Measures Of Japanese Automobile Industry Licensing In The Current Economic Environment: Learning From The Past

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1. Recent Economic Conditions Embracing The Automobile Industry

The financial crisis that triggered in the United States on September 15, 2008 has spread and intensified globally with the force of a billow, drawing the automobile industry into the vortex of a radically changing economic environment. The current crisis is said to be a type that occurs only once in a hundred years. Looking back, there have been similar cases of radical change in the economic environment that have also been called crises. The first and second oil crises of 1973 and 1978 originated a change in the way Middle Eastern crude oil is provided. These events caused radical changes in the economic environment, just like the current crisis.

This paper therefore provides examples of crises that have occurred in the past, and looks back on what happened and what measures were taken to resolve the issues in order to reflect on how crises that may develop in the future, as well as the current one, should be handled.

2. Empirical Rules of Learning From the Past

(1) Empirical Rule 1: Crises produce opportunities for success.

Just what is a crisis? Let us consider this from the standpoint of the West, which has experienced many large and global scale crises. According to Webster's Dictionary, a crisis is "a crucial or decisive point or situation; a turning point"; according to the Oxford Dictionary of the UK, it is "a decisive moment; time of danger or great difficulty." According to the Japanese Kojien Dictionary of Iwanami Shoten, on the other hand, it is "a situation that could develop into a serious problem or difficulty; a precarious situation." The intention here is not to debate the comparative culture of the three dictionaries, but it is the author's opinion that the Japanese definition is somewhat more negative than those of the Western dictionaries.

What can be deduced from these definitions is that the word "crisis" does not necessarily refer to a dismal or negative situation that could result unless some sort of action is taken. Although a crisis is a precarious situation, it only refers to a process or an instant. Thus, it may not refer to a negative situation, depending on one's point of view.

Let us therefore look back at some crises that have radically altered the economic environment in a manner similar to the current one. Figure 1 shows the trend for the number of automobiles manufactured.[1] Oil crises occurred in 1973 and 1978; let us

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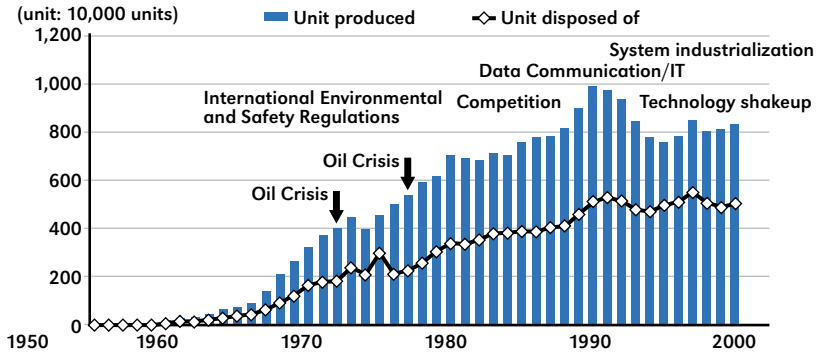
Figure 1. Empirical Rule 1 - Crises Produce Opportunities For Success



Alteration of "Ministry of Economy, Trade and Industry, Yearbook of Machinery Statistics by Ministry of the Environment based on data from JAMA"

see how these rank in terms of the total number of automobiles produced. Production remained at approximately the same level for two years following the 1973 oil shock, but subsequently increased. The 1978 oil shock had no impact on automobile production, which increased dramatically two years later.

Let us take a look at the background of this variation in the number of units produced. The crisis of 1973 was a precarious situation whereby the existing form of industry could not be maintained because the oil supply became backlogged. While a crisis existed instantaneously, it brought about a paradigm shift (i.e., collapse and transformation in the framework of the social system) to a new industrial structure (i.e., the large framework that determines the thinking of the times) for the Japanese automobile industry in particular.[2]

The new paradigm at that time was a social system framework that required automobiles to offer low fuel consumption to protect the health of human beings and the natural environment. Social demand embodied by the Muskie Act in the U.S. and the 1976 laws of Japan also provided the opportunity for change. While this social system was advantageous for producing compact cars, it also demanded technologically difficult specifications that offered both high output and low concentrations of exhaust emissions. Each company responded to the demands in its own way. Toyota and Nissan responded by developing the catalytic converter to reduce the harmful effect of tailpipe emissions, whereas Honda offered a different mode of combustion.

A paradigm shift indicates a dramatic transformation to a new system, and requires optimal technologies. Toyota, for example, responded to tailpipe emissions restrictions with a combination of new combustion, catalyst, and sensor technologies. Engine production technologies grew from experience and expertise in prewar weaving technologies; catalyst technologies grew from chemical plant technologies employing knowledge and expertise of the petroleum industry. Sensor technology is a key for burning fuel in the air and controlling it. This was also derived from the semiconductor and electronics industries. In other words, a new system was established by effectively taking advantage of technologies cultivated in and used by different industries. Licensing is an effective means of acquiring technologies that a company does not already possess, and a new system whereby technologies are incorporated in the process of flexible alliances, realignment, and M&A, such as by technological tie-ups between or among companies was perfected. It could be said that crises are overcome by the trinity of management, technology, and licensing.

The oil crisis of 1978 also transformed into an opportunity as is stated at the bottom the following table (2). The second oil crisis of 1978 resulted in smooth production of automobiles that were even more fuel efficient and friendly to the environment by merit of the experience gained from the first crisis of 1973. There was also a demand to reduce the steadily rising instance of traffic accidents, and attention was turned toward the preparation of social infrastructure involving automobiles in order to use energy more efficiently not only for individual cars, but for society in general. An intelligent transportation system (ITS) consisting of an infrastructure of information between automobiles and road systems was devised by the government hand-in-hand with the private sector. The system was tested in the beginning of the 1980s. This provided the opportunity to switch from the paradigm of single automobile units that run, stop, and turn to a mobile system paradigm that included the road environment.

Business opportunities increase in conjunction with this type of change. Crisis therefore turns into chance whereby the opportunity to grow is produced by crisis.

(2) Empirical Rule 2: Crises do not last forever.

Let us now take a look at how products and systems changed before and after such a paradigm change, and see how much time was required.

Table 1 shows what changes were triggered by the two oil crises. The first oil crisis of 1973 triggered tailpipe emissions restrictions in the U.S. and Japan, and produced a demand for automobiles that offered good mileage and low tailpipe emissions. These social and technical demands forced a dramatic change in specifications of automobiles to be exported to the United States, and resulted in a national crisis when they could not be met. The Ministry of International Trade and Industry at the time therefore grappled with the crisis by working hand-in-hand with the private sector. Two years later in 1975 and from 1975 onwards, Honda and Toyota for instance successfully marketed an automobile designed to comply with tailpipe emissions restrictions.

The shape of the automobile was subsequently modified for the ecology boom that focused on energy conservation and environmental friendliness, and developed into the current family of vehicles. The cars were well-received in both domestic and overseas markets, and production output increased two years after the crisis.

As was previously mentioned in section (1), it took two to three years to change to the mobile system paradigm that included the road environment after the second oil crisis of 1978 as well.

Thus, as it took several years at the longest for this change to occur, the crisis came to its end. The sense that there is no end in sight when caught in the vortex of a crisis is similar to the feeling that the night will never end when one wakes in the middle of the night. The thing these two situations have in common is the fact that both end quicker than expected.

Table 1. Empirical Rule 2 - Crises Do Not Last Forever Oil Crises of 1973 and 1978

	1970	**The Muskie Act in the U.S.**
CRISIS	1973	THE FIRST OIL CRISES — Government hand-in-hand with private sector
CHANGE	1975	Marketed comply with emissions restrictions New technology of combustion, catalyst & sensor Well received in markets by fuel conservation
CRISIS	1978	THE SECOND OIL CRISES Even more fuel efficient and new mobile system are demanded — Government hand-in-hand with private sector
CHANGE	1980s	Transformed to a mobile social system of ITS

Table 2. Empirical Rule 3 - The World Following a Crisis is Frontier Territory

New Technology After a Crisis

1975	Electronically controlled fuel injector *FRONTIER TECHNOLOGY* Mechanical injector → Intelligent mechatronic injector
1980s	From manufacture of individual units into a frontier mobile system industry

(3) Empirical Rule 3: The world following a crisis is frontier territory.

The sight of clear blue skies the morning after a typhoon passes is a commonplace experience in Japan. As is expressed in sections (1) and (2) as well, after having overcome a crisis, the world appears completely different. This is because the world following a crisis is unexplored frontier territory.

Returning to the oil crisis, engine combustion and exhaust which are, figuratively speaking, like the heart and circulatory system, could not comply with regulations as an automobile system unless they were altered dramatically. Incidentally, the regulation values of the Muskie Act of the USA and the 1976 laws of Japan that copy it, which required toxic substances such as CO, HC and NOx to be under ten percent of the amount previously permitted, were considered preposterous in comparison with the previous figures.

Toyota switched from mechanical fuel injection to electronically controlled injection for gasoline combustion, and adopted a system that burns an air-fuel mixture at almost the theoretical air-fuel ratio. The company replaced the previous method of combustion with one that controls the ignition timing and gasoline injection according to the detected oxygen concentration.

From the standpoint of part manufacturers such as those that make the injectors that inject gasoline into the engine, this system is considered a Copernican transformation. The system now requires injectors to contain an oxygen sensor and electronic injection controller. Injection is no longer mechanical, but rather requires electronic, intelligent "mechatronic" injection technology.

This required a correct management decision to determine whether to change the paradigm and enter unexplored territory. If the trinity of management, technology, and licensing could not be correctly used concurrently, unexplored territory could not be entered.

A new world of unexplored territory also opened up following the second oil crisis of 1978. Automobiles equipped with a function for interactive communication of information with the global position system (GPS), which had been converted from military to civilian use, led the way into the unexplored territory of ITS, a computerized intelligent social infrastructure.

Thus, correct operation of the management, technology, and licensing trinity began to transform the automobile industry from the manufacture of individual units into the unexplored territory of a mobile system industry.

3. Qualitative Transition of the Automobile Industry

(1) Transition of the industry and technology from the 1970s to the present

Let us now consider the previously mentioned paradigm transformation of the automobile industry from the different perspectives of technology and industry transition. Figure 2 shows the results.[3]

The word "innovation" (technical innovation) requires no further explanation, but if you refer to "Long-term Strategic Guidelines Innovation 25" on the Japanese Cabinet Office Web site, perhaps to avoid discussion of whether it refers to technical change only, it explains that innovation "does not refer to technical innovation alone, but rather refers to the act of socially effecting significant change by adopting a completely new way of thinking and mechanism, and producing a new value."[4]

Figure 2 gives a summary of the state of effecting significant social change from technology and industry. When Thomas S. Kuhn first described what a paradigm was, he indicated that "scientific technology does not change cumulatively in a certain direction; it changes significantly for each age."[2]

Thus, perceiving the progress of creation, growth, and demise of technology and industry as a bipolar system of "convergence and divergence" like thermodynamic entropy, biaxial matrices consisting of the "expanse of technology (diversity)" and "coherence of technology (cumulative characteristic)," and of the "creation of industry (creation)" and "progress of industry (sophistication)" were created (see Figure 2).[3, 5]

Thus, it has been determined that the automobile industry can be expressed by four combinations of "creation and sophistication of industry" and "expanse and coherence of technology" matrices for each of the four periods from the 1970s up to the present 21st Century.

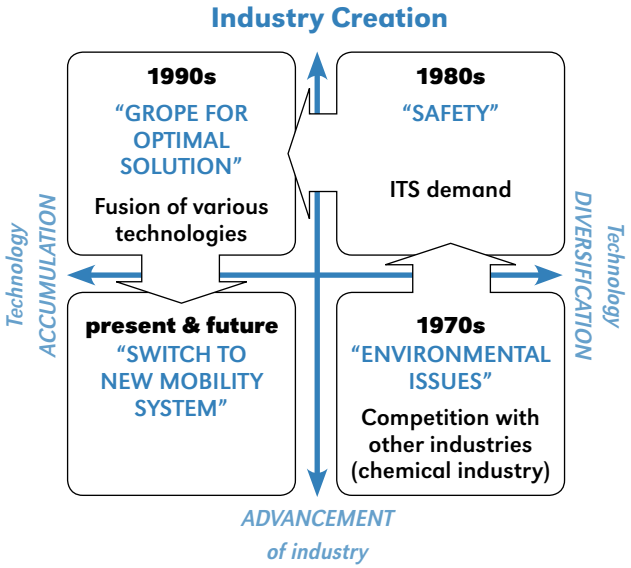
By using an assortment of technologies that had become necessary due to tailpipe emissions restrictions in conjunction with the oil crises of the 1970s such as different types of sensor and catalyst technology, the automobile industry was converted to a more advanced industry with the high added value of high quality engine combustion (bottom right of matrix).

Continuing on in the 1980s, the conventional automobile manufacturing industry was reborn into a social infrastructure industry that included ITS, an information communication industry working in harmony with the road infrastructure. In terms of technology, the new industry required fundamental technologies such as information communication, information technology (IT), software and machine control technologies (top right of matrix).

Then in the 1990s, information communication, software, and electronics technologies related to environment and safety were collected, and a new industry sprung up from them. It was also a period during which industry demanded new expansion of technologies, and those involved in this period began a search for the ideal form that vehicles and the industry should take in the 21st Century (top left of matrix). The hybrid vehicle Prius, which combines electricity as a source of energy, was developed in 1997 during this process.

Since 2000, while continuing to search, the automobile industry has progressed toward achieving the optimum values and conditions for maximum satisfaction in terms of comfort, safety, energy, and the environment. Especially in the radically changing economic conditions since September 2008, the existing industrial framework needed for restoring the previous market scale has been maintained while effectively utilizing currently available technologies (bottom left of matrix).[1]

Figure 2. Substantial Transition of Automobile Industry



5) Prof. Fumio Kodama, Japan Techno-Economics Society, Research on Research Workshop Report, Burden share writing (Y. Yahagi) (2000).

It is probably too early to paint a picture of the world after 2010, but let us touch on the fact that the search for a new sources of power that would serve as the heart, in terms of the living body, has already begun.[6] A movement that differs from the approach up to now, which is taking place in industries other than the automobile industry, is producing results and shows promise. Namely, different types of industries such as the electronics, electric power, and chemical industries have begun to hoist their flags in the search for new sources of power. This has developed into severe competition and intimate alliances among industries. Speculating from this situation, in terms of the matrix from 2010 and beyond, it appears that industry is changing into a more sophisticated form based on the diverse technologies at the bottom right, just as in the 1970s. In this case, industries such as energy, electronics, materials, information communication, IT, finance, and software are participating in parts other than the "heart" and are transforming the existing system and paradigm into a new mobile system industry.

(2) Comparison of management, technology, and licensing for different types of industry

Thus, if we assume future trends, industry will become structured beyond its conventional framework. It is not an overstatement to say that technology is capable of becoming an element of that industry, and technology licensing can become the origin and motive force for creating a new paradigm.

Getting a firm grasp of trends in technologies, licensing, and management for each different type of industry, therefore, is a way of obtaining effective information about competing companies or collaboration partners. We have had the opportunity to investigate and get a solid grasp on these trends, and the results of the investigation are as follows.[7]

We took the five evaluation indices of "License fees are recently soaring," "Reverse engineering is easy," "Individual/broker lawsuits are increasing," "Industrial structure is vertically integrated based on one's own technology," and "Patents are the source of profit" and created pentagonal cobweb charts based on positive/negative answers to these questions. Figure 3 shows the results.

When applicable to these questions, patents are evaluated highly; oppositely, when not applicable, the evaluation is considered low. If the evaluation is high as the target of distribution, the patent can be considered a valid "product." If, on the other hand, it is low, it can be viewed as a "part or element," depending to what extent it can be efficiently used widely in a product or system. The charts therefore show pharmaceuticals and electronics spreading outward and chemistry, measurement and automobiles oppositely facing inward. Steel is in between the groups, and it would probably be appropriate to see it as spreading.[7]

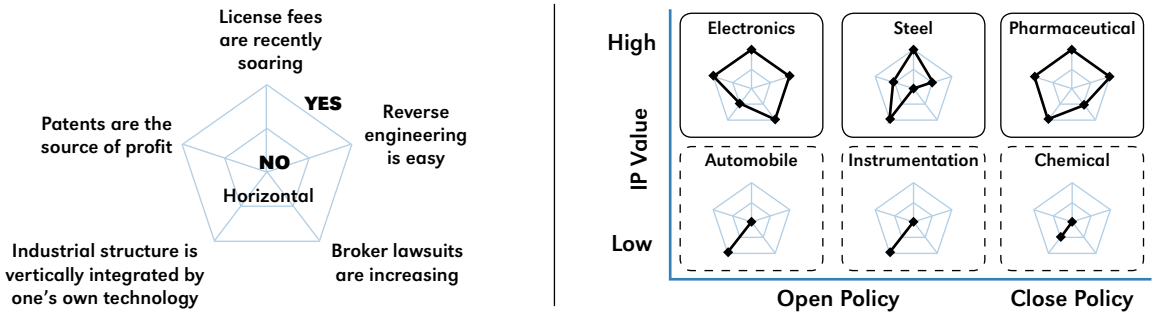
Figure 3 roughly divides industry into closed license and open license policy industries.

Evaluation of patents cannot be said to be high or low as the result of a closed or open license policy, and it was determined that there was no linkage between these policies and the trends of the charts. Rather, it was assumed to be due to the difference in the way management problems encountered up to now were handled.[7]

Consequently, because the way that licensing is handled differs according to the type of industry, when forming an alliance or when becoming a competitor, it is indispensable to know the party or parties you are dealing with, including such trends.

In the case of the automobile industry, automobiles involve a profusion of patents, and are characterized

Figure 3. Management, Technology and Licensing in Various Industries



Modified Data from Licensing Executives Society Japan, Licensing and Management WG, Osaka, Japan (September 2008).

by the fact that the market cannot be dominated. Automobile manufacturing is an integral component of industrial growth, and it is reasonable to consider patents as part of the cost. Sharing patents related to automobiles among automakers increases their value. Cross-licensing is a means of accomplishing this. The automobile industry naturally finds itself in a management environment embracing an open license policy.

Solitary development involves higher risk with uncertain return. Companies are beginning to seek alliances with other types of industries rather than attempting to go it alone. This movement is expected to accelerate in the future as well.

Consequently, as we have seen up to the present, the age of radical change is also an age of inner stirrings toward innovative change with risks and opportunities. As for future licensing activities in the automobile industry, just as crises up to now have been overcome by the trinity of management, technology, and licensing, the trinity must continue to be utilized for the coming age as well. These activities may also serve as the origin and motive force for growth of industries of a new paradigm outside the conventional limits of type.

4. Handling of Intellectual Property in a Radically Changing Economic Environment

The best way to handle intellectual property in the current economy differs according to the industry, company background, and the circumstances. As we have seen up to now, one way is to apply what can be learned from past crises to the radical change of the current economic environment and to prepare for the future.

As was previously mentioned, Empirical Rule 1 states that "Opportunities for success are produced by crisis." The creation, incorporation, and fostering of technologies required for a new form of industry is indispensable through future competition and collaboration with different types of industry, and the key to it is selecting and focusing on effective technologies.

On the other hand, it is necessary to reconsider the process of research and development up to the present, and to reconsider and reduce unnecessary processes and cost. The way that management resources, such as, talent, materials, money, and time, are invested in research and development must also be reviewed, especially the evaluation indices of research and development. Thus, what is demanded is selection and focus on the optimal technologies required for the industry of the forthcoming paradigm, reconsideration of cost and processes for effective implementation, and in terms of numerator and denominator, to determine the limit of cost-effectiveness.

Empirical Rule 2 states that "Crises do not last forever." Although we may be caught in the vortex of change for several years, the change will eventually come to an end. Empirical Rule 3 states that "The world following a crisis will be unexplored territory." This especially involves selection of optimal technologies, but the point is that what is sought after can be obtained earlier by daring to completely change the way we view things and our sense of values by a Copernican transformation. There will absolutely be some companies that will miss the change by fixating on past successful experiences, failing to take notice or becoming distracted. Past cases tell us that, in the world of selection, from the standpoint following change, if the previous sense of values is at least denied, the crisis will come to an end. If the "unexplored territory" of Empirical Rule 3 is discovered and realized early on, it enables a shift to a new paradigm.

Healthy competition and effective flexible alliances, realignment, and M&A among same and different types of industry are indispensable in order to create a new industry paradigm amidst a radically changing economic environment.

This could be an age where businesses that use the trinity of management, technology, and licensing effectively to create and introduce the types of technology needed for a new paradigm using licensing will survive. ■

Bibliography

1) The Ministry of Economy, Trade and Industry, *Trade Trends,* Trade White Paper (August 2007).

2) Kuhn, Thomas S., *The Structure of Scientific Revolutions,* The University of Chicago Press. (1970).

Shigeru Nakayama Translation, "The Structure of Scientific Revolutions," *Misuzu Shobo,* p. 277 (1972).

3) Y. Yahagi and M. Ezaki, "Technology, Management and Licensing in the Automobile Industry of Japan," *Les Nouvelles,* p. 235 (December 2008).

4) Cabinet Office Web site, *Long-term Strategic Guidelines Innovation,* 25 (2007).

5) Prof. Fumio Kodama Leader, Japan Techno-Economics Society, *Research on Research Workshop Report* (2000).

6) *Overview of Energy ITS Promotion Project,* NEDO (January 2009).

7) Licensing Executives Society Japan, *Licensing and Management WG,* Osaka (September 2008).