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Structural source enabling firm revitalization innovation of sector—An empirical analysis of Japanese 31 industrial Sectors

Gentoku Yoshikawa*, Chihiro Watanabe

Department of Industrial Engineering and Management, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro-ku, Tokyo 152-8522, Japan

Abstract

During the "lost decade" of the 1990s, a significant number of Japanese sectors experienced critical business circumstances. However, by adopting a variety of strict disciplinary measures, a number of these sectors have been able to reconstruct their operations, and several of them were able to revitalize themselves since 2004.

This paper attempts to empirically analyze and identify the structural sources that have enabled sectors to succeed in their revitalization efforts.

First of all, on the basis of a comprehensive review of Japan's 31 sectors over the last 13 years, this paper demonstrates that the structure which includes many strategy paths to activate sectors is useful for the firm revitalization innovation at the sector level (*FRI-s*). In Japan, it was especially verified that three independent strategies contributed to *FRI-s*.

Second, by examining the empirical rate of *FRI-s*, this paper demonstrates that the high possibility of *FRI-s* strengthens the revitalization structure of a sector.

Finally, it could be assumed the existence of a circulation mechanism at three layers (a national level strategy, a firm level strategy, and a sector level accumulation) in the revitalization structure.

Keywords: Innovation; Firm revitalization innovation; Strategic revitalization; Spillover

1. Introduction

1.1. Recovery of Japanese economy

During Japan's "lost decade" in the 1990s, a significant number of Japanese industrial sectors experienced critical business circumstances, including decreased earnings, bankruptcy, and rapid increases in liquidation. Despite intensive efforts to improve the business structure, these mitigation measures seemed inadequate for bringing about revitalization within the sectors concerned.

However, in 2004, several sectors adopted comprehensive measures directed at revitalization. Since the end of autumn in 2005, the Japanese economy has experienced continuous firm revitalization innovations in the sectors (*FRI-s*), many of which have been successful.

The mechanism contributing to this economic growth is evident in a significant number of these sectors, which have reversed the decrease in earnings to a continuous increase in earnings.

1.2. Existing studies

To date, several studies have analyzed firm revitalizations. These studies can be classified as follows:

(i) Revitalization case study

The purpose of this type of study is to identify the factors crucial to revitalization success, such as leadership and organizational structure, by analyzing successful cases of revitalization. Examples of successful revitalizations include Nissan Motor Co., Ltd. (1987) which is one of Japan's leading automobile firms, and the cases introduced in "Project X," a popular Japanese TV program that traced the footsteps of successful projects.

*Corresponding author. Tel./fax: +81 3 3430 3061.
E-mail address: gentoku.yoshikawa@jp.pwc.com (G. Yoshikawa).

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(ii) Utilization of firm reconstruction funds
This type of study focuses on countermeasures against the risks of foreign firm reconstruction funds, represented by a source of foreign funds, such as Ripple Wood, which was commended for revitalization of the former Long-Term Credit Bank of Japan, Limited and its effective utilization. (The Long-Term Credit Bank is now called Shinsei Bank, Limited, which is solely responsible for extending financial facilities for revitalization.)

(iii) Firm revitalization tools
This type of study focuses on the evaluation of tools facilitating the revitalization of firms, including firm break-up, the transfer of business required for firm revitalization, the "blood stanching method" required at an early stage of revitalization, and financial restructuring.

(iv) Firm revitalization in the context of the reactivation of Japan's economy
This type of study focuses on the improvement trajectory of Japan's firms in the context of the structural reforms required for the recovery of Japan's economy.

However, all of the reactivation studies deal primarily with individual cases of firms, and none has taken a system-oriented approach for examining the structural sources and systems aspects that lead firms to revitalize the trajectory with a historical perspective. Although some pioneer work attempted to conduct a comprehensive numerical analysis based on a firm's financial data, existing studies are hardly satisfactory for identifying the revitalization trajectory toward a service-oriented economy.

Yoshikawa and Watanabe (2006) investigated this kind of situation to clarify the basic structure of *FRI-s* since 2004, and discovered the following characteristics.

(a) There are two types of firm revitalization innovations: sector revitalization power-dependent and firm revitalization power-dependent.
(b) Sustainable revitalization can be expected by the resonance between sector-dependent and firm-dependent revitalization potencies.

1.3. Scope of the analysis

While the scope of the analysis is decided, it is important to ascertain which level at a national level, a firm level, and sector is focused and to set a structural analysis frame.

It was symbolical to have established Industrial Revitalization Corporation Japan (IRCJ) that supported a firm revitalization as a strategy at a national level. IRCJ was established in 2003 and hung out attempting the recovery and re-activation of the inter-enterprise competition mechanism and the firm finance mechanism through their activity.

Fig. 1 shows the transition of the revitalization at the sector level. It was the feature that the number of firm revitalizations in some sectors increased before and after the establishment of IRCJ.

By this fact, it is guessed that the revitalization know-how was accumulated at the sector level as a result of the approach on a firm revitalization at a national level.

To evolve this assumption, it took a general view of firms that recovered the achievement in the Electronic and Electrical Equipment sector. The Electronic and Electrical Equipment sector was a sector which increased the number of revitalization firms in Fig. 1.

Fig. 2 shows the strategy map of the Electronic and Electrical Equipment sector in Japan. In Fig. 2, the strategies of the firms of the Electronic and Electrical Equipment sector in Japan was observed from 1998 to 2004, and is classified according to the increase and decrease of the share of each firms and the utilization of strategic revitalization.

Fig. 2 shows that the number of strategies chosen in one sector was diversified. In the past, only the market-enhancing strategy was a strategy option to survive in the Electronic and Electrical Equipment sector in Japan, and it existed in the situation in which other strategy options were not chosen easily for survival. However, since 1990's, many firms realized their revitalization by the concentration strategy (P4 Group in Fig. 2).

Moreover, the firms that use strategic revitalization for their recovery appeared and the change in the strategy adoption was observed. By having observed the above-mentioned fact, the focus of this research is defined at the revitalization innovation at the sector level.

In this paper, it is paid attention to analyze the relation between the strategy option of firms and sectors. The data of 31 sectors and 1000 firms is targeted in the analysis as shown in Fig. 3.

1.4. Hypotheses

By a general view in Section 1.3, the hypotheses of this paper are shown as follows.

Hypothesis 1. As seen in the past, a single, excellent strategy must not activate sectors, and the structure which includes many strategy paths to activate sectors is useful for the *FRI-s*.

Hypothesis 2. The mechanism that produced a lot of revitalization firms within one sector was constructed by the diversification of effective strategy paths in one sector.

Hypotheses 3. The revitalization circulation structure was constructed. The structure has a system on which the strategies of a national level acted effectively at a firm level, and the revitalization know-how at a firm level spread in a sector level.

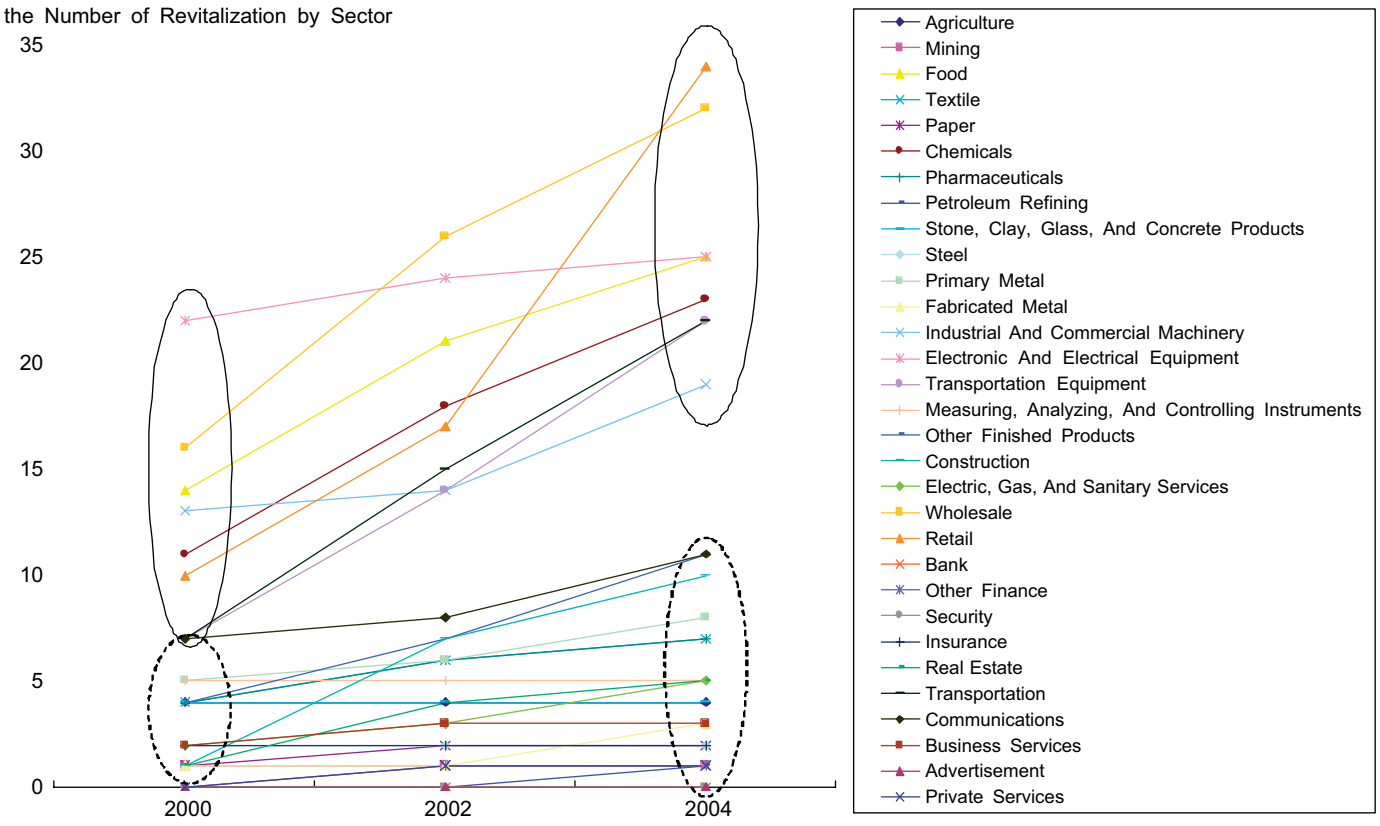

Fig. 1. The transition of the number of the revitalization firms by sectors.

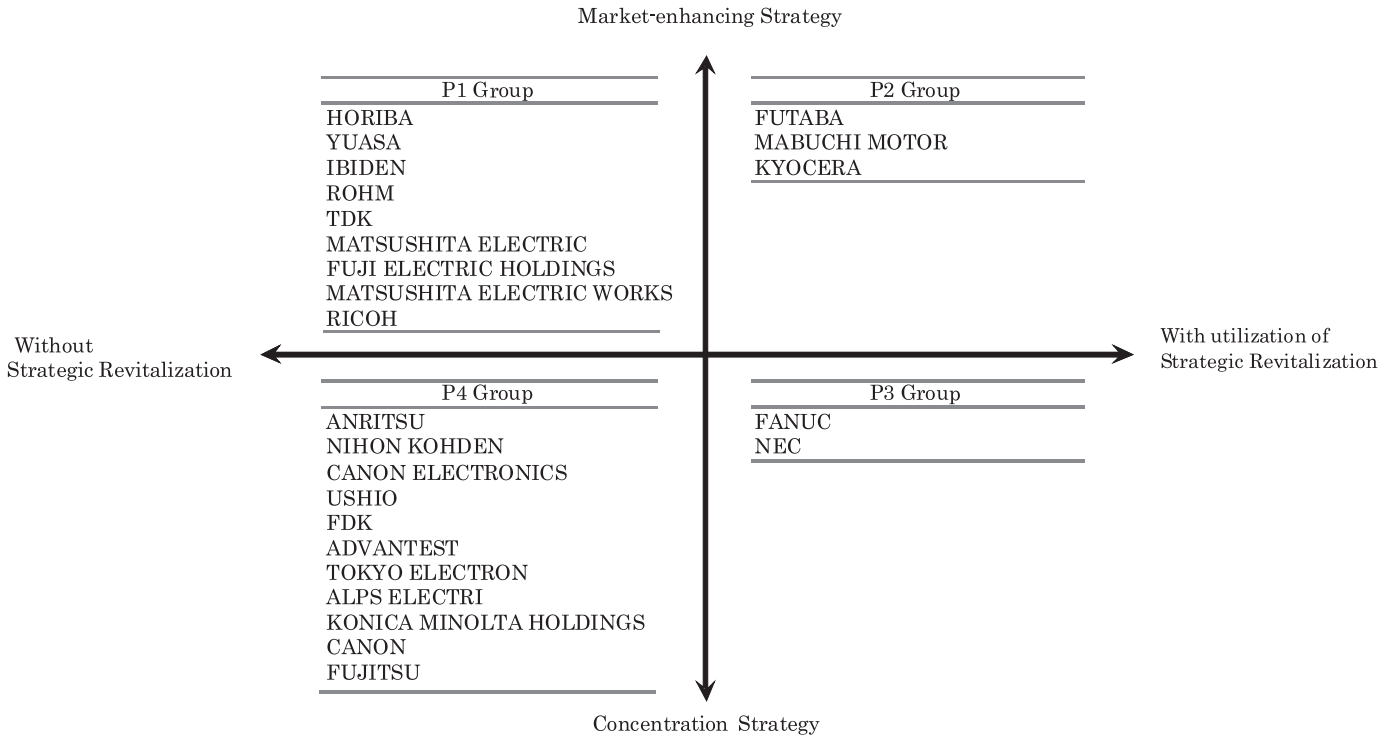

Fig. 2. The strategy map of the electronic and electrical equipment sector in Japan.

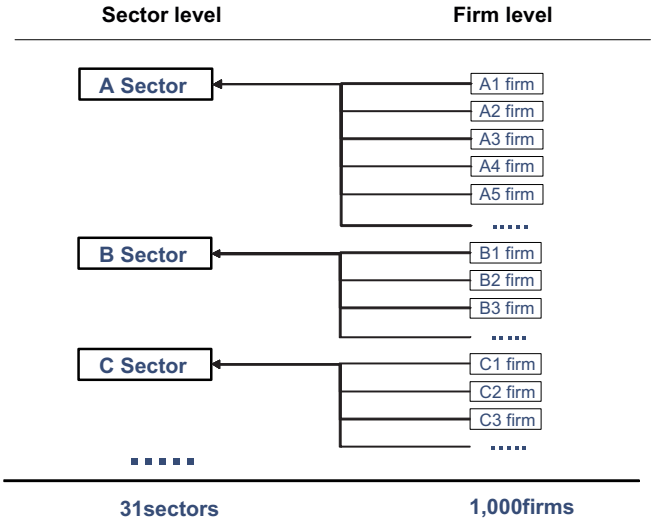

Fig. 3. Relation between 31 sectors and 1000 firms.

1.5. Structure of the paper

Section 2 provides a review of the literature. Section 3 provides the analytical framework. Section 4 describes the results of the empirical analysis, and Section 5 briefly summarizes new findings and policy implications.

2. Review of the literature

Berggren (2001) proposed that, while mergers and acquisitions are usually utilized for economic reasons, another important purpose is to initiate innovation. However, strategic revitalization should not be taken as an omnipotent strategy. If no appropriate person in an organization can absorb knowledge about a strategic revitalization from professional strategic consultants and financial advisors, the organization consequently cannot absorb the spillover of strategic revitalization knowledge. Szulanski (1996) analyzed obstacles that prevent knowledge from being transferred among organizations. He proposed the hypotheses that some of the following factors might become obstacles: (1) characteristics of the knowledge, (2) content of the knowledge, (3) the knowledge provider, and (4) the knowledge receiver. The results showed that, in terms of inter-organizational knowledge transferring, the lack of absorptive capacity of the knowledge receiver is the most significant factor that prevents the transfer of knowledge.

On the basis of the studies related to absorptive capacity, the concept of assimilation capacity (denoted as Z) was developed. First, Cohen and Levinthal (1989, 1990) developed the concept of absorptive capacity as the ability to recognize the value of external information, assimilate it and apply it to commercial ends. Haravi (1995) suggested that absorptive capacity cannot be obtained without cost.

Later, Watanabe et al. (2004a, b) proposed the concept of assimilation capacity as the ability of a host firm to not only absorb knowledge but also assimilate the knowledge absorbed. Moreover, Watanabe et al. (2004a, b) suggested that assimilation capacity is necessary to incorporate knowledge spillover.

Nieto and Quevedo (2005) theorized that absorptive capacity can promote innovative effort. Similarly, Becker and Peters (2000) confirmed the positive correlation between absorptive capacity and innovation. Watanabe et al. (2004a, b) also demonstrated the positive effects of absorptive capacity on innovation.

Watanabe et al. (2004a, b) defined assimilation spillover (denoted as *Z-SRKs*) as the knowledge obtained from the knowledge pool by utilizing assimilation capacity. Firms obtain strategic revitalization knowledge (*SRK*) from the knowledge pool by conducting strategic revitalization and utilizing the assimilation capacity, and the knowledge obtained contributes to the performance of the *FRI*. This paper defines *SRK* as the knowledge accumulated through strategic revitalization.

3. Analytical framework

3.1. Analytical frame at the firm level and the sector level

Based on the analysis of Section 1.3, when it is analyzed *FRI-s*, it is built in the relation between sectors and firms in the analytical model.

It is thought that the strategies chosen at firm level were diversified when the revitalization innovation is achieved as having taken a general view by Section 1.3 in the case with the electric machine industry.

The selections of strategic options that firms choose can be summarized in the following two items:

(1) The strategy can be directed toward market-enhancing or toward concentration and
(2) the knowledge of strategic revitalization (*SRK*) can be obtained by the implementation of strategic revitalization.

By combining (1) and (2), the strategic options can be classified into the following four categories:

P1: strategy toward market-enhancing without strategic revitalization;
P2: strategy toward market-enhancing with utilization of strategic revitalization;
P3: strategy toward concentration with utilization of strategic revitalization; and
P4: strategy toward concentration without strategic revitalization.

The relationships among those strategic paths and hypotheses are shown in Fig. 3. It is effective to verify

whether each strategy path from P1 to P4 contributed to *FRI-s* to verify hypotheses 1.

It is also useful for hypotheses 2 to analyze whether the existence of two or more effective strategy paths created sector structure to produce the revitalization innovation firms (P5 of figure).

The analysis model was designed in Fig. 4 based on the above mentioned.

Fig. 4 is classified at a firm level analysis and a sector level analysis. In the firm level analysis, the relation between the strategy paths from P1 to P4 and *FRI-s* is analyzed by the method explained in Section 3.2. In the sector level analysis, it is analyzed by the method explained in Section 3.3.

3.2. Firm-level analysis

3.2.1. Data construction

For the data construction, Japan's top 1000 firms with respect to sales in fiscal year 2004 were selected and their statistical data from 1992 to 2004 were collected.

These statistical data were collected primarily from the firms financial reports and included sales figures, operating income, and R&D expenditures.

All of the data thus collected was converted to fixed values by considering the economic projections over time due to economic growth. Furthermore, in order to ensure that the data could be effectively compared, all the data was arranged according to sectors in accordance with the Standard of National Accounting (SNA), which is an international industrial classification standard.

3.2.2. Measurement of FRI

In order to determine the most appropriate methods for observing *FRI*, the lead time between R&D and commercialization in the manufacturing sector was clarified (Marten, 2001; Nieto, 2003). Product cycles accelerate in response to rapid technical improvements and market changes, which are both associated with an increase in the risk of obsolescence.

Consequently, decreasing product life cycles is a factor which places firms' profits under pressure in the short-term.

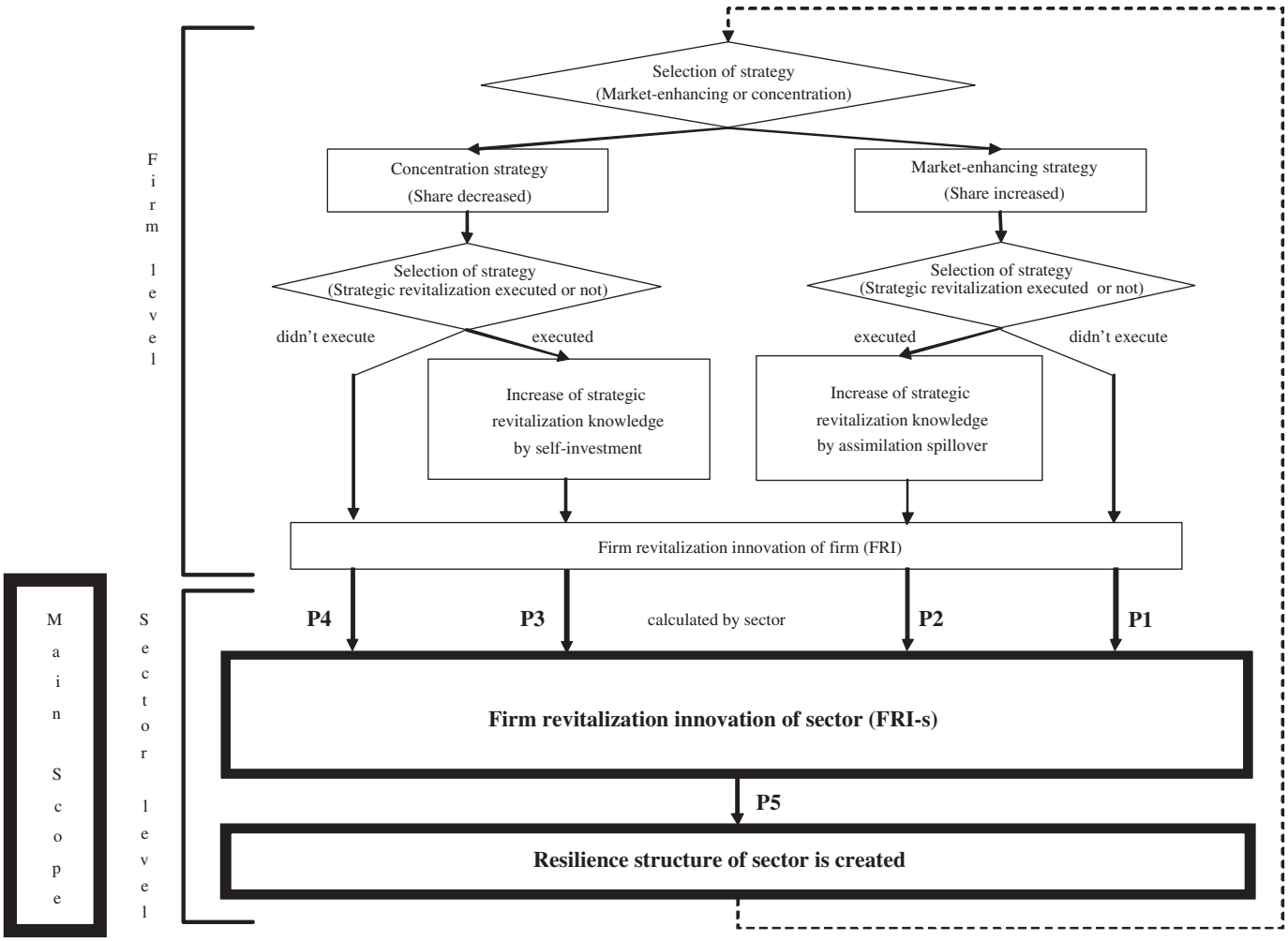

Fig. 4. Structure of analysis.

Therefore, it is necessary to generate earnings to prevent the continuation of this situation and to secure continuous growth before the product reaches the stage of maturity. Another option is to develop a new market by developing a new product.

It is important to establish an intellectual base that can sustain continuous growth of the firm. Some firms do not have the resources necessary for cultivating the market from an intellectual base, and numerous firms experience decreased or no growth as they become mature. When an intellectual base is developed, technological stock is measured through R&D investment (R), the relationship between the rate of obsolescence of the technology (ρ), technological stock, (T) and the lead time (m) between R&D and commercialization. The equation is expressed as follows:

$$T_t = R_{t-m} + (1-\rho)T_{t-1}, \tag{1}$$

$$T_0 = R_{1-m}/(\rho + g), \tag{2}$$

where T_t is the technological stock at period t, R_t the research and development investment at period t, ρ the rate of obsolescence of technology, and g the average rate of change in research and development investment during the initial period.

In addition, the relationship between T, ρ, and m can be expressed by using the following dynamic model:

$$\rho_t = \rho(T_t), \quad m_t = m(\rho_t), \tag{3}$$

$$T_t = R_{t-m} + (1-\rho_t)T_{t-1}. \tag{4}$$

Watanabe (1996, 1999) demonstrated the relationship between technological stock and the rate of obsolescence of technology, as shown in Fig. 5. The rate of obsolescence in technology increased from 8.3% in 1970 to 12.1% in 1994, while the lead time decreased from 3.6 years in 1970 to 2.9 years in 1994.

Based on these findings, it is considered important to maintain the product lead time in the region of 2.9 years, as well as to repeat the product cycle (Watanabe, 1996).

In addition, if firms cannot be constructed in the time limit of 2.9 years, then it is likely that they will miss the next new growth cycle and consequently run the risk of not being innovative.

From the result of the research of Watanabe, the mechanisms of *FRI* can be examined by the following measurement standards:

(i) Continuous growth of approximately 3 years is necessary to realize *FRI*.
(ii) It is important to employ an index that measures the growth of the core business of the firm, and Operating Income by Sales (OIS) is the most suitable index.
(iii) It is necessary to derive earnings from new investments in order to ensure growth for the following 3 years.
(iv) Given (ii) and (iii), the observation index must assume a continuous OIS, which keeps increasing for 3 years, to be considered as an effective index of *FRI*.

This paper focuses on the mechanism which enables continuous growth. We define this innovation of the firm that contributes to the improvement of the operating income per sales at a sustainable and increasing level as the *FRI*.

3.2.3. Measurement of market-enhancing and concentration strategies and SRK utilization

In order to examine whether a firm conducted market-enhancing or concentration strategy, this study measures the share growth rate of each firm from 1998 to 2004.

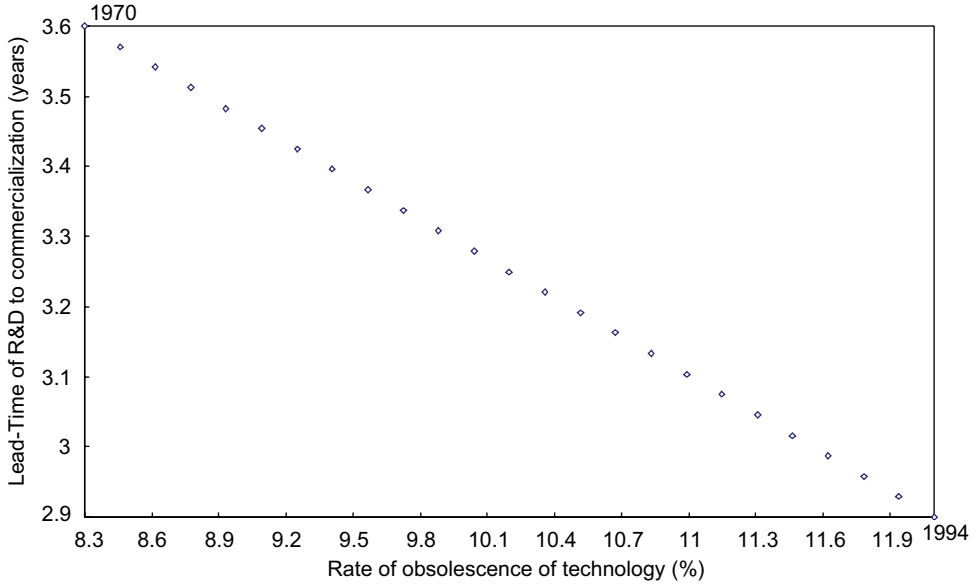

Fig. 5. Trend in the relationship between technology knowledge stock, rate of obsolescence of technology, and lead time of R&D to commercialization in the Japanese manufacturing industry (1970–1994).

An increase in share growth rate during the same period indicates the market-enhancing strategy was applied; on the other hand, a decrease in entropy indicates the concentration strategy was applied.

The utilization of *SRK* differs, depending on whether market-enhancing strategy or concentration strategy is applied.

In the case of the market-enhancing strategy, strategic revitalization is conducted mainly in the form of a merger and acquisition, so it is possible to obtain *SRK* from external firms or sectors with assimilation capability. Therefore, whether a firm that conducted market-enhancing strategy has obtained knowledge from *SRK* can be determined by the existence of assimilation spillover ($Z \times SRKs$).

In the case of the concentration strategy, strategic revitalization is conducted mainly in the form of selling a business and an increase in capital stock, so a firm cannot obtain the spillover from other firms or other sectors. Therefore, a firm will focus on internal investment to obtain internal strategic revitalization knowledge (*SRKi*).

Such self-investment in the concentration strategy to obtain knowledge is similar to the case that a manufacturing sector does not obtain assimilation spillover from other sectors, but increases R&D investment toward the firm itself.

(i) Measurement of strategic revitalization knowledge of sector (*SRKs*)

Regarding R&D, it is common that the spillover of a sector is measured by the total R&D expenditure of the sector. This measurement is based on the concept that the total R&D expenditure of the sector reveals the opportunity to access the stock of the knowledge spillover.

This concept supposes that the strategic revitalization pool will increase with the knowledge stock. Since this concept can also be applied to *SRK*, strategic revitalization is measured by the total investment of strategic revitalization.

(ii) Measurement of assimilation capacity (Z)

Szulanski (1996) proposed that "absorptive capacity of the receiver is one of the principal factors explaining rigidities in companies (firm stickiness) over transfer of knowledge between their organizational unities." Therefore, improving the receiver's absorptive capacity means improving the assimilation capacity.

In general, assimilation capacity (Z) can be expressed as follows:

$$T_i = \frac{1}{1 + ((\Delta T_s/T_s)/(\Delta T_i/T_i))}, \tag{5}$$

where T_i is the a firm's unique technological stock, T_s a firm's technological stock, ΔT_i the increase in a firm's unique technological stock, and ΔT_s the increase in a firm's technological stock.

Based on the existing work, the assimilation capacity of each firm is calculated according to Eq. (5).

(iii) Measurement of *SRK* by assimilation spillover ($Z \times SRKs$)

Watanabe et al. (2004a, b) used the following equation to measure the assimilation spillover ($Z \times T_s$).

$$\text{Assimilation spillover} = Z \times T_s, \tag{6}$$

where Z is the assimilation capacity and T_s a firm's technological stock

This paper applies this equation for measurement of the knowledge stock. By substituting the technological stock with *SRK*, the following equation can be derived:

$$SRK = Z \times SRKs, \tag{7}$$

where *SRK* is the strategic revitalization knowledge by assimilation spillover, Z the assimilation capacity of firm i, *SRK-s* the knowledge pool of all firms' strategic revitalization.

(iv) Measurement of *SRK* by self-investment (*SRKi*)

Watanabe et al. (2004a, b) applied the following equation to measure the technological knowledge stock by self-investment:

$$T_i(t) = (1 - \beta) \times T_i(t-1) + I_i(t), \tag{8}$$

where $T_i(t)$ is the technological stock of firm i at time t, β the rate of obsolescence, and $I_i(t)$ the real technological stock of firm i at time t.

This paper applies this equation to measure knowledge stock.

By substituting the technological stock with *SRK*, the following equation can be derived:

$$SRKi(t) = (1 - \beta) \times SRKi(t-1) + I(t), \tag{9}$$

where $SRKi(t)$ is the strategic revitalization knowledge by self-investment of firm i at time t, β the rate of obsolescence, and $I_i(t)$ the real technological stock of firm i at time t.

3.3. Sector-level analysis

3.3.1. Regression analysis

To verify hypotheses 1, each independent strategy paths from P1 to P4 and *FRI-s* are verified by the regression analysis.

The regression analysis follows the following expressions.

$$\ln FRI - s = \beta_1 + \beta_2 \ln \text{SGR}_a + \beta_3 D, \tag{10}$$

$$\ln FRI - s = \beta_1 + \beta_2 \ln(Z \times SRKs) + \beta_3 D, \tag{11}$$

$$\ln FRI - s = \beta_1 + \beta_2 \ln(SRKi) + \beta_3 D, \tag{12}$$

$$\ln FRI - s = \beta_1 + \beta_2 \ln SGR_b + \beta_3 D, \tag{13}$$

where *FRI-s* is the number of firms which conducted *FRI* successfully in each sector, SGR_a the share growth rate of

firms which conducted *FRI* successfully by the market-enhancing strategy in each sector, and SGR_b the share growth rate of firms which conducted *FRI* successfully by the concentration strategy in each sector

Moreover, to verify hypotheses 2, the following regression analyses are executed:

$$\ln FRI - s = \beta_1 + \beta_2 \ln(-\sum P_i \ln P_i) + \beta_3 D, \quad (14)$$

where *FRI-s* is the number of firms which conducted *FRI* successfully in each sector, SGR_a the share growth rate of firms which conducted *FRI* successfully by the market-enhancing strategy in each sector, and SGR_b the share growth rate of firms which conducted *FRI* successfully by the concentration strategy in each sector.

3.3.2. The analysis of the relationship between national strategy, firm strategy, and sector

It is thought that it was useful for peculiar revitalization structure construction that the strategies of a national level was taken into the firm as explained by Section 1.3, and the know-how concerning about firm revitalization innovation spreads to the sector level. In this analysis, the strategy executed at each level (a national level, a firm level, and a sector level) is listed, and the relation is verified.

This analysis is useful for the verification of hypotheses 3.

4. Results of the empirical analyses of Japanese sectors

The strategic paths of either P1, P2, P3 and P4 selected by 31 firms are verified with the methodology explained in Section 3.

The results are tabulated in Table 1. It is clear that many firms selected P1 or P4 without utilizing *SRK*. Moreover, differences in the strategic path selection can be observed among sectors. While the firms in the Food, Electronic and electrical equipment, and Retail sectors have adopted all kinds of strategic paths, the strategic path selections of firms in the Real Estate sector are limited to P1 or P4.

The number of firms that conducted a *FRI-s* successfully is also analyzed by sector and by strategic path. These results are tabulated in Table 2. According to Table 2, the seven sectors with the highest number of *FRI-s*

Table 1
Number of Japanese firms by strategic path and by sector

Sector code	Sector	P1	P2	P3	P4	Total
10100	Agriculture	4	0	0	2	6
10200	Mining	0	2	1	2	5
10301	Food	24	6	4	20	54
10302	Textile	3	3	0	9	15
10303	Paper	4	0	1	4	9
10304	Chemicals	23	4	1	37	65
10305	Pharmaceuticals	10	1	0	7	18
10306	Petroleum refining	2	2	2	2	8
10307	Stone, clay, glass, and concrete products	5	1	0	7	13
10308	Steel	5	1	4	10	20
10309	Primary metal	5	1	1	9	16
10310	Fabricated metal	4	0	0	9	13
10311	Industrial and commercial Machinery	21	3	4	17	45
10312	Electronic and electrical equipment	39	6	6	38	89
10313	Transportation equipment	28	2	4	21	55
10314	Measuring, analyzing, and controlling instruments	6	0	1	3	10
10315	Other finished products	8	5	1	12	26
10400	Construction	42	5	2	33	82
10500	Electric, gas, and sanitary services	6	0	4	5	15
10601	Wholesale	114	7	5	5	131
10602	Retail	53	11	5	42	111
10702	Bank	33	0	0	4	37
10703	Other finance	5	3	2	5	15
10704	Security	1	0	2	3	6
10705	Insurance	3	1	0	4	8
10800	Real estate	12	0	0	8	20
10901	Transportation	10	1	3	30	44
11906	Communications	17	7	1	16	41
11002	Business services	2	0	1	3	6
11003	Advertisement	2	0	0	2	4
11005	Private services	4	4	1	4	13
		495	76	56	373	1000

Table 2
Number of Japanese firms that conducted a *FRI-s* successfully by strategic path and by sector

Sector code	Sector	P1	P2	P3	P4	Total
10100	Agriculture	3	0	0	1	4
10200	Mining	0	0	1	0	1
10301	Food	12	5	0	8	25
10302	Textile	2	1	0	4	7
10303	Paper	2	0	0	0	2
10304	Chemicals	9	2	0	12	23
10305	Pharmaceuticals	2	1	0	4	7
10306	Petroleum refining	0	0	1	0	1
10307	Stone, clay, glass, and concrete products	1	1	0	2	4
10308	Steel	1	0	0	1	2
10309	Primary metal	3	0	0	5	8
10310	Fabricated metal	1	0	0	2	3
10311	Industrial and commercial machinery	9	0	2	8	19
10312	Electronic and electrical equipment	9	3	2	11	25
10313	Transportation equipment	12	1	1	8	22
10314	Measuring, analyzing, and controlling instruments	3	0	1	1	5
10315	Other finished products	3	3	0	5	11
10400	Construction	4	1	0	5	10
10500	Electric, gas, and sanitary services	3	0	0	2	5
10601	Wholesale	24	2	3	3	32
10602	Retail	17	1	2	14	34
10702	Bank	0	0	0	0	0
10703	Other finance	0	0	1	0	1
10704	Security	0	0	0	0	0
10705	Insurance	2	0	0	0	2
10800	Real estate	3	0	0	2	5
10901	Transportation	3	1	2	16	22
10906	Communications	3	3	1	4	11
11002	Business services	0	0	1	2	3
11003	Advertisement	0	0	0	0	0
11005	Private services	0	1	0	0	1
		131	26	18	120	295

performance are Retail, Wholesale, Electronic and electrical equipment, Food, Transportation Equipment, Chemicals, and Transportation.

4.1. Analysis of correlation between market-enhancing strategy and FRI-s

Based on Table 2, firms that conducted the P1 strategy are selected and the share growth rate of each firm and the number sectors conducting a successful *FRI-s* are calculated to examine the correlation. The result of the regression analysis is as follows.

Table 3 demonstrates the regression analysis result of the market-enhancing strategy and *FRI-s*. The market-enhancing strategy is demonstrated to have a positive correlation with *FRI-s* ($t = 5.96$, at the 1% level of significance).

Moreover, since the adjusted determination coefficient was adj. $R^2 = 0.702$, the regression equation explains the correlation well.

Therefore, the scale advantage due to the market-enhancing strategy contributed to the performance of *FRI-s*.

Table 3
Regression analysis of share growth rate and *FRI-s*

	Partial regression coefficient/verification accuracy
ln (share growth rate)	3.318 (5.96***)
Dummy	−7.312 (3.27***)
Constant term	9.085 (9.89***)
Adj. R^2	0.702

Notes: (1) Under the values for the partial regression coefficients, values of t are given in parentheses. (2) Dummy variables were applied in several sectors. (3) *** Indicates significant at 1% level; ** significant at 5% level.

4.2. Analysis of correlation between SRK by assimilation spillover with market-enhancing strategy and FRI-s

Based on Table 2, firms that conducted the P2 strategy are selected and the *SRK* by assimilation spillover of each firm and the number of sectors successfully conducting *FRI-s* are calculated to examine the correlation. The result of the regression analysis is as follows. Table 4 demonstrates the result of the regression analysis. The correlation between *SRK* by assimilation spillover with market-enhancing strategy and *FRI-s* cannot be proved.

Table 4
Regression analysis of *SRK* by assimilation spillover and *FRI-s*

	Partial regression coefficient/verification accuracy
$\ln(Z \times SRKs)$	0.32 (1.72)
Constant term	0.748 (1.05)
Adj. R^2	0.199

Notes: (1) Under the values for the partial regression coefficients, values of t are given in parentheses. (2) Dummy variables were applied in several sectors. (3) *** Indicates significant at 1% level; ** significant at 5% level.

Table 5
Regression analysis of *SRKi* and *FRI-s*

	Partial regression coefficient/verification accuracy
ln(SRKi)	0.326 (5.09***)
Dummy	1.014 (4.30***)
Constant term	−0.127 (0.41)
Adj. R^2	0.794

Notes: (1) Under the values for the partial regression coefficients, values of t are given in parentheses. (2) Dummy variables were applied in several sectors. (3) *** Indicates significant at 1% level; ** significant at 5% level.

Therefore, during the process of conducting an market-enhancing strategy, obtaining *SRK* did not contribute to the performance of *FRI-s*.

4.3. Analysis of correlation between SRK by self-investment (SRKi) and FRI-s

Based on Table 2, firms that conducted the P3 strategy are selected and the *SRKi* of each firm and the number sectors conducting a successful *FRI-s* are calculated. The result of the regression analysis is as follows. Table 5 demonstrates the regression analysis result of *SRKi* and *FRI-s*.

SRKi is demonstrated to have a positive correlation with *FRI-s* ($t = 5.09$, at the 1% level of significance). The t-value of the dummy variable is 4.30 at the 1% level of significance.

Moreover, since the adj. $R^2 = 0.794$, the regression equation explains the correlation well. Therefore, during the process of conducting the concentration strategy, obtaining *SRK* by self-investment contributed to the performance of *FRI-s*.

4.4. Analysis of correlation between concentration strategy and FRI-s

Based on Table 2, firms that conducted the P4 strategy are selected and the share growth rate of each firm and the number of sectors successfully conducting *FRI-s* are calculated. The result of the regression analysis is as follows. Table 6 demonstrates the regression analysis result of the concentration strategy and *FRI-s*. Share growth rate is demonstrated to have a positive correlation with *FRI-s* ($t = 6.18$, at the 1% level of significance). The t-value of the dummy variable is 3.60 at a 1% level of significance.

Table 6
Regression analysis of concentration strategy and *FRI-s*

	Partial regression coefficient/verification accuracy
ln (share growth rate)	3.219 (6.18***)
Dummy	5.537 (3.60***)
Constant term	6.432 (9.92***)
Adj. R^2	0.720

Notes: (1) Under the values for the partial regression coefficients, values of t are given in parentheses. (2) Dummy variables were applied in several sectors. (3) *** Indicates significant at 1% level; ** significant at 5% level.

Moreover, since the adj. $R^2 = 0.720$, the regression equation explains the correlation well. Therefore, the share growth rate of firms that conducted a concentration strategy is highly related to *FRI-s*. Even if the share growth rate decreased due to the concentration strategy, firms whose entropies were above certain values had more strength to perform *FRI-s*.

4.5. Analysis of correlation between diversity of possibility of successful FRI-s of each path and FRI-s

In order to verify hypotheses 2, it is necessary to examine the possibility of a successful *FRI-s* by strategy and by sector. The possibility of a successful *FRI-s* can be calculated based on Tables 1 and 2. After the results are calculated, the diversity of the possibility of success of each strategic path by sector can be obtained. The results are tabulated in Table 7. Furthermore, since hypothesis 2 was abandoned in Section 4.2, the calculation is only applied to those firms that conducted strategic paths P1, P3 and P4.

According to Table 2, firms which selected strategic path P3 rarely performed *FRI-s* successfully. However, according to Table 7, the possibility of successful *FRI-s* of P3 is higher than that of P1.

Moreover, sectors such as Industrial and Commercial Machinery as well as Electronic and Electrical Equipment reveal a high possibility of successful *FRI-s* by all kinds of strategic paths, while the strategic path selections of firms in the Paper sector includes only a singular strategic path.

This result supports hypotheses 2, which states that multiple strategic paths can increase the possibility of successful *FRI-s* and construct a stronger revitalization structure, which makes performing *FRI-s* easier.

Examinations are conducted by setting the diversity of the possibility of success of each sector as $\sum(-P_i/P_{total} \times \ln(P_i/P_{total}))$.

Table 8 demonstrates the regression analysis result of the diversity of possibility of successful *FRI-s* and total *FRI-s*

Table 7
Diversity of possibility of successful *FRI-s* by strategic path and by sector

Sector code	Sector	P1 (%)	P3 (%)	P4 (%)	$\Sigma(-P_i/P_{\text{total}} \times \ln(P_i/P_{\text{total}}))$ $(i = 1,3,4)$
10100	Agriculture	75	–	50	0.67
10200	Mining	–	100	0	0.00
10301	Food	50	0	40	0.70
10302	Textile	67	–	44	0.72
10303	Paper	50	0	0	0.00
10304	Chemicals	39	0	32	0.72
10305	Pharmaceuticals	20	–	57	0.61
10306	Petroleum Refining	0	50	0	0.00
10307	Stone, Clay, Glass, And Concrete Products	20	–	29	0.59
10308	Steel	20	0	10	0.64
10309	Primary Metal	60	0	56	0.69
10310	Fabricated Metal	25	–	22	0.69
10311	Industrial And Commercial Machinery	43	50	47	1.10
10312	Electronic And Electrical Equipment	23	33	29	0.98
10313	Transportation Equipment	43	25	38	0.99
10314	Measuring, Analyzing, And Controlling Instruments	50	100	33	0.99
10315	Other Finished Products	38	0	42	0.71
10400	Construction	10	0	15	0.70
10500	Electric, Gas, And Sanitary Services	50	0	40	0.69
10601	Wholesale	21	60	60	0.99
10602	Retail	32	40	33	1.08
10702	Bank	0	–	0	0.00
10703	Other Finance	0	50	0	0.00
10704	Security	0	0	0	0.00
10705	Insurance	67	–	0	0.00
10800	Real Estate	25	–	25	0.69
10901	Transportation	30	67	53	0.94
10906	Communications	18	100	25	0.83
11002	Business Services	0	100	67	0.67
11003	Advertisement	0	–	0	0.00
11005	Private Services	0	0	0	0.00
		26	32	32	1.03

Table 8
Regression analysis of diversity of possibility of successful *FRI-s* and the total *FRI-s* number

	Partial regression coefficient/verification accuracy
$\ln((-P_i/P_{\text{total}}) \times \ln(P_i/P_{\text{total}}))$	21.774 (8.52* * *)
Dummy	−11.818 (5.32* * *)
Constant term	−0.030 (0.18)
Adj. R^2	0.730

Notes: (1) Under the values for the partial regression coefficients, values of t are given in parentheses. (2) Dummy variable is applied on manufacturing sectors with few *FRI-s*, agriculture and construction. (3)*** Indicates significant at 1% level; ** significant at 5% level.

number. The diversity of possibility of successful *FRI-s* and total *FRI-s* number demonstrate a positive correlation ($t = 8.52$, at the 1% level of significance). The t-value of dummy variable is 5.32 at the 1% level of significance.

Moreover, since adj. $R^2 = 0.730$, the regression equation explains the correlation well. If many possibilities of success exist, it shows that *FRI-s* can be performed successfully by any strategy. Therefore, increasing the diversity of the possibility of success can strengthen the structure of the sector and generate more firms to perform *FRI-s* successfully.

4.6. The analysis of the relationship between national strategy, firm strategy, and sector

Table 9 shows a chronological table of firm revitalization measures taken in Japan. The table lists the historical background, national level strategies, firm level strategies, and the number of strategic revitalization.

According to national strategy in Table 9, many systems for firm revitalization have been introduced since 1997. Many systems for firm revitalization include a strategic revitalization, which indicates that firms easily found strategies to implement.

Therefore, it can be assumed that firm revitalization innovation was achieved by firms implementing strategic revitalization, with the back-up support of national strategies.

Table 9 also shows that the number of strategic revitalizations that include buy-outs and sell-offs between firms is soaring. Furthermore, in Table 10, it is shown the amount of money of strategic revitalization from 1998 to 2004, the amount of money of strategic revitalization from 1998 to 2004 between same sectors, and the rate between same sectors.

Table 9
Relationship between historical background, national-level measures for firm revitalization, firm trends, and the number of strategic revitalization

Historical background		National level strategies	Firm-level strategies and firm culture	The number of revitalization innovation
1990	Japan's bubble economy bursts; Reunification of Germany			754
1991	Compensation for losses by four major securities companies was revealed; First Gulf War; Collapse of the Soviet Union			638
1992	Heisei combined recession			483
1993	Bribery scandal engulfs the construction industry		Reengineering Corporate governance	397
1994	Collapse of prices; hard times for *n* graduates seeking employment		Compliance	505
1995	Marked increase in the closure of banks/financial institutions		"Have-not" management, Core competence, Benchmarking Shareholder value	531
1996	Failure of housing loan companies; Bankruptcy of pacific Bank		Supply chain management	621
1997	Credit institutions and banks become reluctant to lend money; Japanese version of "Big Bang"	Ban on true holding companies is lifted stock option system introduced	Corporate values	753
1998	Financial Reconstruction Law is promulgated; Long-term credit bank of Japan and Nippon credit bank are temporarily nationalized	Stock transfer and stock exchange system; Mothers market opens on the Tokyo Stock Exchange; Law on Special Measures for Industrial Revitalization (Industrial Revitalization Law) is enacted; Civil Rehabilitation Law is enacted		834
1999	Effects of the special 20 billion yen guarantee are seen; A succession of bank failures occurs			1169
2000	The civil rehabilitation law is promulgated; Snow Brand food poisoning incident	Corporate division law		1635
2001	First period of deflation since the second World War is officially recorded; Government agencies are reorganized; 911 Terrorist attacks on the United States	Organizational restructuring tax system ban on treasury stocks is lifted	Balanced scorecard	1653
2002	29 Listed companies go bankrupt; Comprehensive measures to counter deflation are determined; North Korea abduction issue	The Financial Services Agency released financial revitalization program. Under this program, revitalization programs by sectors were created, Company Rehabilitation Law is revised	Shared services	1752
2003	Public funds are used to support Resona bank and Ashikaga bank is nationalized; Industrial Revitalization Corporation of Japan is formed	Industrial Revitalization Corporation Japan (IRCJ) was established. Law on Special Measures for Industrial Revitalization (Industrial Revitalization Law) is drastically revised		1728
2004	Prices of crude oil and steel products soar	Small and Medium Venture Funds Law is revised	CSR (Corporate Social Responsibility) Local rehabilitation funds	2211
2005	Economic recovery moves into full swing	Drastic revisions to business laws (corporate examined (to be enacted in 2006)	Increasing number of companies e s and profits	2713

According to Table 10, strategic revitalization of 263 Billion$ is executed. Observable is true of the 68% strategic revitalization executed between same sectors.

From these facts, it can be concluded that firm revitalization innovation was spread within sectors through strategic revitalization, which promoted the *FRI-s*. The above-mentioned relationship can be displayed in Fig. 6.

As shown in Fig. 6, it could be assumed the existence of a circulation mechanism, whereby activities between firms, including strategic revitalization, are implemented at the firm level under the influence of national strategies.

Table 10
The amount of money of strategic revitalization from 1998 to 2004, the amount of money of strategic revitalization from 1998 to 2004 between same sectors, and the rate between same sectors

Sector number	10100	10200	10301	10302	10303	10304	10305	10307	10308	10309	10310	10311	10312	10313
Sector	Agriculture	Mining	Food	Textile	Paper	Chemicals	Pharmaceuticals	Stone, clay, glass, and concrete products	Steel	Fabricated metal	Industrial and commercial machinery	Electronic equipment	Transportation equipment	Measuring, Analyzing, And Controlling Instruments
Total merger amount (98–04) (million $)	998	8033	1808	1382	5203	2987	6530	94	13,783	338	297	20,700	4,928	3295
Between same sectors (million $)	846	7605	1171	639	5125	1160	5348	71	243	99	1	12,532	3076	2044
Between same sectors rate (%)	85	95	65	46	98	39	82	75	2	29	0	61	62	62

Sector number	10315	10400	10500	10601	10602	10702	10703	10705	10800	10901	10906	11002	11003	11005	Total
Sector	Other finished products	Construction	Electric, gas, and sanitary services	Wholesale	Retail	Bank	Other finance	Insurance real	Estate	Transportation	Communications	Business services	Advertisement	Private services	
Total merger amount (98-04) (million $)	2439	1735	1797	13,419	4882	87,711	32,236	12,199	3467	4969	27,211	1262	159	111	263,974
Between same sectors (million $)	182	48	25	7573	4006	79,363	5530	12,168	3127	1166	25,319	629	158	46	179,302
Between same sectors rate (%)	7	3	1	56	82	90	17	100	90	23	93	50	100	42	68

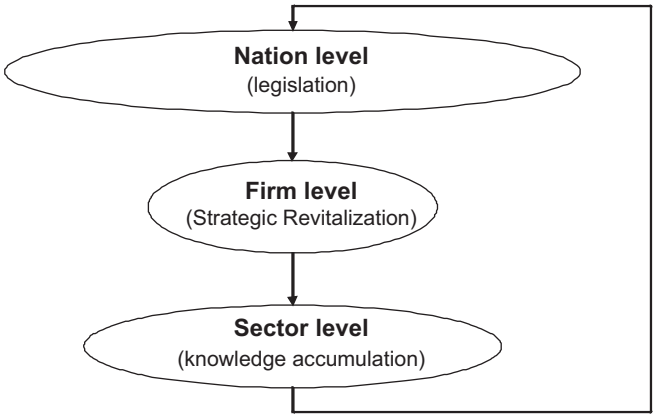

Fig. 6. Revitalization circulation structure.

These activities are then developed into sector-level activities and spread further within sectors, giving rise to new needs that are then incorporated into national strategies (law making).

In Japan, the Law on Special Measures for Industrial Revitalization allowed certain firms, under special conditions, to give compensations other than cash when concluding mergers. This special law was set with an expiration date, and the measures were implemented by a number of firms and developed into sector-level activities. Because this special law was absorbed into corporate laws, now any firm can apply it.

5. Conclusions

The relationships among *FRI-s*, strategic revitalization and diversity were clarified by a systematic analysis.

The significant findings are as follows:

(a) Market-enhancing strategy contributes to the performance of *FRI-s*.
(b) Empirical results did not verify that utilizing external *SRK* toward the market-enhancing strategy can contribute to *FRI-s*. Strategic revitalization in Japan started to increase in the 1990s, and *SRK* obtained from the external firms or sectors is not well utilized yet.
(c) Conducting strategic revitalization by self-investment with concentration strategy contributes to the performance of *FRI-s*.
(d) Improving efficiency with the concentration strategy contributes to the performance of *FRI-s*.
(e) By (a), (c), and (d), it was verified that three independent strategies contributed to *FRI-s*. (Hypotheses 1 was verified.)
(f) Judging from all sectors, among the cases of (a), (c), and (d), firms that conducted strategies (c) and (d) demonstrate a higher possibility of successful *FRI-s*. This results from the fact that the firm revitalization in Japan since the 1990s until now is constructed upon selection, concentration and improvement of efficiency.
(g) If a firm has had multiple strategic paths to choose and selected a certain strategic path, its possibility to perform *FRI-s* is higher. The structure of the sector will be strengthened and will generate sectors that can perform successful *FRI-s*. (Hypotheses 2 was verified.)
(h) It could be assumed the existence of a circulation mechanism, whereby activities between firms, including strategic revitalization, are implemented at the firm level under the influence of national strategies. These activities are then developed into sector-level activities and spread further within sectors, giving rise to new needs that are then incorporated into national strategies (law making). By these facts, it was verified that the revitalization circulation structure was constructed. (Hypotheses 3 was verified.)

Growth of the Japanese economy can be expected, given the increase in strategic revitalization among various sectors. In addition, the findings of this study need to be developed further by focusing on the following aspects:

(i) The influence of institutions (national strategy and social systems, firm organizations and climate, and historical background) that exist in each country on the nature of *FRI-s* of each sector or original firm, and
(j) comparison of *FRI-s* in Japan and the US.

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Gentoku Yoshikawa is Senior Manager at Misuzu Audit Corporation, which is a network firm of PricewaterhouceCoopers (PwC) and PwC has the widest network in the world of accounting, business advisory services, and tax services. He advises firms on improvements in corporate value as a business consultant. He received his Master's degree in Industrial Engineering at Aoyama Gakuin University of Japan and is currently a member of the Watanabe Laboratory of the Tokyo Institute of Technology where he is reading for his Ph.D. His current research is concerned with innovation, especially innovation after restructuring or reorganization. He is mainly interested on mechanism of revitalization and the dynamics of turnaround.

Chihiro Watanabe graduated from Tokyo University with a Bachelor's Degree in Engineering (Urban Planning) in 1968 and received his Ph.D. (Arts and Sciences) in 1992, also from Tokyo University. He began his affiliation with the Ministry of International Trade and Industry (MITI) in 1968. He is a former Deputy Director-General of Technology Development in MITI. He is currently a professor of the Department of Industrial Engineering and Management, Tokyo Institute of Technology (TITech), and also Senior Advisor to the Director on Technology at the International Institute for Applied Systems Analysis (IIASA).