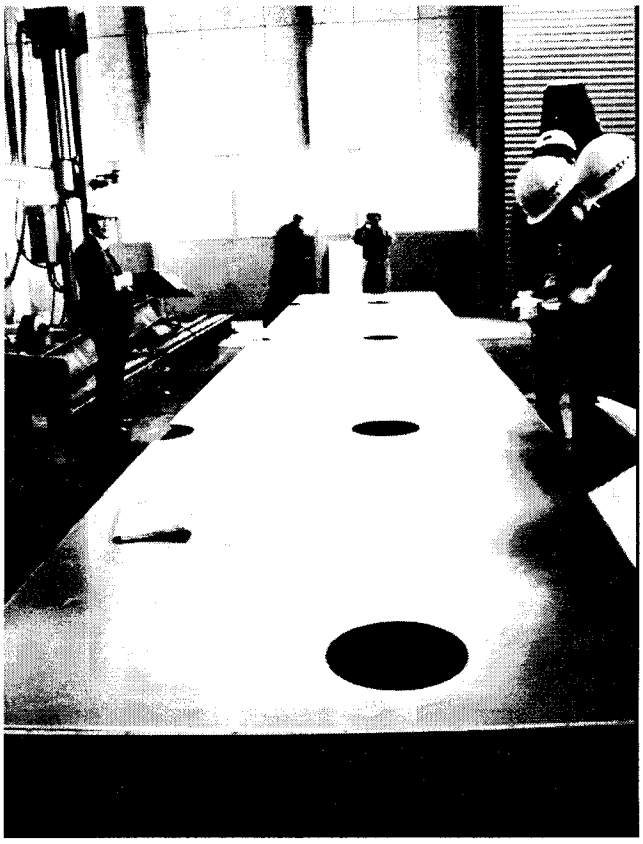

Figure 2. Inspecting a beamless steel floor slab, also intended to act as finish.