Japanese Organizational Knowledge Creation in Anglo-American Environments[1]

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ABSTRACT *Notwithstanding contemporary Western images of 'changing Japan', expectations of lifetime employment within a remarkably stable population of leading firms continue to underpin a distinctive style of Japanese management based on high levels of inter-employee trust and extensive transactions in tacit knowledge. After reviewing some factors that distinguish Japan's national innovation system from its Anglo-American counterparts, we develop an 'inside the black box' model of Japanese organizational knowledge creation. This highlights some aspects of Japanese management which do not sit easily amidst Anglo-American organizational turbulence and predilections for explicit knowledge. The second part of our paper uses two case studies to explore factors limiting the 'transferability' of Japanese management to Anglo and American innovation environments. These case studies illustrate differences between Japanese and Western systems, together with processes by which their respective advantages can combine to produce synergic benefits.*

Japan's 'economic miracle' and the rise of firms that do not appear to be especially efficient nor entrepreneurial intrigued Western observers, stimulating enormous interest in the alluring prospect of 'learning from Japan' and exploiting the secret ingredients in its success. Conversely, the end of the 'bubble economy' boom years in the early 1990s, aroused an opposing tendency to belittle Japan's achievements and exaggerate its problems. But, in both cases, observers seem to be suffering from the problems of looking through a two-way mirror from the wrong side. Quantitative comparisons with Japan and an over-emphasis on its apparent similarities to the West can be misleading if observers fail to appreciate the significance of hidden detail and the way in which the country's underlying innovation system fits together.

Although the so-called 'revisionist' writers have become increasingly successful in revising the popular mythology that Japan's political economy and capitalist system are broadly similar to Anglo-American models,[2] many Western writers on management and innovation ignore the message. Whereas learning from Western innovation systems has been a central theme in Japan's industrialization, many of the West's attempts to interpret Japan have been less thorough. Its 'window on Japan' can all too often resemble a mirror; reflecting insights and reinforcing preconceptions.

To put Japanese organizational knowledge creation in a broader context, we begin by considering some historical factors that have shaped the nature and operation of Japan's national innovation system. This emphasizes the role of government in co-

ordinating economic development across a remarkably stable economic structure, which contrasts with images of Schumpeterian entrepreneurship and 'gales of creative destruction' caused by rival firms seeking to translate knowledge into competitive advantage.[3] For Schumpeter,

> industrial change is never a harmonious advance with all elements of the system moving or tending to move in step. At any given time, some industries move on and others stay behind; and the discrepancies arising from this are an essential element in the situations that develop.[4]

But many aspects of Japan's economic development since the Second World War owe much to 'steady state' knowledge creation, as leading firms innovate without organizational and industrial 'destruction'. Unlike Anglo-American innovation models, the pressures and tensions that drive knowledge creation within Japanese firms do not normally result in takeovers and spin-off companies. Leading Japanese firms, with knowledge bases in previously successful industries, have been able to advance through in-house, incremental innovation (for example, from sewing machines to typewriters or from cameras to photocopiers), providing pillars of stability that lend shape and structure to the innovation system. As Michael Porter recognizes, Japanese companies are 'the principal engine of research and development in Japan. University research is limited, and interchange between companies and universities is modest compared to a number of other nations.'[5] Japan leads the world in per capita R&D expenditure, with spending by private companies accounting for about 80% of this total.[6] Although university entrance exams select the country's elite, on-the-job training at private companies is the system's dominant method for developing university graduates' knowledge creating capabilities.

Expectations of what James C. Abegglen 40 years ago called 'lifetime employment' (but subsequently suggested is perhaps better described as career employment or a social contract), complemented by company unions and age-based promotion, provide a further dimension of stability and an important enabling condition for Japanese-style intra-firm knowledge creation, emphasizing corporate self-reliance over the development of external knowledge creating transactions.[7] The *esprit de corps* amongst lifetime colleagues promotes extensive transactions in tacit knowledge,[8] thereby fostering a mutual understanding of problems and the type of information that would provide solutions. Since today's recruits will have to solve tomorrow's problems, the 'corporate team' has to be flexible in the face of changing circumstances. Japanese firms typically devote considerable resources to developing the skills of their permanent employees and, as we will explain, prefer to recruit bachelor or master level graduates, rather than PhD holders with specialist skills that might be difficult to integrate into the long-term evolution of organizational culture. In comparison with its Western counterparts, Japan produces few doctorates and Master of Business Administration (MBA) graduates.

Commenting on the integrated approach to knowledge generation adopted by Japanese firms, Fruin stresses that they aim to compete the 'old-fashioned way', by doing it themselves.[9] Whereas Western organizations often see working, learning and innovating as separate activities,[10] expectations of lifetime employment in Japanese firms promote their intermingling, with middle managers providing the corporate backbone that supports the firm's ability to evolve business strategies. Our argument is that, far from being a target for 'thinning out', Japan's middle managers play a pivotal role in forming strategies that are neither 'top down' nor 'bottom up', but instead center on 'middle-up-down' management. However, Japanese firms that seek to develop a global reach into the West have to make considerable adjustments to their management

methods. Hire-and-fire employment systems alone effectively prohibit the successful transfer of unalloyed Japanese management and a host of other factors force a revision of practices that work well in Japan.

Our case studies illustrate some of the adjustments to Japanese management which accompany Japan's global reach. First we discuss Nissan's development of the Primera as a high-performance car for the world market with local production in the UK. Next we review a joint venture—between Mitsubishi in Japan and the US-based Caterpillar— to produce hydraulic shovels for a global market. This shows how constructive tension between Japanese and American knowledge-creating systems can fuel a virtuous cycle of achievement through the synergic combination of their respective strengths. The effect is similar to mixing back and white paints to give ever finer black-and-white stripes (i.e. each side retains its distinctive identity), rather than to produce some form of gray monoculture. Although there may be substantial mutual adjustment and compromise, each side has a natural tendency to remain anchored to the more enduring traditions of its respective innovation system; interaction in Japan–West joint innovation systems can be a pincer movement that synthesizes solutions to problems amid contrasts and comparisons.

The Evolution of Japan's National Innovation System

During the mid-1980s, the Swedish economist Bengt Åke Lundvall developed the now ubiquitous notion of national innovation systems as a useful way to interpret technological change in different national environments.[11] According to Freeman, a national innovation system is the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies.[12]

Japan's industrial history has produced an institutional network which differs significantly from three of the Western nations that led the world into an industrial era. Although US demands for trade relations with Japan—delivered by Commodore Perry in 1853—ended over 200 years of seclusion and precipitated the 1868 Meiji Restoration which many take to be the birth of modern Japan, the change was neither a Norman Conquest nor a French Revolution.[13] There were adjustments in the samurai oligarchy, but much of the established system remained intact. Odagiri and Goto observe that the technological and industrial base for Meiji industrialization achieved substantial dimensions during Japan's seclusion, commenting that 'There were a number of cases, even then, of Japan either importing technology for adaptation or inventing and improving its own indigenous technology, showing a rather astonishing similarity to the way it accumulated technology after the Restoration.'[14]

The Meiji government aimed to learn from aboard without compromising Japan's independence. Along with overseas missions, Japan employed some 2,400 foreigners from 23 different countries.[15] Even before the Restoration, Japan's elementary education standards were probably higher than those in the USA, Britain, France and Germany.[16] Japan formed a Ministry of Education in 1871 and was the first country in Asia to introduce universal primary education. In Reischauer's judgment, Meiji leaders used education to brilliant effect by injecting native tendencies into Western techniques,[17] while Sugihara stresses the development of Meiji Japan's 'informational infrastructure' arguing that

> A high literacy rate and a general appreciation of the value of commercial and technical knowledge made it possible to formalize information in accessible form and make it publicly available. The comparison with how other non-European

countries responded to a similar situation raises an important question. Most of these countries did not have an opportunity to fully implement industrial policy, as they were either colonized or under heavy western influence.[18]

Using the slogan *fukoku kyôhei* (rich nation, strong army), the Meiji government sought to establish a prosperous country which remained free from colonization by a Western power. Wolferen points out that

> As Meiji industrialization took off, government control over the economy became automatic, since the government either put up the capital itself or encouraged private investors to do so by according them protection. Wasteful parallel invest-ment was thus minimized. In practically all major industries the Meiji Government took the initiative.[19]

When Japan's National Diet opened in 1890, Meiji rulers created a weak parliament and sought to counterbalance it with a strong bureaucracy, staffed by their own supporters.[20]

Japan's parliamentary democracy emerged in the wake of industrialization and has been more concerned with ratifying than initiating policy. In his classic study, *MITI and the Japanese Miracle*, Chalmers Johnson described the country as a 'plan rational' or 'developmental' state, in which government policy has shaped patterns of innovation pursued by private companies.[21] This differs from Anglo-American capitalism, where the impetus for competitive innovation typically comes from firms acting autonomously and government policy mainly concerns competition's forms and procedures, as opposed to what industries should or should not exist. Sugihara argues that the Meiji government took the British ideals of free trade and freedom of enterprise seriously, but followed Continental Europe in viewing government intervention as an essential condition for supporting such policies.[22]

Meiji leaders were aware that wealth concentration in capitalist nations frequently lay in the hands of a few families and sought to coerce Japan's wealthy merchant families into leading the new industrial age.[23] But these families usually lacked the knowledge and interest necessary to exploit the opportunities offered by industrial technology and entrepreneurs more often took the lead in cooperating with government initiatives to promote economic expansion and military development. By the turn of the century, Japan had several groups of companies that were each owned and operated by single families. Many of these financial cliques or *zaibatsu* grew to prominence between the beginning of the century and the First World War, with Mitsui, Mitsubishi, Sumitomo and Yasuda emerging as the 'big four'. During the war, many of Japan's *zaibatsu* prospered by supplying the Allies with munitions and other goods, bolstering a Golden Era of industrialization.[24]

According to Freeman, four points stressed in most accounts of Japan's industrializa-tion became evident during the First World War:

- a strong impetus from central government to promote modernization of the Japanese economy;
- identification of education and training as key factors in the modernization;
- intense efforts to import and, whenever possible, to improve upon the best available technology in the world; and
- close cooperation between government and large industrial concerns.[25]

Nevertheless, the above features have collectively produced two contrasting phases of economic development, with 1945 marking a shift from military-oriented development to post-war recovery. During the American Occupation, Allied reformers unwittingly strength-ened Japan's ability to operate as a planned rational state by removing its military

interests, thereby freeing the civilian bureaucracy from its greatest rival.[26] But reformers' attempts to dismantle the *zaibatsu* and prevent their re-emergence proved to be less significant.

After the Occupation ended in 1952, the Ministry of International Trade and Industry (MITI) introduced measures to dilute the US-inspired Antimonopoly Law and intervened to offer companies 'administrative guidance'. By 1953, MITI was calling for a '*keiretsu*-fication' of industry and nurtured the proliferation of financial groupings based on banks (as opposed to a *zaibatsu*-style family holding companies).[27] These *keiretsu* feature cross-share holdings, interlocking directorates (created when the *keiretsu* bank or leading group firms assign representatives to the boards of member companies), inter-group trade, and periodic meetings of councils made up of the presidents of member companies. The largest horizontal *keiretsu* (the so-called 'big six') comprise a reincarnation of the four largest *zaibatsu* (but with Yasuda reforming as the Fuyo Group, centered on the Fuji Bank), together with *keiretsu* clustering respectively around the Sanwa and Dai-Ichi Kangyô banks.

Vertical *keiretsu*, involving subcontracting hierarchies in production or distribution, also support stable trading relationships. Top firms in vertical *keiretsu* might be part of a horizontal *keiretsu*, giving the system a three-dimensional grid-like stability. While there is nothing unique in the idea of subcontracting hierarchies, subcontractors in Japan's vertical *keiretsu* are usually dependent on the firm above for most of their business and are obliged to adopt its suggestions about management, often taking the customer supplier relationship far beyond the precepts of unfettered market transactions.

Business strategies to keep the number of tradable shares below the level required to gain a controlling interest provide protection against the threat of takeover. Mergers formed a legitimate route to growth before the Second World War, but they have been comparatively rare during the post-war period and, when they do occur, do so in an orderly manner; for example, a *keiretsu* bank might arrange a takeover to rescue a group company that faces bankruptcy. There are also examples of the bureaucracy engineering mergers in the interests of national competitiveness, but the overall picture remains much closer to coordinated stability than to gales of creative destruction.

A distribution of power across Japan's industrial, bureaucratic and political sectors reinforces structural stability by making it difficult for any one interest group to establish a clear advantage. Like a group of swimmers treading water, major firms can improve their fitness (as indicated by sustained increases in relative market shares), but are not usually able to force their competitors out of business nor to move towards monopoly by taking over rival companies. Government policy has often tried to raise Japan's 'water level' by helping whole industries to rise up together (through even-handed support to leading firms) and providing protection from the potentially devastating effects of foreign competition.

Japanese markets are not market rational in an Anglo-American sense: government coordination, stable trading patterns and the complex web of long-term obligations and commitments mean that Japan's innovation system hardly squares with Western notions of cost-effective efficiency. If Anglo-American versions of interventionist policies correspond to someone contemplating getting into a bath that is too hot (with much concern about what part of the body to insert first, how far and for how long), the Japanese state has effectively built the industrial bath tub and retains control over the economic mechanisms that control its water temperature.

Even though there have been significant changes in the nature and role of elements within Japan's innovation system, these have not eroded its plan rational core. After the Second World War, military activities no longer shaped strategic economic development

(although the nation's defense budget is currently second only to that of the US[28]) and, as we shall see later, lifetime employment emerged as a key feature of Japan's national innovation system. Moreover, industrial policy has changed with the culmination of Japan's catch-up era in the late 1970s and early 1980s. (For example, in the computer industry, MITI's use of research associations switched from support for 'near market' development undertaken mainly by individual firms to basic research and more accent on collaborative knowledge creation.[29]) But Japan's progress towards catching up with US levels of economic output is not synonymous with moving towards an American innovation system. And the potency of Japan's version of capitalism is apparent in Eamonn Fingleton's observation that, in the 50 years after the Second World War, the country's share of world economic output rose from 1.5 to 16%, while the US share dropped from 50 to just 21%.[30]

Japanese Universities

After the Second World War, the number of universities in Japan increased dramatically, rising from a total of 50 in 1950 to well over 500 today. According to 1993 data, 43% of 18-year-olds entered higher education.[31] But there has been no commensurate shift in the contribution of university research to Japan's national knowledge-creating system.

Like its parliamentary democracy, Japan's higher education system evolved in the wake of industrialization. It quickly became geared to serving the needs of industry by producing more graduates in engineering and applied technology than in science. When Japan established its first university—the University of Tokyo—in 1877, the institution initially reflected a European influence, with a Faculty of Science but no separate Faculty of Engineering[32]. This soon changed and, by the early 1890s, the university had a strong base in engineering and agriculture. The formation of Japan's Imperial Universities (which are now leading institutions in the national university sector) replicated Tokyo's emphasis on applied technology and agriculture rather than science. Contemporary Japan has far more undergraduate and master's students studying applied technology and engineering than studying science; in the US and UK the position is the other way round.

Contrary to some Westerners' preconceptions, the ranking of Japanese universities does not correspond directly to research activities nor to the quality of teaching, but depends mainly on the difficulty of their entrance examinations and the extent to which top companies hire graduates. University research plays a relatively small role in Japan's knowledge creating system; according to *The Economist*,

> Japan's universities are not places conducive to doing profound basic research. Most have rigid, hierarchical structures. Elderly faculty heads dominate the research programmes and publishing process. Intellectual dissent is discouraged. And in addition to having their ideas stifled, younger researchers often find themselves carrying out the grunt work that is done in America or Europe by technicians. Lack of money for support staff means that many people who would be better employed doing experiments are doing the washing up instead.[33]

In 1988, Japan produced only 1,717 engineering PhDs and the number of science doctorates was a mere 881. By contrast, the US produced 4,187 engineering and 8,157 science PhDs and the UK produced 4,500 PhDs in engineering and 7,200 in science. Figures for 1992 show that the number of Japanese natural science doctorates had increased to 1,009, while the figure for engineering was 2,362. Respective US figures for 1992 were 9,372 for natural science and 5,439 for engineering.[34]

Although public funding for Japanese university research is increasing, it remains low by international standards. Policies to promote change include a Basic Law for Science and Technology (enacted in November 1995) which makes the government legally responsible for funding research. In the meantime, Japan is seeking to increase its production of doctorates and has also introduced plans to raise the number of post-doctoral fellowships (which were rare in the early 1990s) to 10,000 during the period 1998–2000. With the growing internationalization of Japanese firms, there has been a modest increase in the numbers of Japanese studying for MBAs. Even so, a book published by Lorriman and Kenjo in 1996 claimed that, compared with the annual US production of 70,000 MBAs, Japan has 'just one major, but not particularly well regarded, MBA course'.[35] Notwithstanding gradual changes in Japanese attitudes, lifetime employment for knowledge-creating individuals continues to be a fundamental part of Japan's business culture.

Lifetime Employment as a Platform for Japanese Knowledge Creation

Japan's industrialization initially operated according to hire-and-fire rules; it was not until the post Second World War recovery era that lifetime employment evolved as a key, but frequently misunderstood, element in the country's contemporary innovation system. To many in the West, a job for life is variously a luxury for ineffective workers or a threat to managerial flexibility. But such views misrepresent Japan's marriage-style employer–employee commitment, which is not a free ride nor a myth nor on the verge of extinction.[36] Fingleton stresses that external commentators often fail to appreciate its implications.

> No aspect of Japan's remarkable economy has been so consistently underestimated as its employment system. Because the system's three main principles—lifetime employment, company unions, and seniority pay—flout free-market ideals, West-erners consider it self-evidently incapable in the long run of withstanding global competition of 'more efficient' hire-and-fire labor systems of the US and Europe.[37]

To be sure, not everybody in Japan 'works for life'. For example, most female employees remain peripheral to corporate knowledge-creating processes (less than 1% of Japanese working women occupy managerial posts, compared with 35% in the US).[38] Employers generally expect that the majority of female employees will leave to have a family; they might re-enter employment with a different organization (giving a statistical impression of labor mobility), but these transfers rarely equate to Western-style career moves. More generally, employment in small firms might be less than secure. But expectations of lifetime employment for core knowledge-creating employees in larger companies continue to be an integral part of Japan's national innovation system.

Japanese firms do not consider that it is ethical to poach employees from rival organizations and they do not have to pay inflated salaries to retain their best people. For their part, permanent employees do not expect to change jobs. During the first few years of employment, it might be possible to start again on the bottom rung of another firm's career ladder, but accepted social values and limited opportunities discourage mid-career moves between employers. The 1980s saw some hesitant beginnings of a labor market for specialists, particularly engineers and software developers, but the Federation of Economic Organizations (*Keidanren*) made it clear that this was undesirable,[39] and even workers with a scarce skill are likely to find it difficult to take the lead in negotiating their own transfer to a major company. The initiative for transferring permanent employees between organizations normally rests with employers.

By Western standards, the logic for lifetime employment is easiest to appreciate during periods of rapid expansion, but it is misleading to suppose that an economic downturn will prompt its sudden demise. For one thing, Japan's business system makes it relatively easy for leading firms to maintain full employment by requesting their supply *keiretsu* to cut costs. This transmits pressure down the pyramid and, while firms at lower levels might have trouble or even go out of business, players at upper levels continue to provide the innovation system with pillars of structural stability. Downturns do not last forever and, by analogy with riding a bicycle, stopping means falling over. Japan's interlocking stability means that the system can sustain periods of 'bicycle business' (*jitensha*-sôgyô); hence firms continue to produce when their failed Western counterparts would simply go out of business and create nothing, like fallen bicycles.

Japanese graduates tend to attach more importance to a company's status than to the nature of its business. Employees leave career development to their employers. The prestige of a graduate's university provides a powerful indicator of how far the graduate can expect to rise in the organizational hierarchy. Progress up the career ladder then relates mainly to age and avoids the possible disruption caused by whiz kids who take a lead early in their careers and leap ahead. Senior Japanese workers are able to help their subordinates without fear of being overtaken and firms can draw on years of experience in deciding who should work where. Both the employer and employee have a mutual interest in organizational success, with enterprise unionism being mainly concerned with advancing common goals. For example, Japanese employees generally welcome new technology as a useful addition to the workplace (1996 figures indicate that for every 10,000 workers in Japan there were 338 robots, compared to 21 for the UK).[40]

Anglo-American innovation systems stress the need for someone to be in charge and carry responsibility for decisions, but Japanese decision making is more of a group activity. Clearly there is an ever-present danger that the decision will turn out like the proverbial camel that was designed by a committee seeking to produce a horse. However, the huge amount of information that flows around the organization enhances the decision-making group's awareness of relevant issues. Even apparently redundant information can help employees develop a fuller picture of their colleagues' aspirations and circumstances. Of course, it is easy to exaggerate the idea of consensus (as occurs when the most powerful member of a decision-making group suddenly identifies the consensus view), and informal behind-the-scenes negotiations (*nemawashi*) provide scope to avoid open dissent.[41] Policy implementation tends to be easier if everyone has been involved in the development stage. As Macdonald notes, Japanese firms long ago discovered that the sources of information used in innovation come from many parts of the firm and not just those parts with a specific responsibility to be creative.[42]

Transactions in Tacit Knowledge

Tacit knowledge concerns an individual's personal feelings, which are often difficult to express in a manner that others can understand. It covers hidden ideas and is quite probably partially hidden from knowledge-holding individuals. At one level, tacit knowledge transfer involves a technical element that is a fundamental part of learning in any culture; it occurs, for example, when an apprentice learns from a master craftsman. But there are also cognitive aspects of tacit knowledge, concerned with how individuals construct mental models to interpret their environment.[43] Nisbet has pointed out that it is possible to express much tacit knowledge (insofar as it is expressible at all) in metaphors.[44] Lakoff and Johnson comment that 'The essence of metaphor is understanding and the experiencing of one thing in terms of another.'[45]

Lifetime employment cultivates shared experience that helps Japanese employees interpret new images though metaphors and refine their thoughts by analogy with things that are already part of group understanding. Group activities help employees to share mental models, amplifying implicit ideas and stimulating the externalization of tacit knowledge. Socialization amongst colleagues outside the workplace further increases the probability that problems and potential solutions will intermingle as individuals better understand what their colleagues need to know. In the West, individualism and a respect for personal privacy can mean that mental models remain locked up in each person's head.

Face-to-face collaboration involves real-time exchanges that produce an instant response; one glance at a person's expression can often convey more than many words. The downside is that it takes time for everyone to appreciate new ideas; the process is, perforce, incremental and can get bogged down in the intellectual stagnation of 'group-think'. Japan's preference for on-the-job training, as opposed to Western-style codified knowledge of the type expressed in training manuals and so on, might mean that it takes a relatively long time for new group members to learn the job and sudden personnel changes carry the risk of newcomers making old mistakes.

To encourage effective coordination, key Japanese knowledge creators typically move with a project as it passes from R&D to production and sales departments, taking the project to market rugby-style, with members of the team advancing together in much the same way as a rugby team moves forward, while passing the knowledge ball down the line. Knowledge creation is a group activity; everyone understands the rules and tacit understanding amongst the players nurtures coordinated behavior. By contrast, Anglo-American product development can be closer to a relay race, with the baton of responsibility being passed from department to department. Instead of Japanese-style overlap, different people might be responsible for each successive stage. Naturally, fresh ideas help to prevent group-think, but misunderstandings or failure to grasp the full significance of project details can disrupt or even prevent baton transfers.

Sir John Harvey-Jones provides an astute observation of how shared tacit knowledge can be important to Japanese knowledge creation in his reflections upon racing to build a chemical plant in competition with a Japanese firm. Both firms started at the same time and sought to build identical plants, but the Japanese came into production more quickly with a plant that worked. In Harvey-Jones's view, the most important reason for this was that

> the Japanese plant was built by a team which shared a single large office and lived, worked and dreamt together, twelve hours or more a day, during the whole time of the development and planning of the plant. They were each in each other's minds and did not have to send a memo, or make a telephone call, to check the effects of, for example, locating a valve somewhere else. Any one of them could cover for anybody else.[46]

Harvey-Jones also notes that the same team responsible for designing the plant was involved in construction; there were no handover or communication problems—'the thing just flowed'. In the language of our paper, this illustrates shared tacit understanding and the flow of rugby-style knowledge creation.

Organizational Knowledge Creation and Middle-Up-Down Management[47]

A central theme in our model of organizational knowledge creation concerns the interplay between tacit and explicit knowledge. This involves a tacit-explicit dialogue
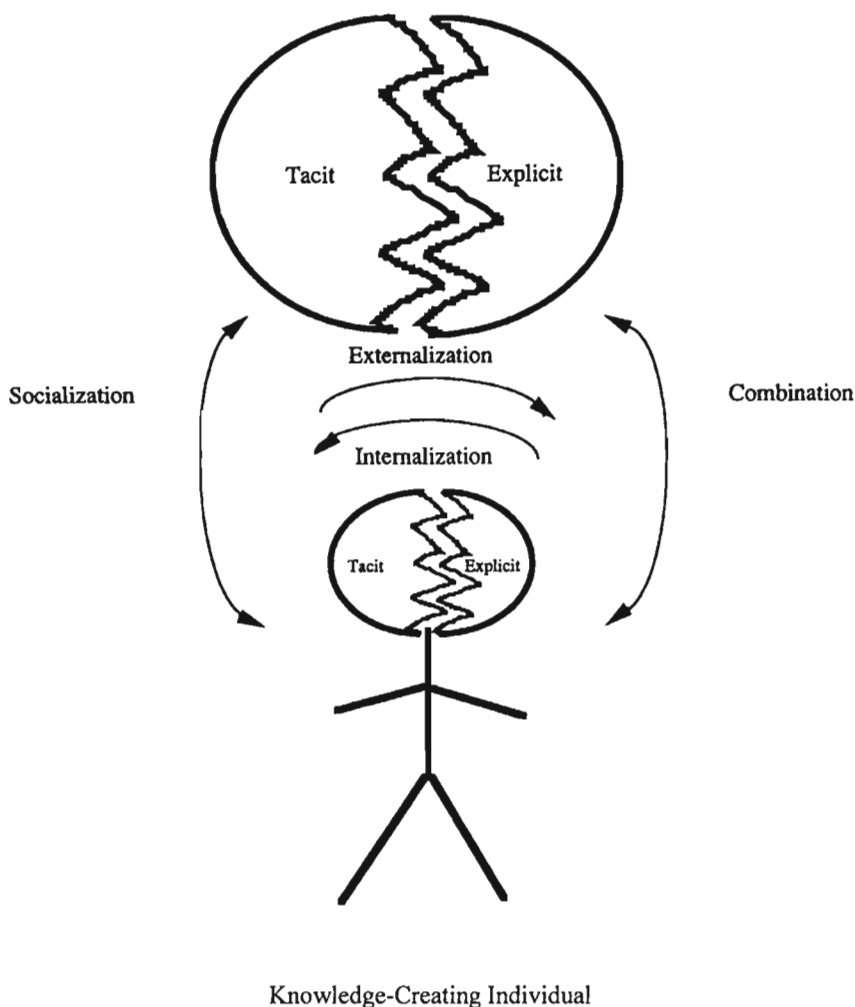
Figure 1.

Tacit   Explicit

Externalization

Socialization   Combination

Internalization

Tacit   Explicit

Knowledge-Creating Individual

Figure 1. Four modes of tacit–explicit knowledge conversion.

which takes place in the minds of individuals and across various knowledge-creating communities. These communities may take a host of different forms ranging, for example, from interaction amongst colleagues at work, to Internet discussion groups or meeting friends at a local sports club. And the tacit-explicit dialogue might operate across any combination of connected knowledge creating communities. Figure 1 attempts to illustrate forms of knowledge conversion in the tacit-explicit dialogue. It uses the umbrella term 'knowledge-creating environment' to depict the sum of potential knowledge-creating communities. Within these communities, our particular focus is on the way in which the boundary of any given business organization defines a particular knowledge-creating arena (i.e. the epistemological dimension of organizational activity).

The broken eggshell effect in Figure 1 reflects the practical difficulties of distinguishing between pure forms of tacit and explicit knowledge. Nevertheless, at an abstract level, we might envisage four modes of knowledge conversion: (1) externalization, as people find ways to explain tacit knowledge in terms of explicit information; (2) the opposite process of internalization, as individuals strive to understand explicit information and

integrate it into their personal knowledge bases; (3) combination of explicit knowledge to produce something new (for example, creating a new idea by consulting books in a library); and (4) social interaction—or socialization—involving the transfer of tacit knowledge amongst individuals (i.e. the transfer of technical and cognitive tacit knowledge).

As we noted earlier, Japan's lifetime employment system gives firms clear organizational boundaries and defines relatively fixed knowledge-creating communities bound together by huge flows of information. Organizational boundaries are solid and, like the walls of a fortress, enforce a high awareness of inside and outside. Within each fortress, information flows facilitate flexible approaches to deploying available resources to best effect. The idea of demolishing the walls is generally off the agenda.

The organizational and epistemological boundaries of Anglo-American organizations can change dramatically through hire-and-fire employment policies, mergers and spin-off companies. Managers might advocate increasing unit efficiency by closing down the inefficient part of a firm's activities (akin to knocking over slow-moving bicycles in the expectation that market forces will reallocate these factors of production to more rational activities). Market rational thinking also underpins Western interest in modular corporations with streamline structures that concentrate on core competencies and out-source the rest.[48] In virtual corporations, networks of companies come together quickly to take advantage of fast-changing opportunities, exploiting temporary relationships which end when the need for their creation passes. According to *Business Week*, the idea comes from

> the early days of computing when the term 'virtual memory' described a way of making a computer act as if it had more storage capacity than it really possessed. The virtual corporation will seem to be a single entity with vast capabilities but will really be the result of numerous collaborations assembled only when they're needed.[49]

In February 1995, after a decade when the West judged middle managers to be time servers who needed thinning out, *The Economist* reported expectations that middle managers might make a comeback, albeit with such titles as 'facilitators' and 'boundary spanners'.[50] But Japan is largely immune to the vicissitudes of Western management theory; the salary man has ridden on regardless, with middle managers facilitating and boundary spanning to combine senior management's top-down visions with a bottom-up understanding of what the organization is capable of achieving. In stark contrast to the abstract qualities of virtual organizations, Japanese management relies heavily on face-to-face meetings and socialization.

Along with visions from above and feedback from below, Japanese middle managers typically synthesize information from all parts of the organization, marrying the dreams of charismatic leaders to the undiluted realism of front-line employees. Top managers might articulate corporate dreams, but generally trust middle managers to seek realistic connections between aspirations and actual capabilities. The view from above might be deliberately ambiguous and even open to conflicting interpretations which give scope for middle managers to use their experience to interpret the task. At lower levels in the organization, front-line employees and junior managers are often saturated by details of technologies, products and markets. Nobody is more expert in the detailed realities of the company's business, but they frequently find it difficult to turn that information into knowledge that relates to broader company objectives.

The high level of trust and mutual understanding embodied in middle-up-down management makes it relatively easy to reconfigure personnel by switching between management styles. For example, Japanese firms often alternate between hierarchy and

special project teams designed to overcome bureaucratic sluggishness. Project teams assemble members with diverse skills from across the organization to work on goal-oriented, fixed-term projects. On occasions, competition between two independent teams pursuing the same objectives in parallel can produce progress that is out of proportion to the costs of duplicated effort. Once the project is complete, team members return to their previous positions in the hierarchy. Unlike matrix models of organization, which assign individuals to two structures at the same time, project team members switch between single-status groups and hierarchical organizational structures.

Transferring Japanese management to Western innovation environments involves expedient adjustments to local circumstances and the ability to learn from a juxtaposition of Japanese and Western approaches to knowledge creation, which can be a challenging but instructive experience. In the same way as computing's use of hypertext files allows a problem to be viewed from different angles, comparing and contrasting alternative approaches to knowledge creation can expose weaknesses and reveal new ways to move forward.[51] Whereas conventional text has only one layer—the text itself—hypertext allows access to different knowledge layers in the form of explanatory notes, diagrams, pictures or whatever, which provide an alternative view of the subject in question. For example, a hypertext version of *Hamlet* might offer references to video clips from film versions of the book, biographical details of the author or other perspectives that provide a different angle on the basic text. By a similar logic, our case studies reveal how interaction with Anglo-American innovation environments can offer scope for a re-examination of Japanese middle-up-down management.

Case Studies of Joint Innovation Systems[52]

Nissan's Primera

Nissan is Japan's second largest auto-maker, coming after Toyota. It has been developing overseas operations since the mid-1970s, but the Primera's launch in 1990 marked the company's first attempt to produce a high-performance car for the global market. Nissan's success in Japan and the US owed much to a reputation for comfort, styling, varied model options and fashionable accessories. The Primera aimed to build on these virtues and compete in European markets, where local makers—such as Mercedes Benz and BMW—had an international reputation for high-quality engineering and performance.

As a first step, Nissan engaged in a massive exercise to give its staff first-hand experience of European motoring culture. The second aspect of global reach was Nissan's decision to establish Primera production at its recently opened UK factory, with 80% of the components sourced from Europe. Nissan's UK production venture illustrates a modified version of middle-up-down management, designed to overcome constraints associated with a multitude of craft-based unions and the possibility of demarcation disputes.

The Primera project's supervisor, Yasuhisa Tsuda, led a team of eight managers who had experience of working in Europe. Tsuda could speak German and English fluently; he had studied at the Berlin Technical College and had worked in the United States, where he led Nissan's joint development with Volkswagen to produce the Santana model. The Primera team's international experience placed its members in the role of translators, tasked with communicating their tacit understanding of European motoring to colleagues in Japan, diffusing ideas and building company-wide support. By using metaphors and analogies, they managed to strike chords with empathetic thinkers who

could relate to their message, while recruiting persuaders and enthusiasts to build a company-wide understanding of the project's objectives and implementation strategy.

Nissan sent more than 1,500 staff to Europe to gain first-hand experience of local conditions. For many, the reality of high-performance motoring away from Japan's notorious traffic congestion provided a rude awakening. Engine specialists who had looked self-assured when they left Japan returned crestfallen. Fortunately, the Primera project coincided with Nissan's decision to send large numbers of staff overseas to increase their awareness of foreign technology and enable them to make a better-informed bottom-up contribution to middle-up-down management. Only about 1% of the Engine Department's 700 engineers had previously been on overseas trips. To motivate the Primera project workers, a middle manager coined the slogan 'comfort and safety on the autobahn', combining Nissan's established reputation for comfort with the image of high-performance motoring on an autobahn.

Meanwhile, Nissan was preparing for production in Britain. Its 1986 arrival in northeast England brought welcome investment to a depressed economic area and a novel management philosophy which insisted on a single union. This one-union policy was essential to Nissan, but the source of enormous UK media attention about departing from traditional custom and practice. The plant's distance from areas with a history of motor manufacturing made it relatively easy to recruit employees who did not have experience of working in the industry and could be socialized in ways that fitted Nissan's management philosophy. Nissan quickly built a reputation as a good employer which respected employee loyalty.

In Japan, Nissan had relied heavily on rugby-style management and the use of tacit knowledge to smooth out difficulties. For example, while it was not uncommon for Nissan's design engineers to produce drawings that caused problems at the manufacturing stage, there was a vast reservoir of tacit knowledge to support the rapid solution of such problems without jeopardizing short lead times and high-quality products. The Japanese operation made little use of formal procedures and manuals. As one of Nissan's managers in Japan commented,

> Much of the knowledge about production which Nissan has so painstakingly built up over the past several decades can, of course, be put into words and numbers. But much of it is locked up within the brains of individuals.[53]

But British workers expect to have their duties and specific operating procedures articulated in explicit language. Nissan responded with a push-pull approach; it set about externalizing tacit knowledge through the production of manuals and began introducing the ideas of Japanese-style knowledge creation to its UK workers; for example, by sending some 300 middle-level British engineers and technicians to Japan for on-the-job training. These preparations proved effective and the UK Primera followed only six months behind Nissan's plant in Japan. When UK production revealed problems with suppliers delivering parts on time, Nissan again responded in a Japanese way by dispatching its engineers to the problematic firms. As a result, they became the best-performing suppliers.

A British view on early days at Nissan Motor Manufacturing (UK) draws on the fascinating experience of Peter Wickens, Nissan UK's Personnel Director. It offers a British perspective on establishing common ground with Japanese management:

> that much that is good about Japanese management is transferable, with modification to a Western environment. Indeed those elements that are transferable can almost be regarded as 'international' rather than 'Japanese' ... As a result of our internal analysis within Nissan we have developed our own transfer list—our

tripod—Flexibility, Quality Consciousness and Teamworking. Like all tripods it is indivisible and independent—lose one leg and the structure falls. These three legs combined with common terms and conditions can be major determinants of success for any company.[54]

Flexibility, quality consciousness and teamworking flow easily from a middle-up-down management philosophy, but the non-transferability of Japan's lifetime employment system represents a fundamental barrier to the fusion of Japanese and Western knowledge-creating systems. Much of this account deals with trade unions and the background to Nissan's single-union deal, which would be of little significance in Japan's business culture of enterprise unionism and lifetime employment. Wickens touches on a related point about common terms and conditions in his conclusion:

> So often in British industry we erect our own barriers to prevent progress. The traditional differences between 'staff' and 'hourly paid' divides employees into first and second class citizens. Put simply, you do not get a first-class response from second-class citizens—why should somebody who is treated as though he cannot be trusted, who is regarded as being 'economic man' motivated only by money, act any differently. The Nissan way is to treat everyone as first-class citizens—to get the basic pay and conditions right and achieve involvement and commitment by the way people are managed.[55]

Nissan's single-union deal aimed to generate something that resembled Japanese-style flexibility by making it clear that all employees were part of the same team and could exchange knowledge without losing ground to 'rival' sections of the firm.

The Nissan case shows how socialization operated as a powerful tool for understanding the European motoring market and translated this experience into company-wide knowledge that supports the production of commercial products. Western firms seeking to establish a market in Japan often fail to give employees similar first-hand exposure to Japanese conditions. Nissan's approach highlights the importance of attempting to recreate Japanese-style organizational stability as a prerequisite for transferring aspects of middle-up-down management to a Western innovation environment.

Shin Caterpillar Mitsubishi's REGA Project

Our second case study considers the interaction of Japanese and Western knowledge-creating systems within a joint venture—Shin Caterpillar Mitsubishi—to develop the REGA series of ultra-advanced hydraulic shovels, launched in 1992. After tough negotiations, Mitsubishi of Japan and the US firm Caterpillar established the Japan-based Shin Caterpillar Mitsubishi in 1987. This gave Caterpillar access to Mitsubishi's technology and the Japanese market (previously prevented by an earlier agreement with Mitsubishi). For its part, Mitsubishi benefited from access to Caterpillar's worldwide sales network.

REGA was Shin Caterpillar Mitsubishi's first attempt to develop a global product for manufacture in Japan, the United States and Europe. It is a spectacular example of constructive tension between Japanese and American knowledge-creation processes. Whereas Mitsubishi was keenly aware of price-sensitive competition in the Japanese market, Caterpillar recognized that US users would pay a premium for safety and special performance characteristics. In the event, REGA benefited from Caterpillar's commitment to safety and performance specifications, as well as Mitsubishi's attention to engineering issues and design image (REGA's side profile resembled a Japanese sword and won widespread acclaim for transcending the generally unglamorous image of power shovels).

Product development took place over four years at Shin Caterpillar Mitsubishi's Hydraulic Excavator Design Center (HEDC) using a Japanese approach, tempered by Caterpillar's engineers, who went to Japan to work on the project. Two-person teams, comprising one Japanese and one American, took responsibility for REGA's engineering and general management functions. At any one time, there were about 20 teams and each individual in the pair had identical status. They sat at adjacent desks and frequently spent time together outside the office. This extensive socialization quickly exposed a fundamental difference in thinking. When the Americans could not understand, they asked 'why?' But most of the Japanese could not answer when confronted by a long series of 'why's'. In the Japanese system, much of the shared knowledge that would answer the American questions remained tacit. Suddenly, the Japanese engineers had to explain their position to foreigners, who demanded that things be explicit and logical.

Caterpillar's business culture stressed the importance of disseminating explicit information. Compared with Mitsubishi, it had a much clearer division of labor and Caterpillar engineers had little contact with the machines they developed. In some respects, Caterpillar's gains in efficiency were at the expense of matching Mitsubishi's ability to achieve flexibility. Mitsubishi's engineers were familiar with a broad cross-section of activities in the development, production and marketing of new products. They continually reconfigured problems, passing ideas rugby-style among departments and working on different activities simultaneously. Development at Mitsubishi took only three to four years, which was distinctly quicker than Caterpillar's five to ten year relay-style approach.

A striking illustration of differences between Japanese and American approaches came when one of Mitsubishi's managers, Noriyuki Itakura, went to visit Caterpillar's REGA manufacturing facilities to observe pilot production and take lessons back to Japan. In the process, Caterpillar designers—who rarely visited production plants—heard Itakura extol the virtues of Japanese 'on-the-spotism' and the importance of socialization that brought designers into contact with the staff who manufactured their machines, helping to generate rugby-style overlap to support a hitherto sequential approach to project management.

Caterpillar's attitudes to cost were also a surprise to Itakura. For his American colleagues, 'can' was a technical question, but for Mitsubishi the issue was 'can we afford it?', reflecting a tempering of R&D activities by broader business considerations. Indeed, cost-cutting plans had been underway at Mitsubishi's Akashi plant for almost ten years and, through a process of trial and error, efforts eventually started to bear fruit after five years. Caterpillar was facing similar difficulties and Itakura met with senior staff to talk about what they might do. He left feeling that he had made a strong impression, but had not been completely understood. The surprise came six months later, when Itakura found that Caterpillar staff had turned his explanation into a powerful piece of cost-monitoring computer software. They had succeeded in translating tacit knowledge accumulated in Japan into explicit knowledge. He later explained,

> Well the idea was Japanese. But the ability to document or to compile manuals was definitely on their side. In Japan, you might find a kind of superman who can do a difficult job, which is convenient enough. But after he has gone, no one else can do it. In America anyone can do a job as long as there is a manual. Documentation, the sharing of software, and building them into a business system are going to become important to manufacture the exact same product in many countries, while taking into account local conditions and cultures. In this respect, I think I learned the advantage of the American approach to documentation and software sharing.[56]

Itakura's comments embody key differences between Japanese and US approaches to tacit and explicit knowledge. More generally, the REGA case shows how resolving conflicts through mutual adjustment can stimulate effective knowledge creation and the generation of products that appeal to markets across the world.

Conclusion

Many Western assertions that Japanese companies are variously paragons of virtue or not worthy of serious attention ignore the reality of Japan's management and knowledge-creation processes. We have attempted to reveal some aspects of this reality by starting with Japan's industrial history. Japan was East Asia's pioneer of industrialization but, despite learning a great deal about Western science and technology, its system for translating knowledge into economic wealth has remained distinctly Japanese. Some Western practices (such as a hire-and-fire employment system) have been a part of that history, but apparent similarities with the West are often superficial.

A balanced picture of Japan's innovation system depends upon understanding the interrelationships that exist amongst its constituent elements. For example, it is unrealistic to expect British or American managers to adopt Japanese attitudes to overtime; their system neither expects nor rewards such commitments. In Japan, the whole basis of employment and its associated social values differ from custom and practice in Anglo-American innovation systems. Top firms seek to recruit graduates from prestigious universities with a bachelor's or possibly a master's level degree, but rarely a PhD or MBA. Thereafter the earning potential of lifetime employees is contingent upon working for the same firm, whereas Western labor markets provide options for alternative employment and make it relatively easy for employees to relate their capabilities to the going rate for doing a similar job elsewhere. The West's market rational system supports real labor markets for employees of all ages and provides the enabling conditions for virtual organizations. In many respects, Japan's position is the other way round. Fortress companies admit knowledge-creating employees for a lifetime of mutual commitment in real organizations; they emphasize hierarchy over market.

For better or worse, Japanese employers and employees are in the same boat, fashioning the effect that Harvey-Jones described as communal living, working and dreaming. Japanese management is much more concerned with promoting long-term, intra-organizational flexibility than short-term, Western-style efficiency. Nissan's efforts to give its Japan-based employees first-hand experience of European motoring culture illustrates the point. In the case of a Japanese who has never seen an autobahn, the experience of driving on one at otherwise unimaginable speeds is likely to convey more than any number of written reports. Although a Western firm might baulk at the costs of the exercise, for Nissan it was an investment in long-term flexibility; the policy aimed to allow employees to relate more effectively to corporate knowledge creation by better understanding European user requirements.

Both of our case studies offer examples of how the Japanese firms had to accommodate Western expectations about making things explicit: British workers expected Nissan to be explicit about job requirements and Caterpillar's engineers wanted to know 'why?' The turbulence of Anglo-American innovation places a premium on free-standing explicit knowledge which does not depend on the context-specific nature of socialization (i.e. sharing tacit knowledge). Explicit knowledge is open to interpretation by suitably qualified individuals who have had nothing to do with its creation. Exchanges of explicit documents, videos or whatever allow recipients to review and reappraise complex information. The information might be subject to a variety of interpretations, but its

stand-alone quality offers the potential to convey elaborate ideas and leap over possible stumbling blocks associated with group-think which can occur in tacit knowledge creating systems. This speed factor can support rapid shifts in strategy to accommodate changing threats and opportunities, while the stand-alone quality of explicit knowledge helps virtual organizations operate without middle-up-down management's central core of middle managers.

The relative advantages of rugby and relay approaches vary according to circumstances. For example, given clear market and technological trends, Japanese rugby-style knowledge creation can achieve outstanding results through steady streams of improvement innovations. The motor industry is a good example; Japanese auto-makers have a formidable international reputation for coupling product-performance characteristics to evolving patterns of consumer preferences. Under a rugby-style approach, consensus about what can and should be done helps the company to coordinate its activities in the face of creative crisis. But building consensus requires a great deal of time and effort, making the system vulnerable to catastrophic crisis and paralysis caused by sudden changes that overtake prevailing views about how to continue.

Western assumptions about responsibility resting with individuals can underpin rapid and decisive action by individual heroes or macho managers who rise to a challenge by taking charge and cutting red tape. But in less turbulent times, the organizational selection environment might be less suited to recognizing leaders. Without the opportunity to prove their worth, would-be leaders might embark on unnecessary conflicts. Concerns about individual performance can easily discourage people from sharing information that could help their colleagues. Alternatively, well-intentioned members of the organization might simply be unaware of their colleagues' circumstances and the type of information that would be useful to them.

Put simply, a Japanese organization typically relies on the extensive use of interpersonal understanding and tacit knowledge, but attaches less importance to Western-style preferences for explicit information. In terms of knowledge-creating communities, Japan's system exploits group-based activities and lifetime employment, whereas the West more readily rewards the contribution of outstanding individuals and expects that there will be labor mobility. Juxtaposing Japanese and Western innovation knowledge-creating systems can produce enormous benefits, but it is important that the juxtaposition does not seek to resolve intrinsically Western problems with Japanese solutions, or vice versa. The systems have different strengths and weaknesses; the challenge is to combine their virtues effectively.

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