

Innovation vs. Learning by Doing: Implications of Japan's "Lost Decade" in the Information Age

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Innovation vs. Learning by Doing: Implications of Japan's "Lost Decade" in the Information Age*

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Abstract

This paper describes the strengths and weaknesses of "learning by doing" in comparison to those of "innovation," with attention to the experience of Japan's "lost decade." It is apparent that the Japanese economy has failed to reap the benefit of innovations in information technology in the 1990s. With the concepts of "modularity" and "integrality," it seems reasonable to infer that the integral system of Japan works well for technological improvement of learning by doing, but it does not induce dynamic "new combinations" that boost innovation. Therefore, it is necessary to recognize the importance of a modular system, rather than an integral one, for engendering appropriate regional innovation system, or RIS, in this emerging information age.

Keyword: information technology, innovation, learning by doing, modularity, integrality, economies of outsourcing, Japanese system

JEL Code: L2, O3, O4, O5, P5

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1. Introduction

Learning by doing was considered to be an important source of competitive advantage in Corporate Japan, especially in the 1980s. Nevertheless, the Japanese economy has seen its competitiveness erode over the last decade. One can now see a clear contrast in economic performance between Japan and the United States. As is well known, in the 1990s, the United States economy was improving in marked contrast to the worsening Japanese economy. In fact, it is often said that the 1990s were the “lost decade¹” in Japan because of the long economic slump in the wake of the bursting bubble of the late 1980s. In contrast, the U.S. economy experienced the longest expansion ever with its miraculous productivity resurgence. Ex-president William Clinton called the 1990s expansion the “soundest decade.”² All that is in sharp contrast to the economic outlook of both countries in the 1980s. It seems that the respective economic conditions of the 1990s have completely reversed from those of the 1980s.

Contemporaneously, the world witnessed innovative information technology prevailing globally in the 1990s. Fifteen years ago, there were few computers in schools and homes, and even in offices; little was known about the Internet in general. Now computers are ubiquitous, not only in the office, but also in schools, restaurants, hospitals and homes. In addition, more than 170 million host computers connect with each other via the Internet all over the world.³ This great change is sometimes referred to as the “information revolution.”⁴ Alfred Chandler (2000), a professor of business history at Harvard University, asserted that the U.S. economy underwent “the transformation from the Industrial [Age] into Information Age in the last decades of the twentieth century.”⁵

¹ Economic Planning Agency (1998).

² Uchitelle (1999).

³ As of January 2003. Survey of the Internet Software Consortium (<http://www.isc.org/>). The number was only 0.3 million as of 1990.

⁴ Chandler (2000), p. 3.

⁵ *Ibid.* The word within [] is added, not in the original.

The salient question here is why and how Japan failed to reap the benefits of innovation in information technology. It used to be considered that Japan was quite good at managing technological improvement on which it had achieved its marvelous economic prosperity since the 1950s. To consider the regional innovation system (RIS) in the midst of information revolution, it seems essential to re-examine Japan's experience of the "lost decade." How did it succeed in technological improvement in the matured industrial age and how has it failed in this emerging information age?

This paper is intended to address these questions. As a beginning, the macro-economic performance of Japan is reviewed in comparison with that of the United States, focusing on investment in information technology. Then, comparative analysis of two different types of technological change, *i.e.* learning by doing and innovation, is conducted in the context of strength and weakness of the integral system of Japan.

2. Review of the Japanese Economy

This section presents a review of the Japanese economy, showing the contrast and reversal in economic performances between Japan and the United States with three major macro-economic indicators. They are economic growth, the job market, and fixed investment.

2-1. Contrast and reversal in the 1990s

The first indicator is a typical data series, the annual growth rate of gross domestic product, or GDP. Since the end of the World War II, Japan's annual growth rate had always been higher than that of the U.S. through to the end of 1980s, even though the gap between the countries continued narrowing over time (Table 1). In the 1990s, however, the position of rivalry in those rates reversed. The annual growth rate of Japan was only 1.7%, which was about half the 3.0% of the United States. The contrast becomes much clearer when viewed from 1992 to 2000. The year 1991 was the turning

point in the economic performances in both Japan and the United States. February 1991 was the peak of the Japanese business cycle just after the late 1980s economic boom. On the other hand, March 1991 was the trough of the U.S. business cycle. Since then, the U.S. experienced its longest economic boom, which came to last exactly ten years. Thus, 1991 was the watershed year of the economic outlook and 1992 was the beginning year of a new stage in both economies.

Table 1. Annual Growth Rate of GDP (%)

	1960s	1970s	1980s	1990s	1992-2000
Japan	10.4	5.2	3.8	1.7	1.0
U.S.A.	4.4	3.3	3.0	3.0	3.6

Sources: Cabinet Office [Government Office of Japan], U.S. Department of Commerce.

Another indicator that clearly shows the contrast is the unemployment rate. It used to be argued that the natural unemployment rate, or NAIRU (non-accelerating-inflation rate of unemployment), in the U.S. ranged 5.5-6.0%, whereas in Japan it ranged 2.0-2.5%. In the late 1990s, however, the actual unemployment rate in the U.S. had been falling to a far lower level than NAIRU; it finally reached 3.9% in 2000. On the other hand, Japan's unemployment rate continued increasing up to higher than 5%, its highest level ever. Consequently, Japan's unemployment rate exceeded that of the U.S. in 1998, a phenomenon unseen in the post-war era.

Finally, non-residential fixed investment has also represented a sharp contrast between these two countries. Japan's intensive capital investment led the country to the fastest economic growth among developed industrial nations since the 1950s, with the exception of the 1970s (Table 2). In the early and the late 1970s, the world economy suffered from the first and the second "oil shocks" that forced severe stagnation on the Japanese economy. Japan relies on imports for almost all of its crude oil, mainly from middle-eastern countries. Exacerbating matters, Japanese exporters were damaged by the appreciation of the Yen against the U.S. dollar in the early 1970s as foreign exchange markets entered into a floating system from a fixed one. Going through this hard time, the Japanese economy had revived in the 1980s as a result of its intensive investment in technology, especially in the

automobile, microelectronics and semiconductor industries. In the 1980s, the annual growth rate of fixed investment in Japan was more than double that of the United States. *Japan as number one*, the title of a book written by Harvard University professor Ezra Vogel, became well known in those days.

Table 2. Annual Growth Rate of Fixed Investment (%)

	1960s	1970s	1980s	1990s	1992-2000
Japan	19.1	4.0	7.8	0.8	-0.5
U.S.A.	7.2	5.4	3.3	6.9	9.0

Sources: Cabinet Office [Government Office of Japan], U.S. Department of Commerce.

Conditions, however, had completely reversed in the 1990s. Corporate Japan was so pessimistic in their business and was not willing to invest, whereas Corporate America aggressively invested in their businesses. As Table 2 shows, business investment in Japan declined from 1992 to 2000 on average. On the other hand, it posted a nearly double-digit increase in the United States. Fixed investment figures represent those of the clearest contrasts between Japan and the United States in the 1990s, which were apparently opposite trends from those in the 1980s.

2-2. Innovations and investment in technology

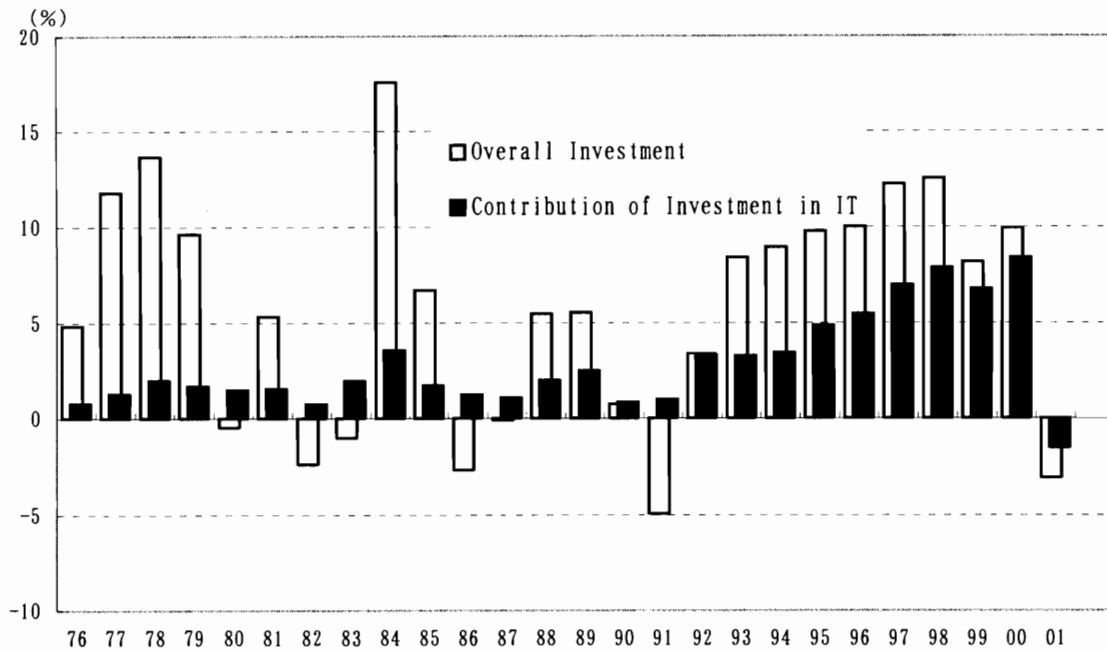
What should be stressed here is the importance of business investment because it is one of the major means to introduce technological innovation to the economy while it generates current demand on capital goods and pushes the business cycle upward. Introducing new technology is the key factor to innovate the supply side of the economy, which eventually leads to the surge of productivity. As is well known, productivity is critical for future prosperity, as Krugman (1990) suggested, “productivity isn’t everything but in the long-run, it is almost everything.”⁶

As for management, investment requires an important decision-making. Over-investment

⁶ Krugman (1990), p.9.

engenders non-performing assets and a debt burden, causing subsequent business failure. On the contrary, under-investment will bypass introduction of new technology: an enterprise will lose competitiveness and innovative business opportunities in the long run. Therefore, appropriate business investment in technology is crucial for sound economic development and business success.

Figure 1. Growth Rate of Fixed Investment and Contribution of IT



Source: U.S. Department of Commerce.

In the 1990s, the transformation period toward the information age, business investment focused mainly on information technology in the United States. From 1992 to 2000, the contribution of investment in information technology amounted to two-thirds of the total increase in non-residential fixed investment. Figure 1 shows well that intensive investment in information technology began in the early 1990s and remained strong all through the decade.

Our concern here is whether investment in information technology paid off or not. In the late 1980s, a skeptical view of information technology appeared and prevailed among corporate executives. They could not see any clear and concrete improvement in efficiency and productivity in their businesses even though they had poured huge amounts of money into the technology. They

came to think it as just losing money. Robert Solow's famous quip, "we can see the computer age everywhere but in the productivity statistics,"⁷ well represents the negative consensus in those days.

By the late 1990s, however, a positive consensus had emerged. Several empirical studies revealed that the technology had finally paid off. According to studies based on firm-level micro data (Brynjolfsson [1996]), aggregate micro data (Jorgenson [2000], Oliner and Sichel [2000], the Council of Economic Advisors [2000, 2001]), and industry level data (Stiroh [2002]), information technology contributed to the U.S. productivity resurgence in the late 1990s (Table 3). With these studies as background, Solow finally acknowledged the positive impact of information technology on productivity growth. He mentioned in an interview, "you can now see the computers in the productivity statistics."⁸

Table 3. Accounting for the Post-1995 Productivity Speedup

	Oliner&Sichel 74-90 96-99	Gordon 72-95 95-99	Jorgenson 73-90 95-99	Whelan 74-95 96-98	ERP2001 73-95 95-2000	ERP2002 73-95 95-2001
ALP before early 1990s (a)	1.37	1.42	1.26	1.16	1.39	1.39
ALP since late 1990s (b)	2.57	2.75	2.11	2.15	3.01	2.60
Acceleration of ALP (b)-(a)	1.20	1.33	0.85	0.99	1.63	1.21
Cyclical effect of ALP	-	0.50	-	-	0.04	-0.48
Acceleration of ALP Trend	-	0.83	-	-	1.58	1.70
Contribution of capital deepening (of which informaton technology)	0.29 (0.52)	0.33 (-)	0.45 (0.54)	- (0.46)	0.38 (0.62)	0.57 (0.60)
Contribution of MFP (of which informaton technology)	0.83 (0.32)	0.31 (0.29)	0.50 (0.31)	- (0.27)	1.19 (0.18)	1.07 (0.16)
Other	0.08	0.19	-0.10	-	0.00	0.04
Contribution of information technology	70%	-	100%	74%	49%	63%

Sources: Oliner & Sichel (2000), p. 13, Table 2; Gordon (2000), p. 55, Table 2; Whelan (2000), p. 34, Table 5; Jorgenson (2001), p. 25, Table 8; Economic Report of the President (2001), p. 28, Table 1-1, and (2002), p. 61, Table 1-4.

Note: ALP stands for average labor productivity. MFP stands for multi factor productivity.

As Solow was concerned then⁹, some components of productivity improvement might derive from business cycle effects. The actual growth rate of productivity, however, surely made him feel

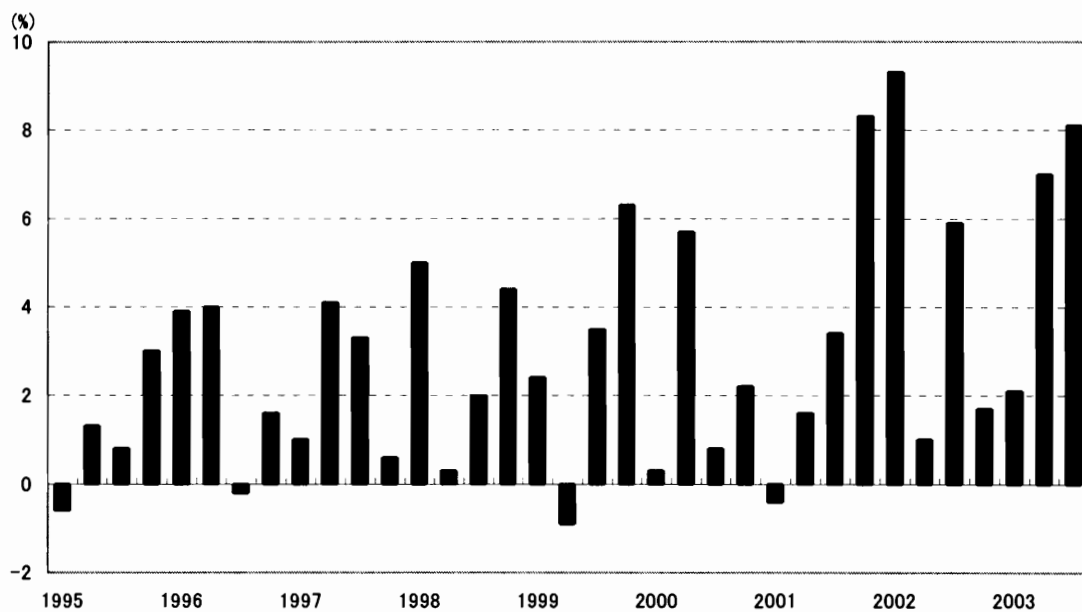
⁷ Solow (1987).

⁸ Uchitelle (2000).

⁹ *Ibid.* Solow said in the interview that, "I will feel better about the endurance of the productivity improvement after it survives its first recession."

better. It remained high even though the economy underwent recession from March 2001 through November 2001; that high speed has continued through another recovery period since then. Therefore, it seems reasonable to presume that a fundamental resurgence in productivity resulting from the accumulation of information technology remains solid and steady. In conclusion, the United States has succeeded in introducing technological innovation to the supply side of the economy as well as in pushing the business cycle upward.

Figure 2. Output per Hour in the Nonfarm Business



Source: U.S. Department of Labor. Note: Percent change from previous quarter at annual rate.

2-3. Japan's problem in the Information Age

Turning now to Japan's investment in information technology, we found that it went a different way in the 1990s. In Japan, an investment boom in information technology was seen in the late 1980s when the lion's share of the investment was going to mainframe computers and building closed-network systems. Growth rates of investment in information technology were much higher in Japan than those in the United States in all items of technology, from hardware to software (Table4). Nevertheless, the boom had gone by the 1990s, especially in the early years, when the major target

of the technology had transformed radically from integral mainframe systems to decentralized personal computers and from closed telecommunications networks to open Internet communications systems.

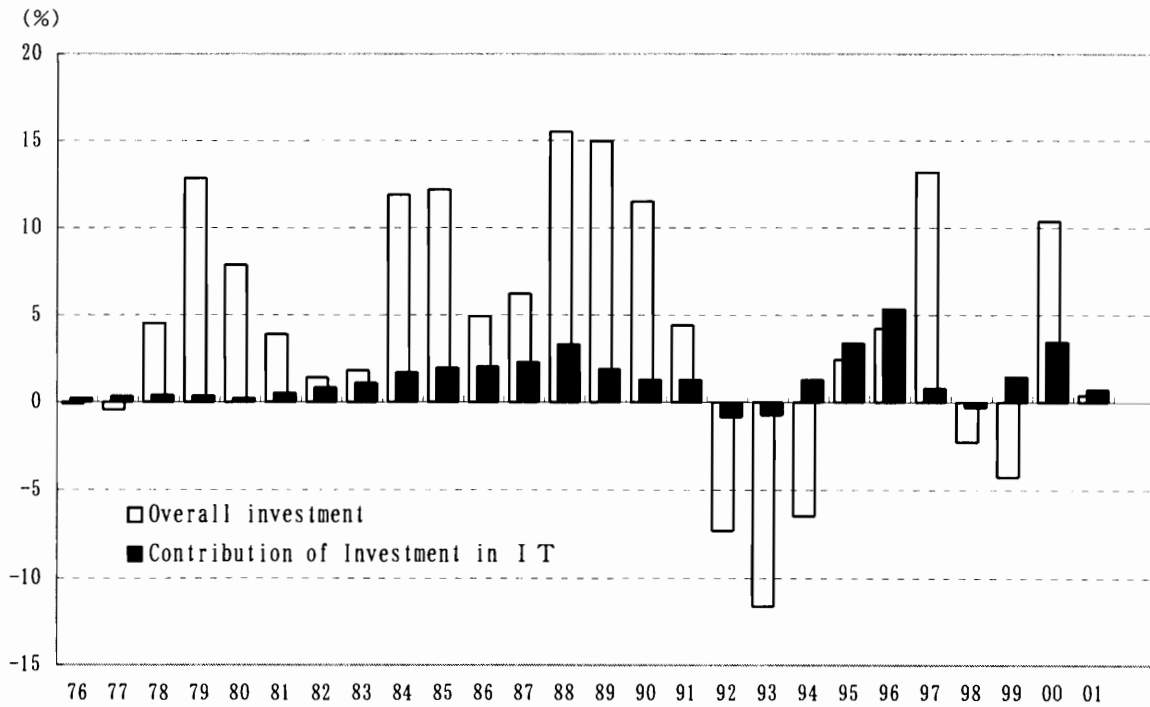
Table 4. Nominal Growth Rate of Investment in Information Technology (IT) (% annually)

		1981-85	1986-90	1991-95	1996-2000
J P N	Total IT investment	18.7	14.5	2.2	7.2
	Hardware	17.6	10.0	2.6	5.3
	Computers	20.6	11.9	1.3	5.7
	Communications	14.3	6.3	8.7	7.8
	Software	34.0	40.0	2.0	12.9
U S A	Total IT investment	14.0	5.6	8.7	13.2
	Hardware	12.8	2.5	7.6	10.8
	Computers	22.7	3.1	11.2	11.2
	Communications	9.2	3.7	5.0	14.4
	Software	19.2	14.5	10.8	17.0

Source: Shinozaki (2003), p. 94, Table 5-7.

Regarding the trend of investment, one can easily understand that Japan's investment in information technology presents a repeated up and down cycle, instead of maintaining the strong growth seen in the United States. Japanese corporate executives moved to cut technology investment when they saw the economy going into recession. Sometimes they cut the technology investment much more quickly and sharply than other expenditures, which typically appeared in 1997 (Fig. 3). Had they actually realized the importance of the technology, they should have kept investing in it as Corporate America did during the sluggish "jobless recovery" in the early 1990s, or at least, they should have minimized cuts in the technology investment relative to other expenditures.

Figure 3. Growth Rate of Fixed Investment and Contribution of IT



Source: Shinozaki (2003), p. 95, Figure 5-2.

Consequently, Corporate Japan failed to introduce new information technology and to reap its benefits. This fact suggests some impediments in Japan for taking full advantage of open network innovation that began prevailing around the world in the 1990s. Why and how? To address the question, we must examine the strengths and weaknesses of the Japanese system from the viewpoint of innovation.

3. Strengths and weaknesses of the Japanese system

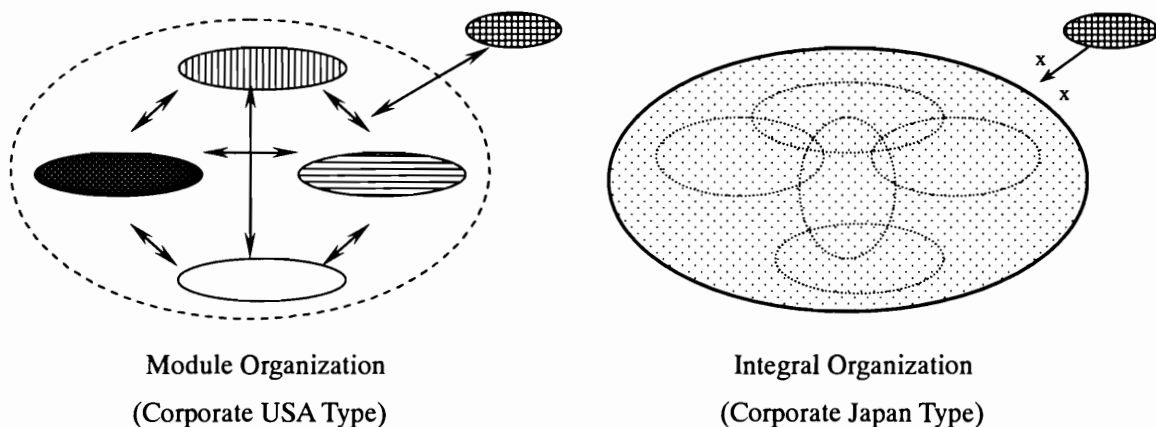
This section is intended to reexamine the features of Japanese system that made the economy prosperous through to the 1980s and conversely made it stagnant in the 1990s. We first review the strength of Japanese system, then consider how that strength became weakness in the midst of the information technology revolution.

3-1. Integrality versus modularity

According to the 1990 analysis of Japan's Economic Planning Agency (EPA), Corporate Japan had several striking features in its organizational structure, with which it succeeded in technological improvement and in transforming the structure toward well-advanced R&D economy. They were (1) intensive face to face communications based on an intimate human network; (2) shared business information by informal communications; (3) overlapping missions in some parts of jobs under a flexible organizational structure and unrestricted job descriptions; and (4) on the job training for additional skills based on "life-time employment."

Herein, we refer to these above-mentioned features as an "integral system" or "integral organization."¹⁰ In an integral organization, information circulates by means of informal traffic and is shared in a tacit manner. Accordingly, an integral system is quite appropriate for technological improvement of "learning by doing"¹¹ because invisible and tacit skills can be easily shared and transferred among employees, being accumulated within an organization day by day. That is the reason Corporate Japan has performed well in continuous improvement such as *kaizen* and total quality management in its production line.

Figure 4. Modularity versus Integrality



¹⁰ Policy Research Institute (2000) refers to Japanese system as integral system.

¹¹ Arrow (1962) argues the implication of learning by doing.

In contrast, Corporate America has different features in its organizational structure, which we call here as a “module system,” or “module organization.”¹² In a module organization, the mission of each job is obvious by means of formal job descriptions; moreover, borders between each job unit, or division, are much clearer than those in the integral organization. In the module system, however, it is sometimes difficult to understand what is going on inside another job unit and to share information that covers an entire organization. Therefore, the standard format for the open interface is created to promote formal communications smoothly between the units. With this common interface and simple protocol, it is easier to communicate, even with new-comers in a module organization than it is in integral organization.

3-2. Learning by doing versus innovation

As for learning by doing, the integral system presents more advantages than a module system does because, in the long run, learning by doing leads to steady improvement of performance based on repetitive activities. As Arrow (1962) mentioned, “knowledge is growing time,”¹³ learning by doing is an important engine of R&D activities in the integral organization, which is characterized by its continuous improvement, tacit skills, long-term relations, integrality, common culture, step by step (flying geese style) progress, etc. That is one reason why Japanese business retains better performance in such industries as automobile and liquid crystal display manufacturing.

At the same time, another type of activity improves the R&D pay off. Joseph Schumpeter (1926) mentioned them as “innovations,” which are characterized as disruptive change, new combinations, open source relations, modularity, freshness and variety, random (leaping frogs style) progress, etc. These characteristics are suitable for innovative venture businesses. Unfortunately, promoting venture business remains a considerable challenge for Japan even though its importance

¹² Langlois and Robertson (1992) argue the nature of modularity.

¹³ Arrow (1962), p. 155.

has been advocated over the past decades.

Before rethinking the Japanese system, one must consider the dynamic changes of the economic environment. In fact, it seems reasonable to presume that economies are going to change from those in favor of learning by doing toward those in favoring innovation. With the open network and the digital technology prevailing, what have been emerging are not only “network effects,” but also “economies of outsourcing.”

Table 5. Economies of Information Age and Industrial Age

	Emerging Information Age	Matured Industrial Age
Scale Merit	Network Effects (Externalities) - consumer’s scale merit	Economies of Scale - producer’s scale merit
Resource Merit	Economies of Outsourcing - outside resources - multiple organizations - synergy effect - innovations (new combinations)	Economies of Scope - in-house resources - single integral-organization - cost saving - learning by doing
Industrial Organization	Multiple small players Competitive market Compatibility Modularity	Larger organization Oligopoly, or monopoly Continuity Integrity

Source: Shinozaki (2003), p.169, Figure 9-1, with some modifications.

Next, we clarify the notion of “economies of outsourcing” and incorporate it into other concepts of economies. As Table 5 shows, the notion of “economies of outsourcing” is the other end of that of “economies of scope” just like the “network effects” are the other side of “economies of scale.”¹⁴ Under economies of outsourcing, merit arises from resources outside the organization, rather than in-house resources under economies of scope, inducing the synergy effect of dynamic new combinations. With the open network and the digital technology prevailing, modularity is gaining an advantage over integrality, where some of the strength of integral systems turns into weakness. That is considered to be what happened in the 1990s.

¹⁴ Network effects represent scale merit of demand-side (consumption), whereas economies of scale represent that of supply-side (production). Katz and Shapiro (1985) argue the nature of network externalities.

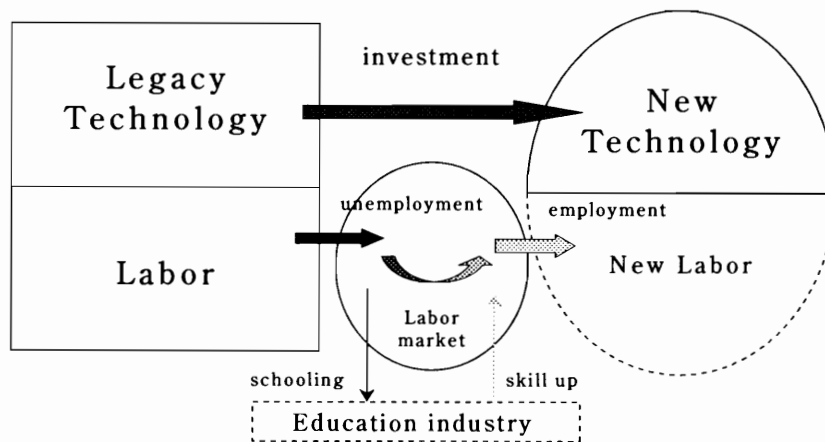
3-3. The Japanese system revisited

Now we have to demonstrate why and how the strength of the Japanese system became a weakness in the 1990s. Taking intensive face-to-face communications as an example: that preference results in a locational constraint when the organization expands its business globally. Too much dependence on face-to-face and informal communications of the human network implies less, perhaps inadequate, attention to creating a formal means of information traffic and consequent reluctance toward building and using an information technology network. Lacking appropriate technology, a global organization will fail to make prompt decision. Another problem arises from overlapping missions and unclear borders of job units. Such complexity must be confronted during re-organization or restructuring the organization through mergers and acquisitions. That complexity also forces the expenditure of time for making decisions. Thereby, business opportunities will bypass such firms in the agile digital economy.

Moreover, the lifetime employment system and the main-bank system are on the verge of crisis. Lifetime employment is suitable for learning by doing, through which knowledge accumulates over time. The main component of knowledge resulting from learning by doing comprises firm-specific skills, which are useful only if existing organizations continue in their business. With discrete innovation, however, new technology often forces disruptive change on firms. Such change appears in the guise of restructuring, reengineering, or even business failures and start-ups. In these uncertain conditions, firms no longer carry on in the form of their legacy organizational structures. Therefore, firm-specific skills based on OJT are not all-powerful in a transforming economy.

Under secured lifetime employment, employees tend to resist changing their way of jobs drastically; managers try to introduce new technology while leaving existing business processes unchanged, which often results in increasing redundancy and inefficiency. In such conditions, it seems important to create a lifetime education system, instead of a lifetime employment system, for acquiring new skills and better jobs.

Figure 5. Innovative technology and employment

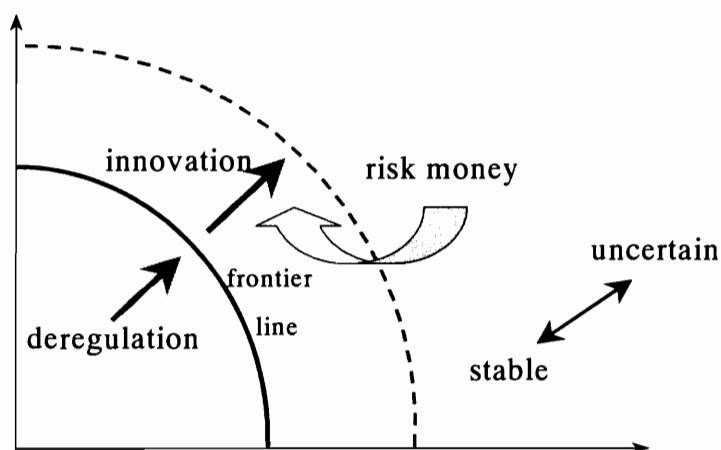


Source: Shinozaki (2001), p. 78, Figure 3-3.

The main-bank system is another factor that used to be suitable for business expansion by “learning by doing.” A main bank can provide business loans to firms under a sophisticated monitoring system based on long-term relations. The main bank has more information about firms it loans to because the banks’ knowledge regarding the firm widens and deepens over time. Credit analysis conducted by the main bank has typical characteristics of learning by doing and funds financed by the main bank are typically low risk money.

Nevertheless, in a higher-uncertainty environment, high-risk money is needed to achieve innovations. Because the Japanese financial system has depended too much on the main-bank system, there are few and narrow channels for providing high-risk money. Although that system functioned well under continuous improvement through learning by doing, it is another weakness presented to enterprises in innovative information age.

Figure 6. Innovations and Risk Money



Source: Shinozaki (2001), p. 78, Figure 3-3.

Finally, it should be noted that the integral system tends to exclude outsiders and newcomers. It is difficult for newcomers to build deeper relations promptly with existing members based on informal communications. This is true because newcomers are not familiar with a particular way of communications. This nature is not suitable for promoting “new combinations,” which form the impetus for innovation. In contrast, a modular system provides a standard format of communications with an open interface on which outsiders and newcomers can access others easily and build new relations quickly with each other. This system creates innovative circumstances that often boost “new combinations.”

4. Conclusion

Before concluding, it should be emphasized that this paper is not intended to reject all features of the Japanese system by any means. Learning by doing remains an important method of building some kinds of knowledge and competitive strength. The integral system works quite well in some businesses such as high-quality consumer products industries. In a similar vein, this paper does

not argue that modularity is an all-powerful structure. The modular system has some weaknesses and strengths, just as with learning by doing.

It is notable that there are two different types of technological progress: learning by doing and innovation. An integral system works well for learning by doing, but it does not accommodate innovation, whereas the modular system functions well for innovation even though it is not suitable for learning by doing. Each system has strengths and weaknesses. Our task is to recognize the importance of modularity and incorporate the modular system for building an appropriate regional innovation system (RIS) in this emerging information age.

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